JAPAN INTERNATIONAL COOPERATION AGENCY

CHUUK STATE GOVERNMENT
FEDERATED STATES OF MICRONESIA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR THE DEVELOPMENT
OF ARTISANAL FISHERIES
IN
CHUUK STATE
OF
THE FEDERATED STATES OF MICRONESIA

MARCH 1995

Fisheries Engineering Co., Ltd.

JICA BASIC DESIGN STUDY REPORT ON THE PROJECT FOR THE DEVELOPMENT OF ARTISANAL FISHERIES IN CHUUK STATE OF THE FEDERATED STATES OF MICRONESIA
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PREFACE

In response to a request from the Government of the Federated States of Micronesia, the Government of Japan decided to conduct a basic design study on the Project for the Development of Artisanal Fisheries in Chuuk State of the Federated States of Micronesia and entrusted the study to the Japan International Cooperation Agency (JICA).

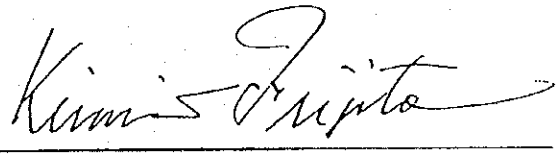
JICA sent to Micronesia a study team headed by Mr. Noboru Tazoe, Senior Technical Official, Office of Overseas Fisheries Cooperation, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries and constituted by members of Fisheries Engineering Co.,Ltd., from December 10 to December 28, 1994.

The team held discussions with the officials concerned of the Government of the Federated States of Micronesia and conducted a field study at the study area. After the team returned to Japan, further studies were made, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Federated States of Micronesia for their close cooperation extended to the team.

March, 1995



Kimio Fujita
President
Japan International Cooperation Agency

March 28th, 1995

Mr. Kimio Fujita,
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for the Development of Artisanal Fisheries in Chuuk State of the Federated States of Micronesia.

This study was conducted by Fisheries Engineering Co.,Ltd., under a contract to JICA, during the period from December 6, 1994 to March 28, 1995. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Micronesia and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

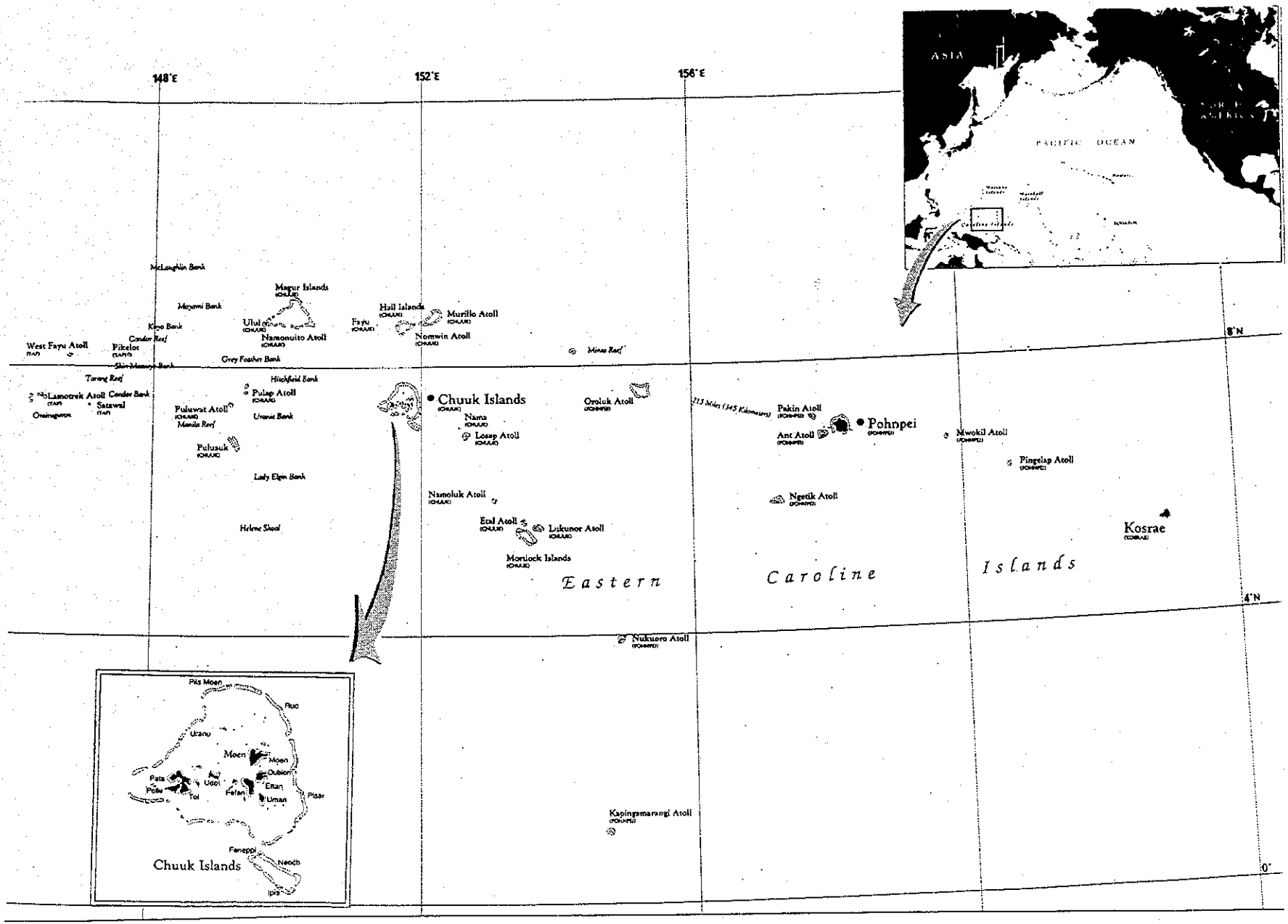
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries. We would also like to express our gratitude to the officials concerned of the Department of Resources and Development, the Department of External Affairs, the Chuuk State Government and the Consulate-General of Japan in Agana for their cooperation and assistance throughout our field survey.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

T. Toshihara

Takafumi Toshihara
Project Manager,
Basic Design Study Team on
the Project for the Development of
Artisanal Fisheries in Chuuk State of
the Federated States of Micronesia
Fisheries Engineering Co.,Ltd.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Nomwin Atoll
Kayo Bank
Condor Reef
West Fayu Atoll
Pikelot
Grey Feather Bank
Mina Reef
Tarang Reef
Hitchfield Bank
Lamotrek Atoll
Condor Bank
Satawal
Pulap Atoll
Puluwat Atoll
Urunoe Bank
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Pulusuk
Lady Elgin Bank
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Etal Atoll
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Mortlock Islands
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Islands
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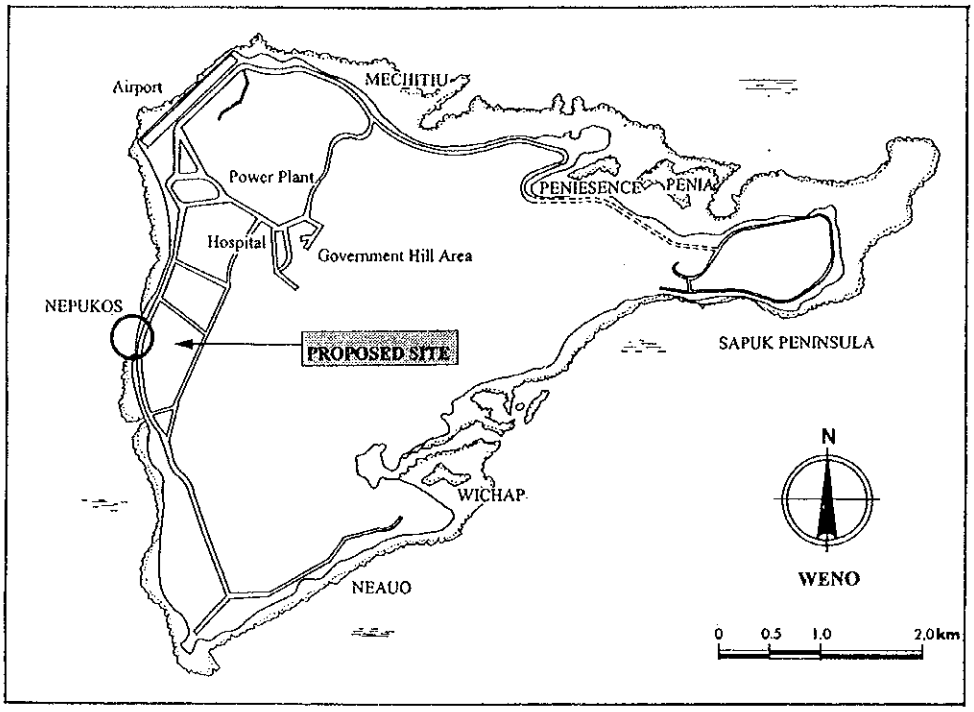
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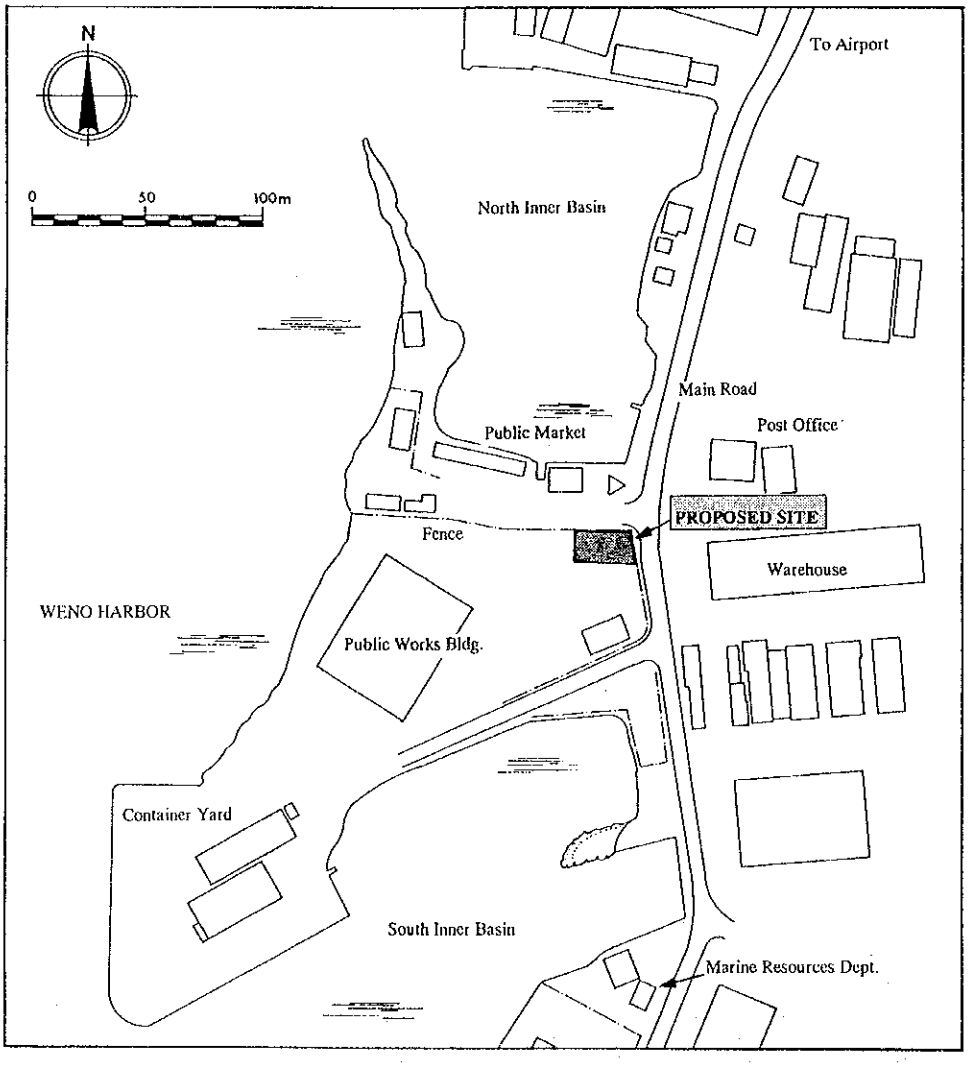
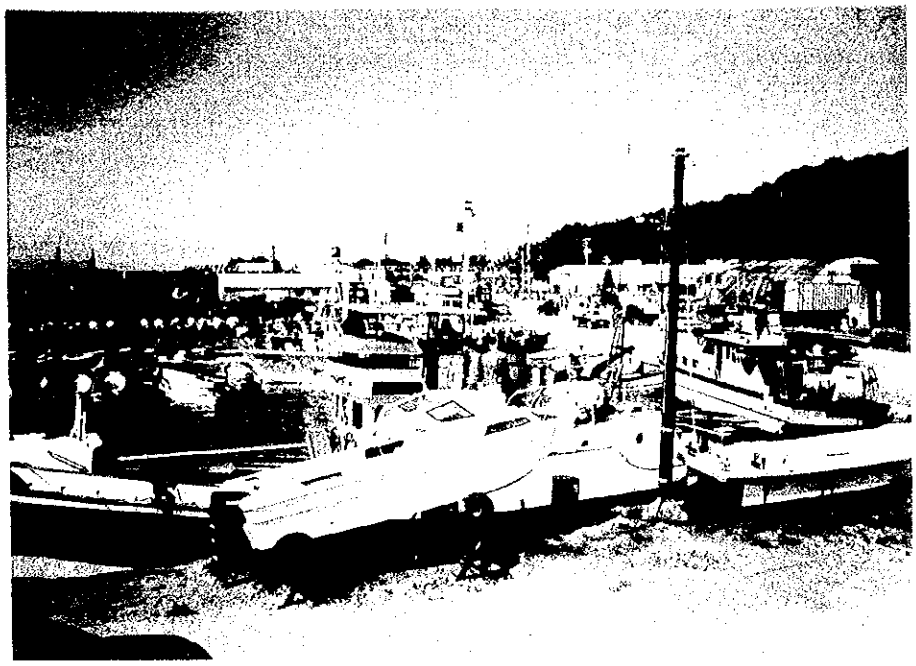
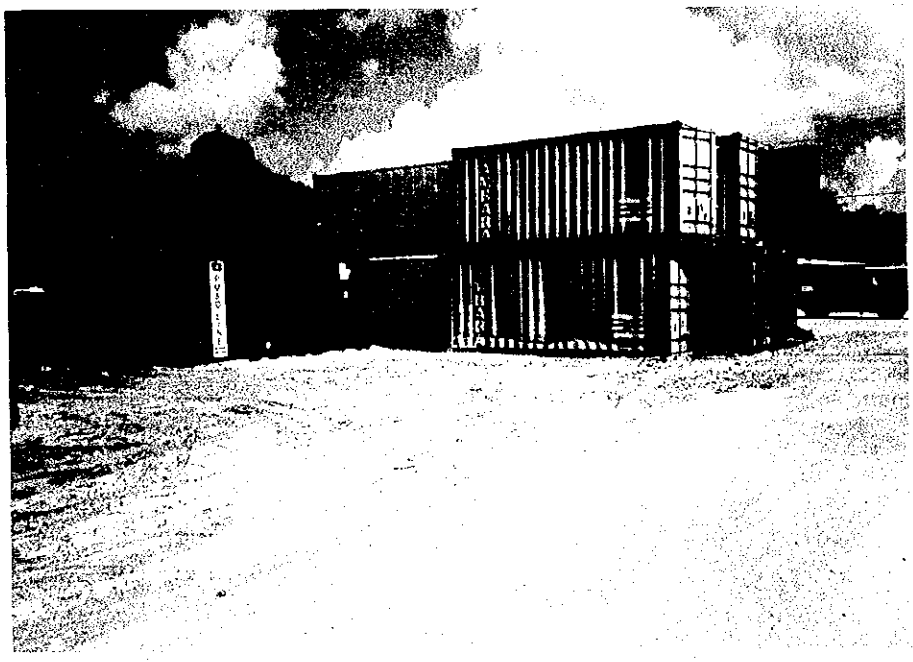

N
To Airport
0 50 100m
North Inner Basin
Main Road
Public Market
Post Office
PROPOSED SITE
Fence
Warehouse
WENO HARBOR
Public Works Bldg.
Container Yard
South Inner Basin
Marine Resources Dept.



The Plan site is shown in the left-rear section of the photo, near the Commercial Port in the center of Weno Island.

The plan site, as viewed from the main road

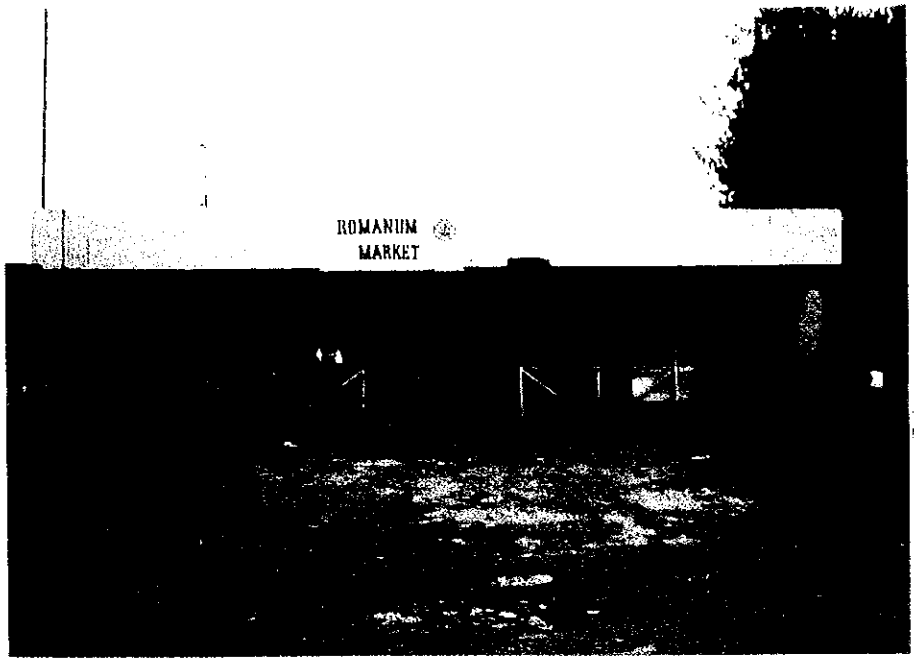


The Plan site (within the Commercial Port at Weno) is temporarily being used as a container yard.

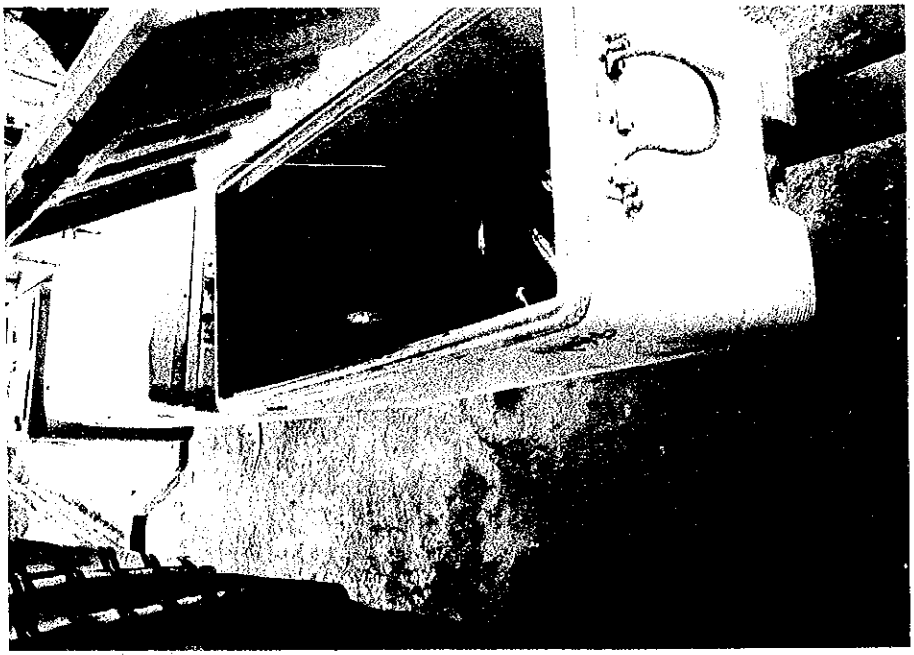
At least 2,000 small boats are reported to be in operation inside the Chuuk Lagoon. They are also used for fishing

Insulated containers are used to haul fish

Fish being landed from small boats. Unloading facilities are as yet developed.

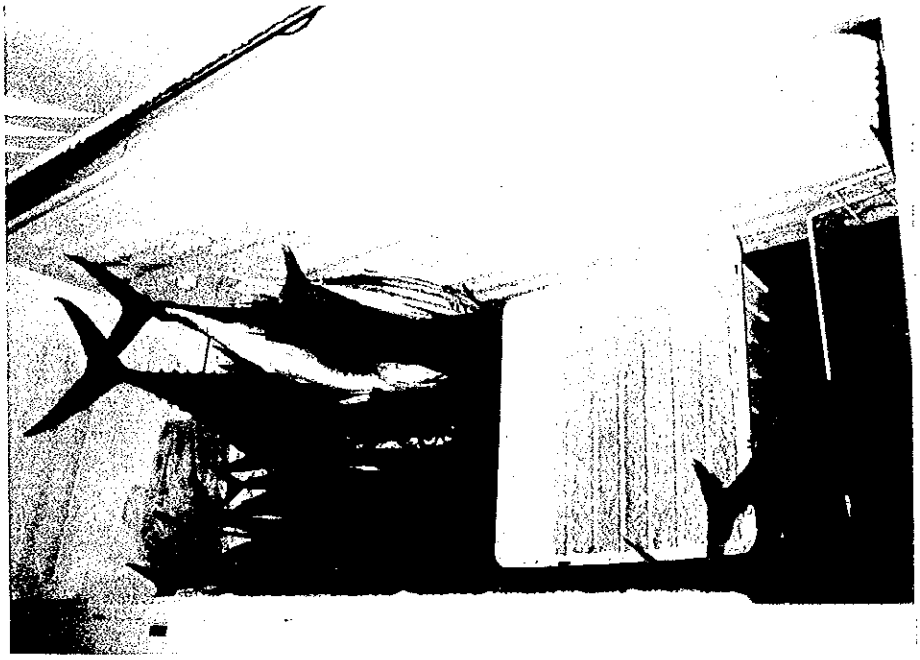


Fish market in Weno
(Local office of a cooperative from an island inside the Chuuk Lagoon).



Fish packed with ice for sale in insulated containers.

A private operated fish retail shop in Weno.



Making use of a small freezer because of a shortage of ice.

Reef fish being shipped by air to Guam

–ditto –
Ice cannot be used during air transport, based on instructions from the airline

SUMMARY

The Federated States of Micronesia (FSM) is an island country scattered over the Western Pacific between the Equator (0°) and 14°N and between 135° –166°E. The distance from Kosrae State on the eastern border to Yap State on the western is about 2,800 km, but the country's total land area is only 837 km^2. The Micronesian economy is presently highly dependent on financial aid from the United States, based on a Compact of Free Association with that country, but, in 2001, this treaty will come to an end. In order to prevent a subsequent fall in per –capita GDP, there is an urgent need to develop local industry. Although the nation is blessed with abundant rainfall, thanks to its tropical marine climate, and has a reasonable amount of fertile volcanic soil to support a productive agricultural base, in view of the dispersion of the many small domestic markets, the considerable distance from the main markets of the Pacific Rim, and a relatively high wage scale, it will not be easy for FSM to develop a viable industrial base.

The FSM, in its Second National Development Plan (1992 –1996), has accorded the fishing industry the highest priority in the country's industrial development, followed by tourism and agriculture. Micronesia's Exclusive Economic Zone, extending over some 2,900,000 km^2, is known as one of the world's prime fishing grounds for skipjack and tuna, with the total 1993 catch in these waters recorded at 173,000 tons, though the great bulk of this fish is caught by foreign fishing vessels operating under fishing permits. The FSM government has been making strenuous efforts in recent years to establish a foothold in the rapidly expanding fresh tuna air –freight business, building landing and shipping bases for the use of the tuna longline fishery to facilitate unloading operations, shipments, and vessel supply services for fresh tuna destined for the export market. Operations at these bases are intended to generate employment and increase incomes, and preparations are also being expedited to establish marketing and distribution channels for fresh tuna. In addition to capital investment in fishery –related industries, the fishing fees paid by foreign fishing vessels are also making an important contribution to the national treasury, as a result of which the fishery sector has already developed into a core industry in the FSM economy. However, in contrast to the large –scale fisheries, for which facilities are being actively developed, infrastructure for the artisanal fisheries, which play a major role an supplying animal proteins, particularly on the outer islands, has been conspicuously lagging. There is a serious shortage of facilities required to retain freshness and thereby insure a stable supply of fish for distribution channels. The FSM government has, accordingly, drafted a Chuuk State Fishery Development Plan, involving the establishment of a support station, primarily for the supply of ice to preserve fish freshness, at Weno, the capital of Chuuk State, which has the largest population of the 4 states making up FSM (Yap, Chuuk, Pohnpei, and Kosrae), with low per –capita income. The lack of freshness control has been a major constraint on the development of the artisanal fisheries in this state. In July, 1994, the FSM Government requested a grant –aid from the Government of Japan to

implement this project.

In response to this Request, the Government of Japan decided to conduct a Basic Design Survey, which was carried out by the Japan International Cooperation Agency (JICA) in December, 1994. A Basic Design Survey Team (BDST) held a series of discussions with officials of both the Federal and Chuuk State government to validate the Plan contents and conducted a field survey and interviews on the present state of fishery production in Chuuk State and the implementing and operating structure for the Plan in order to assess the project's background and appropriateness and determine the nature and composition of the facilities and equipment required for its implementation.

With regard to the Plan site, the proposal contained in the original Request was to reclaim and develop an area near the southwest corner of the North Inner Basin. However, owing to the large volume of soil that would be required for the land fill as well as the extensive time and cost involved, along with the poor road access and the considerable time that would be consumed in reconciling the reclamation project with the master development plan for this Basin, it was determined that an alternate Plan site should be considered. The BDST then conducted an on -the -spot survey of a new site, as presented by the Chuuk State government during the Team's stay, in the northeast corner of the cargo handling area in Weno Harbor.

The embankment work in front of the public market, as included in the original Request, was eliminated because of the change in Plan site, along with the office equipment, which is to be provided, in principal, by the Federal government. On the other hand, an emergency generator was added to the original Request, as a defense against the unstable power supply conditions in the area. It was further agreed that consideration would be given to the installation of a pontoon (small floating dock) in the mooring area in the North Inner Basin, where a quay does not yet exist, for the convenience of small boats taking on ice from the Plan facility.

After returning to Japan, the BDST, based on the survey findings, continued its assessment of the optimum contents, scale, and operating structure for the Plan facilities and prepared a Basic Design, incorporating a design of the stipulated facilities and equipment, a construction plan, and cost estimates, along with a project evaluation. The optimum facilities and equipment required for Plan implementation, based on this analysis, have been summarized below :

(1) Support Station Building
(Steel frame construction, with a partial second floor) 240 m^2

Office 40 m^2

Staff room	4 m^2
Storage area	10 m^2
Toilet	6 m^2
Working (handling) area	80 m^2
Ice –making room	30 m^2
Ice storage room	30 m^2
Chilling storage room	22.5 m^2
Generator room	17.5 m^2
Water intake tank	30 ton capacity

(2) Equipment :

Ice –making units	5 ton/ 24 hours, flake ice	2 units
Ice storage unit	5.4 m x 4.5 m, about 50 m^3 with refrigerator	1 unit
Chilling storage unit	2.7 m x 2.7 m, about 15 m^3, -5_o C	1 unit
Insulated containers	160 lit	10 units
Weighing scales	150 kg	2 units
Statistical equipment:	Personal computer and peripheral equipment	1 set
Pontoon	2.5 m W x 10 m L, with connecting bridge	1 unit
Ice transport vehicle	Pickup truck, with a load capacity of 750 kg, for use as an ice transport vehicle	1 unit
Other items	Facsimile, copier, and cash register for sales and administrative use	1 set

The construction period, including preparatory work in Japan and on –site work, has been set at 6 months. Among the equipment items, the ice –making units, which are to be sourced in Japan, will require the longest lead time. About 4 months have been allowed for the equipment phase.

The Plan facilities will be operated by the State Department of Marine Resources (DMR). This Department, with a staff of 81 persons, has 5 Divisions: Administration, Research and Development, Resource Conservation, Operations and Tecl. `cal Assistance, and the Tonowas Fishery Complex. This organization has been operating the ice –making facilities at Weno and Tonowas, and technical personnel have been trained to manage these installations. Thus, no particular problems are anticipated in connection with Plan operations. And, since it is projected that operating income from the facilities will amply cover operating expenses, the Plan facilities should be self –supporting without

having to seek financial assistance from the State government.

As a result of Plan implementation, it is predicted that the chronic ice shortage, estimated at about 1,000 –1,100 tons a year, will be eliminated, thereby insuring an adequate supply of ice for preserving the freshness of catches at Weno (in Chuuk State),and in meeting the demand for ice at Weno's 20 fish retail outlets, which should stimulate the consumption of fresh fish in this area. It is also expected that ice from the Plan facilities will flow smoothly to fishermen on the State's outer islands, beyond the Chuuk Lagoon, which should lead to increased fish supplies from these islands. In addition, since a public chilling facility and working area will also be established for the benefit of the artisanal fisheries, the risks presently borne by these fishermen, in terms of a drop in the commercial value of their catches induced by a loss of freshness in fish shipped to Weno, will be significantly reduced. Furthermore, since these facilities are also intended to function as a fish distribution base, they should facilitate the collection of various types of statistics required to expedite effective resource management within the Chuuk Lagoon. Based on the above considerations, it has been concluded that there would be major significance in implementing the subject Plan via a grant –aid from Japan.

In connection with Plan implementation, it is hoped that the DMR will see fit to adopt the following suggestion. The Plan facilities are to serve as a support station for the artisanal fisheries, which is expected to develop into a major fish distribution base at Weno.
As such, the facilities will have an important public service dimension, and so it is fitting that they initially be administered by DMR employees. However, since the income from ice sales and chilling storage services at these facilities is projected to cover all operating expenses, including staff salaries, once these operations have gotten firmly underway, consideration should be given to gradually increasing the autonomy of the operating organization, with a view to converting it eventually into an independent public corporation. On this basis, we believe that operating efficiency could be further enhanced and the scope of activities expanded, enabling the Plan facilities to contribute even more effectively to fishery development, which has been accorded the highest priority in the nation's development planning.

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Perspective of the Facilities
Location map and Photographs
Summary

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SECTION ONE : BACKGROUND OF THE REQUEST

1.1 Background

The Federated States of Micronesia (FSM) is a federation comprising four states: Yap, Chuuk, Pohnpei, and Kosrae. It is an island nation, scattered across some 2,800 km, in an east –west direction, in the lower latitudes of the Pacific Ocean. The country is heavily dependent on financial assistance provided under the Compact of Free Association with the United States, which came into effect in 1986. But since this aid will be steadily reduced in anticipation of the expiration of this Compact in 2001, the FSM is compelled to develop new industries with a view toward achieving economic viability. Given the paucity of land resources, the development of the nation's marine resources, extending over a broad expanse of ocean, is being given the highest priority in economic development planning. But, to utilize these marine resources effectively, many problems must be rapidly overcome with respect to improving the fishery infrastructure and cultivating human resources.

Under these circumstances, in order to increase the supply of ice in Weno, the political and economic core of Chuuk State, which has the largest population in the FSM, with a low per – capita income, and to maintain fish freshness, which has been a major constraint on artisanal fishery development, the FSM government has drawn up a Fishery Development Plan for Chuuk State, providing for the establishment of a support station for artisanal fisheries, ice –making equipment, and other facilities. This Plan is intended to provide required facilities for freshness retention, a most critical factor in the landing and distribution of catches by the artisanal fisheries, whose development has lagged considerably behind that of the large –scale tuna longline fishery, directed mainly at the air –shipment of fresh tuna, for which facilities have been actively developed. In July, 1994, the FSM government requested a grant –aid from Japan to implement this project.

1.2 Outline and Main Components of the Request

The contents of the original Request, as received from the FSM government, were as follows :

(1) Plan Objective

The objective of the Plan is to secure a source of cash income for artisanal fishermen and to promote the market consumption of fresh fish by expanding both catches and domestic consumption in the artisanal fisheries and managing marine resources so as to permit their

sustained utilization.

(2) Plan Site

The original Plan site shown in the Request was to be provided by dismantling half of the existing market facility on the southwest side of the mooring area in the North Inner Basin of Weno Harbor. However, this was subsequently changed, pursuant to an official communication from the FSM government, to a reclaimed site in the southwest corner of the above mooring area.

(3) Plan Implementation and Management

The implementing and management organization for the subject Plan will be the Marine Resources Department of Chuuk State.

(4) Contents of the Request

1) Support Station Building (180 ㎡, prefabricated, 2 -story)

Ice -making machines	(2 units of 5 tons each)
Ice storage units	(2 units of 8 tons each)
Chilling storage unit	(7 m^3)
Working area	(about 60 ㎡)
Office	(air conditioned)
Warehouse	
Toilets	

2) Ice transport vehicle : 1 pickup truck (0.75 ton)

3) Insulated containers : 10 units (160 lit each)

4) Rainwater catchment tank : 1 FRP unit (10 tons)

5) Weighing Scales : 4 units (200 kg each)

6) Office furniture desks, chairs, and cabinets (2 sets)

7) Office equipment : Facsimile machine, copier, personal computer, typewriter,

cash register, and caluculator (1 set)

8) Shore -protection works: for use in fish landing and ice -loading operations; reclaimed land, with concrete pavement (about 40m x 3m)

1.3 Outline of the Survey

Based on the Request from the FSM government, the Government of Japan instructed the Japan International Cooperation Agency (JICA) to conduct a Basic Design Survey on the Plan facilities. JICA then dispatched a Basic Design Survey Team (BDST) to the FSM, headed by Mr. Noboru Tazoe, Chief, Overseas Survey Section, Overseas Fishery Cooperation Office, International Division, Fisheries Agency in the Ministry of Agriculture, Forestry and Fishery. The Team stayed in the FSM from December 10~28, 1994.

The BDST validated the Plan contents through discussions with concerned officials of the Federal and Chuuk State governments and then conducted a field survey on the present status of fishery production in Chuuk State as well as the organization charged with Plan implementation in order to assess the background and appropriateness of the Plan, along with the composition of the required facilities and equipment.

With respect to the proposed Plan site, the revised site contained in the Request document was to be provided by reclaiming land in the southwest corner of the mooring area in the North Inner Basin. However, owing to the large volume of soil that would be required for the land fill as well as the extensive time and cost involved, along with the poor road access and the considerable time that would be consumed in reconciling the reclamation project with the master development plan for this Basin, it was determined that an alternate Plan should be considered. The BDST then conducted an on -the -spot survey of a new site, as presented by the Chuuk state government during the Team's stay, in the northeast corner of the cargo handling area in Weno harbor.

The basic understandings on project implementation, as reached in the course of the talks between the BDST and the Federal and Chuuk State governments, have been summarized in a Minutes of Discussions, which was signed by and exchanged between both parties. Upon completion of the field survey and its return to Japan, the BDST further analyzed and evaluated the survey findings, assessing the need for the required facilities and equipment, and prepared a Basic Design Survey on the composition, technical specifications, and quantities of the Plan facilities.

This Survey comprises a Basic Design for the facilities and equipment deemed optimum for the subject Plan, a Project Implementation Plan, and a Project Evaluation. The composition of the BDST, its field itinerary, and names of discussants are shown in the Appendices following the main body of the report.

SECTION TWO : THE PROJECT ENVIRONMENT

2.1 National Economy :

In November, 1986, FSM, which had formed part of the United Nations' Trust Territory of the Pacific Islands , along with the Northern Mariana Islands, Palau, and the Marshall Islands, gained its independence under a Compact of Free Association with the United States. This Compact runs for 15 years and so will expire in 2001, but the FSM economy has been heavily dependent on financial assistance pursuant to the above Compact. The nation's GDP in 1990 was estimated at $157 million, of which about $120 million was accounted for by foreign funding, the bulk of which was provided under the Compact of Free Association.

The FSM economy, which has depended so much on external funds, must now overcome several major handicaps. The FSM islands are remote from the main markets of the Pacific Rim ; while the size of the country's domestic marked is limited by its small population (only about 108,000), which is scattered over a broad expanse of ocean, making the infrastructure overhead much higher than in other countries. The Micronesia economy is considered still far too fragile to overcome these infrastructural disadvantages, cultivate domestic industries to displace imports, and earn foreign exchange by offering products that are competitive on international markets.

While the Micronesian economy cannot survive without external funds, owing to the inadequate development of domestic industries, virtually all of these outside funds flow into government accounts. Although these public funds are distributed to the people via infrastructure investments, other development projects, and subsidies at the government level, in order to handle this considerable sum, representing so high or proportion of GDP, a large and capable corps of government workers has been required, leading to an ever -expanding bureaucracy. As of 1990, total employment in Micronesia, including self -employed workers, was 26,372, of which government employees totaled 6,410, accounting for 24% of the labor force. Wage levels in government agencies are relatively high, reflecting salary levels that can be earned in Guam and other U.S. territories, which are open to Micronesian citizens under terms of the Compact of Free Association.

Given the generally high wages prevailing in the FSM, which must be in line with those available in the public sector, it is far from easy to cultivate domestic industries capable of replacing low - priced imports or competing in export markets.
Under the Compact of Free Association with the U.S., economic aid is progressively being

reduced at five year intervals to encourage the FSM to achieve some degree of economic independence by the end of the Compact period. In 1997, Compact assistance is projected to be lowered to 45 million per year (at 1986 prices), which would be about 60% of the assistance provided under the Compact in 1990.

To put this steady decrease in aid and post -Compact economic self support into proper perspective, unless national industries can be developed by the expiration of the Compact period, per -capita GDP will inevitably fall sharply. Everything, then, depends on the country's ability to nurture relatively strong and highly productive industries within the short time remaining under the Compact. At present, local industries with the potential to increase added value and a low import content include three sectors : fisheries, agriculture, and tourism. While it is evident that, in preparation for the expiration of the Compact of Free Association, domestic production must be increased and exports expanded to compensate for the reduction of U.S. assistance, for the Micronesian government to realize these goals, it must drastically curtail expenditures, while maintaining domestic revenues, and shift to an organizational structure that will more effectively mobilize the human resources and facilities that have been excessively concentrated in the public sector, while adopting major structural reforms, such as an urgent program for promoting industrial development.

2.2 Foreign Trade :

FSM has only an limited group of primary export products. The value of exports, by major commodity, for 1991 -93 inclusive, is shown in Table 2.1 following.

Table 2.1 Major Export Goods by type (1991 -1993) in thousand U.S. dollars ($1,000)

Type/Year	1991	1992	1993
Agriculture product	464.8	961.0	1684.6
Copra	(263.1)	(222.2)	(0)
Banana	(136.1)	(278.0)	(754.4)
Betel Nuts	(8.8)	(94.3)	(267.0)
Black Pepper	(23.9)	(32.0)	(36.1)
Others	(32.8)	(334.3)	(626.9)
Marine Products	9,158.9	20,110.2	25,320.3
Fish	(8,627.6)	(19,485.0)	(25,216.5)
Trochus Shells/meat	(427.6)	(523.6)	(2.6)
Crab/Lobsters	(97.7)	(65.0)	(74.5)
Others	(5.9)	(36.4)	(26.5)
Others	6,423.9	8,232.2	7,146.4
Buttons	(187.0)	(130.9)	(0)
Garment Products	(0)	(2,045.1)	(2,055.3)
Tourism	(5,612.2)	(5,491.5)	(4,638.8)
Others	(624.7)	(564.5)	(452.2)
Total	16,047.8	29,303.6	34,151.3

Source: Trade Bulletin No.7, Office of Planning and Statistics, Sep. 1994

The share of marine products in total exports is extremely high and rising year by year : 57% in 1991, 68% in 1992, and 74% in 1993.

Sources of foreign exchange other than exports include stamp sales and fishing fees. Taking 1993 as an example, these sources brought in foreign exchange of $36,193, and $15,083,868, respectively (on a calendar year basis), for a total of $ 49,271,459 combined. Receipts from fish exports and fishing fees came to $40,404,210 in that year, accounting for 82% of Micronesia's overall foreign exchange earnings. Thus, the contribution of the fishery sector to Micronesia's foreign exchange receipts is exceedingly high, making it abundantly clear why the FSM government has positioned fisheries as a top priority sector for industrial development.

Imports are shown in Table 2.2.

Table 2.2 Major Import Goods by type (1991 –1993) in thousand U.S. dollars ($1,000)

Type/Year	1991	1992	1993
Food	23,795	19,752	31,170
Beverages & Tobacco	8,549	8,048	7,035
Crude Materials	134	60	99
Petroleum Products	11,692	16,896	11,221
Animal & Veg. Oil	0	13	4
Chemical	3,661	4,416	4,245
Manufacture Goods	12,757	13,873	18,503
Machinery & Vehicle	12,509	16,793	22,086
Miscellaneous Manu. Goods	8,218	7,619	2,955
Others	7,315	11,327	2166
Total	88,631	98,796	109,486

Source: Trade Bulletin No.7, Office of Planning and Statistics, Sep. 1994

Over the 3 –year period 1991～93, the level of imports ran 3.7 times that of exports. Although, under present circumstances, it would hardly be realistic to institute a policy to achieve a trade balance immediately, unless steps are taken to control imports and expand exports, the country would clearly be bankrupted if policies predicated on aid receipts from the U.S. continued to be followed.

One of the measures that are frequently taken by developing nations to encourage domestic production and strengthen the competitiveness of exports is currency devaluation. However, this does not represent a viable option for FSM, since its currency is the U.S. dollar. In Micronesia's circumstances, it is felt that tariffs must be raised somewhat to discourage imports, and the government has already decided to impose a duty of 3% on food products and one of 25% on beverages. However, in terms of promoting domestic industry, the high current tariffs on key imports, such as machinery and raw materials, tend to weaken the competitive position of domestic products. Under the these conditions, it is recognized that it will be no easy task to

foster industrial development, and so the government is actively considering introducing a policy of raising import duties while providing a system of subsidies to offset these duties on export products.

2.3 National Finances

National revenues in the FSM are highly dependent on overseas funds, particularly aid pursuant to the Compact of Free Association with the U.S.. While the government is attempting to reduce the degree of reliance on Compact funds, it will not be easy to attain this goal under existing conditions, with domestic revenue sources so limited.

Budgeted revenues for fiscal 1993~95 inclusive (running from October of the preceding year to September of the current year) are shown in Table 2.3.

Table 2.3 National Government Budget (1993 –1995) in U.S. dollars ($)

Year	1993	1994	1995
(1) General Fund	59,179,963	51,174,055	40,277,524
FSM National Taxes and Revenues	(30,314,000)	(27,400,000)	(28,250,000)
Compact Funds	(28,865,963)	(23,774,055)	(12,027,524)
(2) Special Compact Funds	5,066,572	4,502,378	4,108,109
(3) Compact Special Block Grant	1,039,754	516,365	505,229
(4) Other Revenues	610,200	787,940	1,061,693
Total	65,896,486	56,980,738	45,902,555

Source: Office of Planning and Statistics, Dec. 1994

Items (2) and (3) in the above table both represent aid funds under the Compact of Free Association. Together they accounted for 53% of national receipts in fiscal 1993, 50.5% in fiscal 1994, and 36.2% in fiscal 1995, indicating that reliance on Compact funds is gradually declining. However, total receipts are also falling, reflecting the inability to secure replacement revenue for Compact funding in the domestic economy.

Revenues from Federal taxes and other domestic sources (such as customs duties, income taxes, and sales taxes) came to $8,150,000 in 1993, $8,350,000 in 1994, and a projected $9,150,000 in 1995, evidencing no clear growth pattern. The largest Item of domestic revenues is fishing fees, which brought in $17,640,000 in fiscal 1993, accounting for 58% of domestic receipts. The budgeted shares from this source for fiscal 1994 and 1995 are 54% and 53% respectively,

indicating that national revenues are greatly impacted by fluctuations in fishing fee income.

2.4 Profile of the Marine Products Industry

2.4.1 Tuna and Skipjack Fishery :

The Exclusive Economic Zone of the FSM, covering some 2,900,000 km^2, is known as one of the world's prime fishing grounds for tuna and skipjack. The total fish catch in Micronesian waters during 1993 come to 173,011 tons, but the bulk of this was accounted for by operations of foreign fishing vessels. Directed species may be broadly classified into skipjack, yellowfin, and bigeye tuna, with catch statistics classified accordingly.
Incidental catches of sharks and marlin are included under yellowfin. Total catches by species for 1993 were reported as follows :

Table 2.4 Fish Catches in the FSM EEZ in 1993 (unit:m/t)

	Skipjack tuna	Yelowfin tuna	Bigeye tuna	Total
Catch (m/t)	102,000	64,000	7,000	173,000
Catch Composition (%)	59	37	4	100

Source: Two Year Report of the Micronesian Maritime Authority, 1992 –1993

Fishing methods comprise purse –seine, longline, and pole and line, with purse –seine accounting for the overwhelming share of catches, representing about 86% of total volume (149,881 tons), followed by longline at 9.6% (16,557 tons), and pole and line at 3.7% (6,573 tons). An outline of the three fishing methods follows ;

(1) Purse –seine fishery ;

Japanese fleets participating in the foreign purse –seine fishery take about 90,000 tons of fish a year, accounting for some 60% of the total purse –seine catch. Other participants include Taiwan, Republic of Korea, and the U.S, along with two Micronesian joint ventures. The latter operate a total of 7 small purse –seine vessels, with a combined catch of about 2,000 tons in 1993. At the present stage, however, these ventures are not profitable, relative to the large investment, though it is expected that operations will become viable in the future.

American purse –seine vessels operate on this basis of a special collective fishery agreement with the 15 nations and regions, member of the South Pacific Forum, including Marshall Islands,

Palau, Kiribati, and the FSM. These 15 nations and regions share equally in 15% of the contract proceeds, with the remaining 85% distributed in proportion to total catches by U.S. fishing vessels in the 200 -mile zones of each country.

(2) Longline fishery :

A total of 412 vessels, from Japan, ROK, China, and FSM, participate in the longline fishery. Since 1992, the Taiwan and China fleets have been mounting full -scale operations from bases in all 4 Micronesian states (Yap, Pohnpei, Chuuk, and Kosrae), with fresh tuna air -shipped to Japan, via Guam and Saipan, in two private aircraft. The FSM government has up a plan which positions fresh tuna air shipments at the core of future fishery development. A domestic longline fleet is being rapidly developed, under the aegis of the National Fishery Corporation (NFC), with 7 tuna longline vessels already in operation as of December, 1994. The plan is to expand this fleet to 40 vessels, based on funding from the Asian Development Bank. The NFC, in cooperation with the Yap and Chuuk State governments, is also starting to supply ice, water, fuel, and other items to its tuna longline vessels and is also building shore bases equipped with fish handling areas and port facilities. By adding distribution supply and related activities to its fishing operations, FSM seeks to develop its own integrated fishing industry and thereby generate new employment opportunities .

In addition, the Pohnpei State government and NFC have established a joint fish processing venture in that state, called the Pohnpei Fisheries Corporation (PFC). At this plant, reject fish -- i.e., fish not fit to be shipped in fresh form —are frozen and packed as chunks or in loin for export to Japan and the U.S. This operation was launched in 1992.

In order to secure a stable supply of raw fish, the PFC has contracted to purchase the catches of 75 longline vessels of Chinese registry. We were told that this processing plant has passed U.S. food hygiene inspections and is finally getting on track. The target is to process 1,000 tons of raw fish annually, with sales of $5,000,000. At some time in the future, this company is expected to be privatized.

(3) Pole and line fishery :

The pole and line fishery, directed at skipjack, is conducted only by Japanese vessels. In recent years, however, reflecting the depressed skipjack market as well as rising crew wages and the growth of the purse -seine fleet, pole and line catches have been on a declining trend, accounting currently for less than 4% of the total catch in the FSM Exclusive Economic Zone.

Table 2.5 tabulates catch volume and the number of fishing vessels in FSM waters for 1993, classified by country and fishing method.

Table 2.5 1993 Catch by Flag and Gear Type

Flag	Purse Seine (m/t)	No.of Boats	Longline (m/t)	No.of Boats	Pole & Line (m/t)	No. of Boats	Total Catch by Flag	Total Boats by Flag
Japan	89,710	35	10,072	117	6,573	36	106,355	185
Taiwan	35,943	43	3,010	75	—	—	38,953	118
Korea	19,499	33	14	6	—	—	19,513	39
FSM	2,153	7	77	7	—	—	2,230	14
USA	2,576	45	—	—	—	—	2,576	45
China	—	—	3,384	207	—	—	3,384	207
Total	**149,881**	**160**	**16,557**	**412**	**6,573**	**36**	**175,583**	**608**

Source: Two Year Report of the Micronesian Maritime Authority, 1992 -1993

2.4.2 Small -scale Fisheries :

In comparison with the commercial fisheries directed at skipjack and tuna, statistics on artisanal fisheries in the FSM are relatively undeveloped, making it difficult to prepare an accurate assessment of their present situation. Although these fisheries play, on the whole, a major role in supplying animal proteins on the outer islands, quantitative data do not exist on catches and consumption for the fishermen's own tables. Slight variations exist in the patterns of artisanal fishing operation's from state to state, reflecting differences in fishing ground conditions as well as consumer preferences. We will, therefore, confine our discussion to conditions in Chuuk State, which is the target area for the subject project.

Chuuk State is located virtually in the center of the FSM. It is made up of 16 volcanic islands scattered inside the Chuuk Lagoon, which has a rounded triangular shape, with sides of about 70 km and an area of 2,100 km^2, and 5 outer islands of coral reef origin lying beyond the Chuuk Lagoon. 80% of the population of Chuuk State live on islands within the Chuuk Lagoon, which is blessed with a mild oceanography, permitting constant transportation inside the Lagoon via small boats. There boats are for the most part of FRP construction, with a total length of 6~8 m, with no decks, and are fitted mostly with 30~60 PS outboard motors.

Since the boats do not have to be registered, no figures are available on their number but, according to estimates received from State officials, some 2,000 boats ply the waters within the

Chuuk Lagoon. They are used not only to catch fish, either for personal or commercial use, but also as a means of transport in everyday life, for commuting to work or school, shopping, and business. It is, therefore, impossible to classify them functionally as either fishing or transport vessels.

Since data do not exist on catch volume, distribution volume, and self -consumption for the artisanal fisheries in Chuuk State, it is not possible at this stage to develop a full grasp of artisanal fishing activity from secondary sources. As the great bulk of this fishing activity is conducted in small boats, as the occasion demands, and, when catches are sold commercially, the tendency is to sell through family connections, organizations representing the interests of the fisherman's home village, or other special channels, it is frankly difficult to collect meaningful statistics on these fishing operations. With outboard motors making steady inroads, fishing activity is mostly directed at surface species, using trolling gear, followed by bottom fish, caught with hand lines, with net -fishing still minor. While the fishing grounds are primarily within the Chuuk Lagoon, there are said to be rich resources of reef fish on the ocean slope outside the atoll, including lobsters and other species with commercial value in the export market. Fishing in these outer waters is quasi -full -time, geared to producing cash income. The fish taken inside the Lagoon are mainly pelagic species, such as indian mackerel and round scad, which the Chuuk people are quite fond of, but, owing in part to the low penetration of net gear, pelagic fishing was formerly conducted with dynamite. Although dynamite fishing is now prohibited, illegal operations of this nature still persist, and in order to expedite the shift away from this dangerous and environmentally destructive method, serious efforts are being made to promote the spread of stick -held dip net (boukeami) and other techniques. Thus, the time is ripe for disseminating this technique, and it is hoped that the DMR will see fit to provide ongoing guidance in this connection.

There has been notable population growth in Weno, the political, economic, and administrative heart of Chuuk State, reflecting primarily an influx of people seeking employment and higher educational opportunities.

Under present circumstances, however, employment opportunities are limited in the private sector, i.e., apart from jobs in the State government. The State employs up to 2,823 persons but, including related agencies and boards, the total personnel requirement is said to number about 3,400. Most State government workers live in Weno and, including others employed in private industry, the bulk of these salaried employees are fish consumers. There are reported to

be about 20 retail fish stores in Weno, but no definitive figures exist on the sale or distribution of fish products in this area. Also, in the absence of facilities that could serve as collection points for fish brought to Weno, distribution channels tend to be established on the basis of home – town or personal relationships.

There is a flourishing export trade in reef species from Chuuk, particularly to fill a strong demand for fresh fish in Guam. Almost all of these fresh shipments are made via regular flights; apart from fish carried on as personal hand baggage, the exports are shipped as air cargo, but there are no State figures on the volume of these shipments. According to the cargo records of airlines operating scheduled service, during the first 23 days of December, 1994 alone, the total weight of fish transported as air cargo came to 12.6 tons.

Based on airline regulations, ice is not permitted on shipments of fresh fish. While such fish is sometimes shipped in insulated boxes, the bulk of the shipments are packed and sealed in cardboard containers, with the fish chilled and sprinkled with salt. Judging by this type of packaging, it may be estimated that the net weight of the exported fish is at least 80% of total shipping weight. Shipments tend to be higher during December; in Guam and Saipan, they peak during the Christian Lent season in April, considering these factors, the annual level of fish exports from Chuuk to Guam would appear to run at least 100 tons.

As discussed above, on the production level, an increase in catch effort may be anticipated in the artisanal fisheries of Chuuk State, based primarily on development of the net –fishing method, while, on the consumption level, there is a trend toward increased demand for fish products in urban districts within FSM as well as for exports . However, it must be recognized that the development of an organized distribution system by the State governments lags seriously behind this growth in demand.

It is expected that a resource management controls will soon have to be introduced for reef species in Chuuk State, particularly inside the Chuuk Lagoon. In this connection, an effort should be made to establish distribution points to enable the authorities to accurately monitor developments in the Slate's small –scale fisheries.

2.4.3 Fishery Education :

In 1990, the FSM government established the Maritime Fisheries School of Micronesia Maritime and Fisheries Academy (MMFA) to train local crews and develop the country's fisheries, using Micronesian vessels. This school offers two courses : one for skippers and the

other for engineers serving aboard small fishing vessels, with both programs oriented primarily to crews on small tuna longliners owned by the FSM government. Each course has an enrollment of 12 students and runs 5 months, with two courses offered per year. There are 8 instructors in all: 5 specialists from Europe dispatched with the assistance of a religious group and 3 experts provided by the OFCF. This is a boarding school, with of the students supported by scholarships from their home states, and courses have been virtually full. The school does not have its own training vessel, but plans are underway to procure one with funding from the Asia Development Bank.

2.5 Related Development Plans :

2.5.1 Second National Development Plan (1992~96) :

The Second National Development Plan of the FSM government is a successor to the First National Development Plan, covering the 5 year period 1985~89. In the course of the first Plan, 32% of the total national developmental budget ($140 million) was accounted for by fisheries development ($45.0 million). Thus, the marine fishery sector has been positioned as the primary engine of national development, geared to the following objectives :

(1) Commercial Fisheries :

1) to build a major FSM tuna fishery within 10 years.

2) to fund the establishment in each State of shore -based support facilities for the tuna fishery, including processing plants.

3) to manage the country's tuna resources so as to permit sustainable production over the long -term.

4) to strengthen ties between the various State governments, the Micronesian Maritime Authority (MMA), the Federal government, the National Fishery Corporation (NFC), and related associations.

(2) Artisanal fisheries :

1) to expand artisanal fishery production and increase domestic consumption of marine products ;

2) to manage marine resources from a long –term perspective ;

3) to promote the commercial development of artisanal fisheries, including exports.

(3) Aquaculture :

1) to develop and introduce economically viable aquaculture technology.

2) to transfer this technology to the private sector, both for artisanal (subsistence) and commercial use.

3) to employ aquaculture techniques, wherever feasible, to introduce seeds and restock areas whose resources have been depleted.

2.5.2 The Chuuk State Development Plan (1992~96)

The Development Plan for Chuuk State, like those of the other states, attaches a high priority to fishery development. The Chuuk State government has positioned the fishing industry as a vehicle for increasing cash incomes and employment opportunities, expanding and diversifying food production as a substitute for imported proteins, and earning foreign exchange from tuna exports, based on the development of large –scale fisheries. The specific developmental objectives in the marine fisheries sector are as shown below :

(1) Improve the distribution and processing of pelagic species, while increasing fishing capacity.

(2) Establish a domestic distribution system and promote commercial development in the fisheries sector.

(3) Provide training opportunities in both the management and technical areas.

(4) Foster the development of the artisanal coastal fishery via technical support and resource management.

(5) Develop resources for future use.

(6) Establish an appropriate resource management structure.

In order to achieve the above objectives, the Development Plan incorporates 12 specific projects which are to be carried out during the plan period. Two of these projects call for the creation of public fish markets and the development of a fish distribution system, which are intimately related to artisanal fisheries development. Ice production, fish handling, temporary storage, and data collection are vital functions at these facilities in terms of realizing the twin goals of increasing catches by the arttisanal fisheries and expanding the consumption of marine products. Accordingly, implementation of these plans can be expected to contribute in an important way to the development of artisanal fisheries in Chuuk State.

2.5.3 Development Plan for a Fish Distribution System in Chuuk State :

The Development Plan for a Fish Distribution System, as incorporated in the master Development Plan for Chuuk State, was prepared in December, 1994 by the State's Marine Resources Department (MRD).

This Plan expressly excludes the Chuuk Lagoon, where fishing effort is disproportionately concentrated, reflecting the Lagoon large population and proximity to the Weno market. The Plan is instead targeted at the 5 outer islands beyond the Chuuk Lagoon which offer considerable potential for future development. The objectives include optimum development of reef species (e.g., surgeon fish, goat fish, parrot fish, and fish of the Wrasse family) by artisanal fisheries and establishment of a distribution network for local consumption and exports of fish products taken around these outer islands. In more specific terms, a fresh fish purchasing base will be established at 5 locations 250~300 km from Chuuk Lagoon: the West Island, Namonuito, Hall, Upper Mortlock, and Lower Mortlock, at which ice and insulated containers will be supplied and fish bought from fishermen and local associations for shipment to the fish markets to be established in Weno, where the fish will be sold to either local fish retailers or exporters.

We were told that, as a means of implementing this Distribution Plan for Reef Fish, the MRD was considering applying for permission to draw on the Federal Block Aid allocation, which forms part of the funds provided under the Free Association Compact with the U.S. But, if the subject project is implemented under a grant -aid from Japan, the principal components of the Distribution Plan can be realized, and so it is hoped that the subject Plan will be speedily carried out.

2.6 Status of Japanese Aid Programs :

Japanese assistance to the FSM covers a wide range of fields, reflecting the historically close ties

between the two countries. The fishery sector offers the strongest potential for economic development in FSM, and Japan has an extensive record of accomplishments in fisheries – related aid programs. We shall describe two such projects which were found to be quite similar to the subject Plan : the Improvement of Pohnpei Artisanal Fisheries Station and the Fisheries Development in Chuuk State.

(1) The Improvement of Pohnpei Artisanal Fisheries Station:

This Project, executed in 1993, provided a small –scale fishery support station geared to supplying ice to artisanal fisheries in Pohnpei State. A plate ice plant, with a production capacity of 2 tons per day, was installed at this facility, coming on line in January, 1994. The operating history of this ice plant has been as follows.

Total ice sales from the start of operations in January, 1994 through the end of November amounted to $22,967. The ice is being sold at 50 cents per bucket (5 kg), which translates to a volume of about 230 tons, based on the above sales figure. On this basis, the average monthly volume works out to at least 20.9 tons. However, after adjusting for ice consumption by small boats owned by the State Division of Marine Resources as well as slight losses after production, the average monthly volume can be estimated at about 25 tons.

This support station is operated by the Pohnpei State Division of Marine Resources. The ice plant is managed by 2 operators, with ice sold some 10 hours per day. From January to November, 1994, operating costs for the facility totaled $9,584, but this figure does not include electricity or water. Power costs could not be determined for the ice operation alone, since the invoices cover all power consumed by the Department of Fisheries, but, in November, the support station paid $ 4,000 as its shore of the power bill through that month, bringing overall operating costs for that month to $13,584. With sales revenues for the period at $ 22,967, the operation was found to be operating smoothly, according to plan, with a healthy surplus.

(2) Fisheries Development Project in Chuuk State.

This Project, implemented in 1985, was designed to provide a fishery complex for artisanal fisheries at Tonowas (formerly known as Dublon Island), located about 10 km from Weno, the capital of Chuuk State.

The equipment supplied included a cold storage plant, ice –making facilities, and an emergency generator. At present, the 25 kg block ice facility within the complex, with a daily output of 5

tons, is being operated by the State Department of Marine Resources, but the equipment has already seen many years of service and shows clear signs of age. Wear and tear on the electrical systems is particularly severe, which is adversely affecting operations. While the rated production capacity of the ice -making unit is 5 tons per day, as of December, 1994, the maximum production of 25 kg ice blocks was only 70 blocks, or 1.75 tons / day. The drop in ice production capacity may be ascribed to such factors as the aging of the entire installation, the fact that 1 of the 2 emergency generators has been out of commission, and a shortage of ice - making cans. The poor power supply situation in Tonoas discourages the spread of household refrigerators, intensifying the demand for ice, not only for fishing use but for general food storage as well so that ice production at this facility is sold out. Ice sales at the Tonowas ice plant ran $40,665 in 1992 /93 and $36,086 in 1993 / 94. Since the unit selling price is set at $ 2.00 per 25 kg block, the volume of ice sales in 1992 /93 totaled about 508 tons and, in 1993 /94, 451 tons, attesting to an alarming deterioration in ice -making capability with each passing year.

2.7 Conditions at the Plan Site :

2.7.1. Natural Conditions :

Chuuk State is located at the western edge of the Eastern Caroline Islands chain, about 900 km north of the Equator. From July to November, the area falls under the influence of a tropical convergence moving up from the south, with tropical depressions observed during this season. There is little annual variation in either temperatures or humidity, while rainfall is relatively light between January and March. Meteorological observations in Chuuk State are made at the Weather Station on the south side of the international airport northwest of Weno, Weather date are sent to NOAA (National Oceanic & Atmospheric Administration) in the United States for editing, and the summaries shown below are based on the weather data published by this agency. Detailed temperature and humidity figures for 1992 are shown in Appendix V -1.

(1) Temperature :

The maximum temperature reading recorded over the past 40 years is 34.4℃, and the minimum 18.8℃. The highest average monthly temperature occurs in November (30.6℃), the lowest in August (24.8℃), confirming the narrowness of the annual range.

(2) Humidity :

Humidity is normally highest in the early morning, when temperatures fall, and lowest toward

evening. The average annual humidity at 4:00 AM runs 86% and, at 4:00 PM, 77%. Thus, humidity is high throughout the year.

(3) Precipitation :

Annual precipitation varies considerably from year to year, with past measurements ranging from 3,050 –4,600 mm. Rainfall is lowest in February. Average monthly precipitation over the past 30 years ranges from a low of 160 mm in February to a high of 376 mm in May. The lowest monthly rainfall over this 30 year period was 14 mm, in February, 1983, while the highest was 721 mm, in May, 1976, with an annual average of 3,556 mm. The highest rainfall during a 24 –hour period was 282 mm, recorded in May, 1976.

(4) Wind Conditions

From November to June, when northeast trade winds predominate, average wind velocity runs from 3.5~5.5 m. The trade winds weaken from July to October, with the prevailing wind direction shifting to west / southwest. From July to November, the area frequently comes under the influence of tropical depressions. Typhoons generally pass to the northwest of Chuuk State, though some do pass directly through the Chuuk Lagoon vicinity; during a typhoon in November, 1987, a wind velocity of 42 m / second was recorded at Weno, and, in November, 1990, one of 26.4 m.

(5) Tides :

According to tidal observations taken at Weno harbor during April, 1993, diurnal tidal cycles predominate around Weno harbor, though half –day cycles appear from middle to spring tide. Based on tidal charts for Weno harbor, the tidal range during December 1994 at high tide was about 0.85 m. In charts datum, the average surface is shown as –0.6096 m (–2 f t).

2.7.2 Infrastructure :

(1) Power :

Power at Weno is provided via diesel generators. 2 units with a capacity of 2,000 kw, 2 at 2,035 kw, 2 at 800 kw, and 1 at 1,200 kw, with a combined output of 10,970 kw. However, owing to shutdowns while awaiting replacement parts or power failure during operation, the true

level of stable power that can be supplied is no more than 4,000 kw. Under present conditions, therefore, as a result of power failures, the electricity supply in the area cannot be described as reliable. Chuuk State is planning various improvements in its power facilities, such as the purchase of new generators, repair of existing units, purchase of repair tools, installation of new transformers, and upgrading trunk lines. If these plans are implemented, a major improvement in Weno's power supply can be expected, but the total budget needed for this purpose would be in the order of $ 4.7 million. The State government is currently seeking to improve the operating efficiency of its power system while also reducing government power subsidies, and in this connection, in October, 1994, transferred its power operations from the Department of Public Works to a newly established Chuuk Utility Corporation.

Power rates as of December, 1994 were at $0.12 / kwh, for consumption of not over 10,000 Kwh per year. However, this level is predicated on substantial subsidies from the State government, and so it is anticipated that power rates will eventually be raised so as to have users bear a fair shore of the higher costs that will result from a reduction in subsidies.

(2) Water supply :

Water supply at the Plan site in Weno is derived from 24 wells. However, a portion of the pumping facilities suffers from advancing corrosion, owing to salt penetration, which has caused a drop in the water supply capacity. As a consequence, time rationing was instituted in Weno in December, 1994, with the hours of water supply thus limited in each service area. Fortunately, however, the commercial port in Weno, which contains the Plan site, is in a low – lying area and thus relatively well endowed in terms of water supply. Water mains cover about 3/4 of Weno, with an underground 12 inch main running up to the road in front of the Plan site. The State government recognizes the need for improving the aging water supply facilities, with restoration work scheduled to begin in 1995. Given the plentiful rainfall, rainwater should be used to the maximum possible extent. As of December, 1994, water rates were $ 6.00 / 1,000 gallons. Should the regular supply via the water mains prove inadequate, it will be possible to obtain additional supplies from water wagons, but at a premium rate of $ 15. 00 / 500 gallons — 5 times the rate for municipal water.

(3) Drainage :

While sewage pipes have been laid under the main roads, the system serves mainly State buildings, hospitals, schools, and other public facilities; with few private homes connected. A sewage treatment Plant is located at Point Gabert, just south of the Weno International Airport.

After being treated and purified, the sewage is discharged into the ocean. The present volume of sewage disposal averages 2,890 m^3 per day, which is reported to represent about 40% of the total capacity of the treatment plant.

(4) Roads :

Road surfaces in Weno are in urgent need of repair. While the State government has already initiated a road improvement plan, it is not proceeding at a satisfactory pace. Repaving is planned for the heavily traveled main roads but, owing in part to the improvement work on the water mains, the repaving work is not expected to be completed for some time.

2.7.3 Description of the Plan Site :

The site proposed in the original Request from the FSM government was to be on reclaimed land in the southwest corner of the North Inner Basin. As is reflected in the population density of Chuuk State (382 persons / km^2), by far the highest level in the FSM, the feeling runs deep in the area that traditional land ownership is the prime source of one's livelihood, and so problems in transferring or inheriting land cannot be entirely resolved through the modern legal system that has been established in this State. There are said to be 15,000 parcels of land in Chuuk State, of which fewer than half (7,300 plots) are actually registered at the State Land Bureau, with definitive titles established on only 4,300 plots. At the present time, only a limited amount of land is owned by the Chuuk State government, with unresolved land problems said to be seriously impeding progress in the State's developmental plans. Given this background, the Chuuk State government had planned to reclaim for the subject Plan a portion of the southwest corner of the Northern Inner Basin of Weno Harbor, which is presently an important mooring area for small boats used for distribution, commuting to work or school, commerce, and other activities.

Weno Harbor has developed as the only international port in Chuuk State. However, in order to accommodate the growing volume of container trade, consideration has been given to a plan to refurbish jetty and shore facilities. In a Master Plan for the Development of Moen (now Weno) Harbor, drafted in July, 1989 by the State's Government. It was planned to reclaim the entire western side of the North Inner Basin at Weno (including the Plan site shown in the Request) to house a public market and other facilities and to conduct shore protection work on the eastern side to build a mooring jetty for small boat use. But, while awaiting implementation of this Master Plan, operating conditions at the Commercial Port underwent progressive changes, resulting in the creation of a new Master Plan in January 1993, using the services of an American

consultant. Based on the revised Plan, as released, the work will be confined to riparian work and a mooring jetty on the west side of the Master Plan area (i.e, the North Inner Basin) and disposal of a sunken vessel and straightening the water line on the east side. The mooring area for small boats would then be established at a site some 400 m north of the Master Plan area.

In the Basic Design Study conducted by JICA in April, 1993 on the Weno Harbor extension Project, based on this new Master Plan, it was decided to assign the highest priority to improving port facilities for both foreign and domestic trade, which were deemed to be most urgently needed. As a result, the planned work in the North Inner Basin was excluded from the project. Based on the findings of the above Basic Desugn Study, as of December, 1994 construction work for this Weno Harbor Extension Project was being carried out under a grant -aid from Japan, geared primarily to extending the jetty and expanding the container yard in the Commercial Port section, with these facilities expected to be completed in March 1996.

2.8 Environmental Conditions :

The FSM, as an island nation with a limited land area, is keenly interested in conserving its reproducible resources while preserving the natural environment. The country's Environment Protection Act (EPA) was enacted in 1984, with the Federal Division of Health of the Department of Human Resources having jurisdiction over environmental preservation, regulations, and enforcement relative to air, soil, and water pollution. In the Coastal Development Plans carried out under the Compact of Free Association with the United States, environmental assessments are mandatory, based on the U.S. National Environmental Policy Act. However, such assessments are not always being adequately carried out for small -scale development plans, but it is, in practice, difficult to invoke legislative penalties in such cases.

Since the Plan site for the subject project will use a portion of the shore area within the boundaries of Weno Harbor, no land fills or excavations will be required at the water line in connection with Plan implementation. Furthermore, since the project will be carried out in the heart of Weno, where the infrastructure is well developed, all power, water and sewage facilities will be supplied from trunk lines or mains laid along main roads adjoining the Plan site. Thus, the direct environmental impact of the facilities themselves on air, soil, or water quality will be negligible.

With regard to the ice -making equipment, which will be the major items at the Plan facility, a problem will be presented by the freezing medium. While Freon gas has traditionally been used as this medium, owing to its high degree of stability and safety, this substance has become

the target of international controls as a result of its high ozone destruction coefficient. As of December, 1994, the only medium being used with a zero destruction coefficient is ammonia.

While ammonia is inferior to Freon gas in safety and makes equipment miniaturization difficult, there is a tendency to reuse this substance at large -scale facilities consuming a large volume of refrigerant. However, since the capacity of the two compressors for the ice - makers at the Plan facility is planned to be only about 5.5 kw each, while there are no compressors on the market with this freezing capacity that can use ammonia as the refrigerant, we plan to use an HCFC -type refrigerant presently in commercial use (a compound with a low ozone destruction coefficient, since it contains hydrogen in addition to chlorine). It is expected that, in the near future, a coolant with a zero ozone destruction coefficient will be developed that will totally replace HCFC, at which time it will be necessary to Plan for a changeover to the new substance.

SECTION THREE:PROJECT CONTENTS

3.1 Basic Concept

3.1.1 Need and Appropriateness:

(1) Present State and Problems Affecting the Artisanal Fisheries in Chuuk State :

In the absence of public market facilities, the distribution of fish caught by artisanal fishermen relies primarily on family ties and associations in their home villages, making it difficult to gain an understanding of conditions in these fisheries from catch statistics or other data. There are said to be about 20 fish sales points in Weno and, based on estimates from the State Department of Marine Resources, total fish consumption in this area runs 1,000~1,200 tons per year. In addition to this domestic consumption, a brisk business is being done in exports of fresh reef fish to Guam, which are believed to total at least 100 tons a year, as estimated from airline shipping records. Ice is widely used to maintain the freshness of fish from small -scale fisheries from catch to distribution. Ice -making installations in Chuuk State are located only at Weno, Tonowas, and Tol, within the Chuuk Lagoon, with none found on the outer islands. While large -scale ice facilities are also found at the landing facilities for the tuna longline fisheries geared to air shipment of fresh tuna, these installations, for both technical and economic reasons, cannot handle small -lot demand. But the bulk of the existing ice -making equipment for small orders is becoming increasingly superannuated . For example, annual ice sales during 1994 at the Weno and Tonowas plants were only about 540 tons, far below the level required to fill the demand for distribution purposes. Thus, the ice bottleneck is a major obstacle to maintaining freshness as well as a stable supply of fish, not to mention fishery development on the outer islands beyond the Chuuk Lagoon.

The demand for fish as a valuable source of protein, particularly for the outer islanders, is steadily growing in response to the increase in population, and it is expected that, in the near future, there will be a need to develop resource management policies for reef species in Chuuk State, particularly inside the Chuuk Lagoon. For this purpose, an effort will have to be made to establish distribution bases so as to facilitate monitoring of conditions in the artisanal fisheries.

(2) Description of Existing Ice -making Facilities :

Although the State Department of Marine Resources (DMR) has been making an effort to repair and maintain equipment in the aging ice -making plants, it has not yet been able to check the

progressive decline in ice production capacity. Present conditions at the existing ice facilities are discussed below.

1) The Weno Plant run by the Department of Marine Resources :

The Department of Marine Resources operates two ice -making units, with a daily production capacity of 5 tons and 1 ton respectively, located adjacent to its head office building. The 5 ton installation has a compressor of equivalent capacity but the condenser has been replaced, and the replacement unit has only a 3 -ton capacity, which effectively limits the daily ice -making capacity to 3 tons. The equipment is U.S. -made ; white the date of manufacture is unknown, it is reported to have been in service for more than 20 years. Just on the basis of an exterior inspection, it is apparent that the installation is severely worn, with make -shift repairs of leaky pipes observed in many places. It is no longer just a question of falling production capacity but rather one of how much longer the equipment can keep running. This is a plate ice installation, with a standard 20 -foot ice storage container.

The 1 -ton ice -maker is a plate -ice unit of Japanese manufacture, produced in 1987. As of the time of our survey, the ice thaw pump was out of commission, and so the installation was not in operation. The compressor and condenser showed no particular outward signs of wear, but there were no spare thaw pumps. However, if the present pump can be repaired, the unit can probably be reactivated. The ice chest is a prefabricated $3.3m^2$ model. The ice sales generated by this 1 ton unit totaled $17,245 in 1992 / 93 (October, 1992 to September, 1993) and $9,914 in 1993 / 94. Since the Department of Marine Resources has set the ice selling price at a standard $0.05/ 1b., the sales volume in 1992 / 93 worked out to 155 tons, vs. 89 tons in 1993 / 94. While the actual production volume is presumed to be larger than sales, allowing for losses and captive consumption by the DMR, the above results reveal a substantial decline in ice -making capacity along with a progressive deterioration in the equipment. These ice -making facilities are operated by Department personnel, with sales hours limited in principle to regular business hours from Monday to Friday.

2) The ice -making unit at Tonowas (operated by the Department of Marine Resources) :

This ice -making facility forms part of a fishery complex that was completed in March, 1986, under a grant -aid from Japan, and is operated by the Department of Marine Resources. As a result of aging, production capacity has been steadily declining, as already detailed in Section 2.6.

3) Ice Plant operated by the Pis Fisheries Federation :

This ice –making installation is located in the fish handling area of the Fisheries Federation on the east side of the jetty in the North Inner Basin at Weno. This Federation is composed mainly of residents of the Pis area within the Chuuk Lagoon, and the subject facility is understood to be a shipping and sales base that was established at the Weno market for the financial benefit of the Pis area. Ice –making capacity is 1 ton per day of plate ice, and the equipment is of Japanese origin, though the year of manufacture is not known. The ice chest is a $3.3m^2$ prefabricated unit. A though any surplus ice supplies are sold on the open market, considering the nature of the above Federation, precedence is naturally given to the requirements of the fishing /transport vessels (total length : 12 m), which are owned the State and leased to Pis; Pis –area fishermen; and ice for use in selling the catches of these fishermen. No figures are available on ice sales to the general market, but it may be presumed that, with a 1 –ton daily capacity, surpluses for the open market (i.e, apart from Pis area demand) are negligible.

4) Ice –making facilities for tuna longline vessels :

According to data from Chuuk Fresh Tuna Industries (CFTI), the Chuuk –based tuna longline fleet operating in Micronesian waters includes 96 Chinese, 20 Taiwanese, 9 Japanese, and 3 Micronesian vessels, but these vessels operate on a flexible basis, depending on conditions in fishing grounds and air –shipment schedules. It is widely recognized, however, that Chuuk State has distinct advantages over the other states of FSM, from the standpoint of both fishing grounds and shipping logistics, as a base for air shipment to Japan of fresh tuna caught by the tuna longline fishery. The FSM government has been making a sustained effort to prepare landing bases for use by longline vessels directed mainly at fresh tuna, and, in Chuuk State, a tuna company, CFTI (Chuuk Fresh Tuna Inc.), has been established as a 50 / 50 joint venture by the National Fisheries Corporation (NFC) and the State government. In August, 1994, this company established a landing base at Weno for the air Shipment of fresh tuna, equipped with a landing jetty, packing and handling facilities for air shipments, and facilities for supplying ice, water, fuel, and related items to fishing vessels. These handling operations for fresh tuna have gotten off to a smooth start.

The Ice –making facilities at CFTI have a daily production capacity of 75 tons of flake ice along with a 45 tons ice storage unit, with ice supplied exclusively to tuna longline vessels discharging catches at this base. Considering the chronic ice shortage at Weno, there have been strong requests that the ice from this plant be made available also to small users other than fishing vessels, but it is recognized that CFTI would find it difficult to fill such small lot orders, owing to

the fact that the facility was designed originally for the efficient supply of ice to fishing boats, the increase in office and administrative costs that small orders would entail, and problems concerning sanitary and safety controls.

At Tonowas, a private Taiwanese handling group operates its own ice-making plant to furnish ice mainly to Chinese and Taiwanese tuna longline vessels, under a subcontracting arrangement with CFTI. This facility is capable of producing 100 tons of 135 kg blocks per day and is equipped with its own generator. While the facility at Tonowas is aging, with a concomitant fall in production capacity, this company too offers no ice to the general public, in part because small orders are already being filled by the block ice facility operated by the Department of Marine Resources.

(3) Condition of Cold Storage Facilities :

The State government is aware of the need to improve the distribution system and infrastructure for fish landed by small-scale fisheries. At present, CFTI operates a cold storage at Weno for temporary storage of fresh tuna awaiting overseas air shipment, but this facility does not service catches from the artisanal fisheries destined for the domestic market.

Since no public cold storage facilities are available in Chuuk State for small fishing boats, their catches are presently being sold through the fisherman's family connections or organizations representing the interests of his home district. Sales lots, therefore, are very small, geared to individual use and passing through a variety of distribution channels. When a fisherman does not have his own individual channels or does not have access to a regional association, since public cold storage facilities do not exist for fresh fish, once the fish is brought to Weno, he has no means of preventing a serious decline in commercial value due to a loss of freshness.

With regard to establishing a fish distribution system, in December, 1994, the DMR drew up a Plan for the Distribution of Reef Fish, intended to set up sales channels for reef fish, primarily for five outer islands beyond the Chuuk Lagoon. It is hoped that this plan can be funded through the State and Federal governments, via the Federal Assistance Plan under the Compact of Free Association with the U.S., but the project is still at a conceptual stage. Given the lack of public cold storage facilities at Weno for artisanal fishermen, there is an ever-present danger that the fishermen themselves will be obliged to bear the financial losses arising from a deterioration in freshness at the marketing stage. Since no facilities have been provided for preserving freshness or for the temporary storage of catches pending shipment, catches from the outer islands, where surplus resources exist, are placed in a disadvantageous condition at the

distribution stage. To avoid this sort of risk, catch effort is being concentrated in waters within the Chuuk Lagoon, close to consuming areas. This practice is also seen as having a highly undesirable effect in terms of achieving sustainable resource utilization.

(4) Basic Project Concept :

Ice is basic to retaining freshness in fish, but the ice supply at Weno, the capital of Chuuk State, is quite insufficient. And with the aging of the ice –making facilities, which have been in use for many years, supply is now on a declining trend, seriously handicapping the development of the State's artisanal fisheries.

The Plan facilities are intended to supply ice, which is indispensable to freshness retention and expanding the distribution of fish products, provide cold storage for and facilitate simple handling of fish catches, and function as a distribution and support base for the artisanal fisheries of Chuuk State.

3.2 Examination of the Plan Site :

3.2.1 Evaluation of the Site Proposed in the Request :

As shown in Figure 3.1, the Plan site shown in the original Request is adjacent to the southwest corner of the mooring area in the North Inner Basin, lying some 100 m off the main highway and served by an unpaved 8 m wide access road to the office and warehouse of the Namonuito Island Development Corporation, located beyond the proposed site. Thus, in order to secure land on which to build the Plan facilities, it would be necessary to reclaim the entire water area in front of the site. If this site were to be reclaimed for Plan purposes, it was estimated that 300～400$m^2$of water area would have to be reclaimed. And, assuming an average depth of 2.5 m in the reclamation area and that the height of the filled land would be made equal to that of the present road, an estimated 1,200～1,600 m^3 of earth and sand would be required for the land – fill operation.

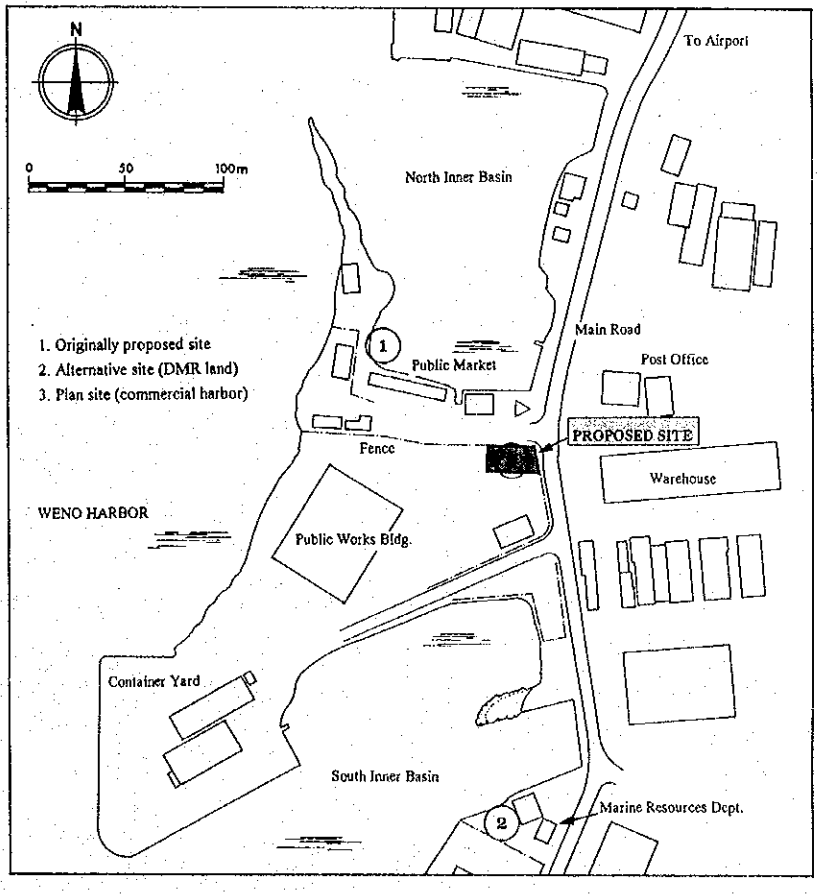
This amount of fill presupposes embankment work to provide a sand guard at the water's edge. Supposing that this embankment work were not done, an even larger reclamation area would be required to ensure the safety of the Plan structures.
In the plan drawn up by the Chuuk government, it was anticipated that the earth and sand for reclaiming the proposed site would be supplied from the dredging operations that are currently underway to expand the Commercial Port. However, the embankment work in front of the

reclaimed area was not included in the Chuuk Plan, presumably because of the high cost that the State government would have to assume in connection with site development as well as the considerable time that this work would entail. Since time must also be allowed for the fill mater to settle, a problem could develop in connection with the construction schedule for the Plan buildings.

As already noted in Section 2.7.3, a number of plans have been considered for building a mooring jetty and berthing facilities for small boats in the North Inner Basin, including the proposed site, but the Chuuk State government recognizes that, at the present juncture, no firm plans have yet been made for implementing this project. Judging from the uncertainty over the direction of future development plans for these waters, we must necessarily be cautious about reclaiming the required land solely for Plan purposes.

As discussed above, in order to prepare the site proposed in the Request, the financial burden on the State government would be excessive, while the work would also be time -consuming. And, even if the Plan facilities were to be constructed on this site, unless improved access were provided to the main highway, transportation would likely be seriously disrupted. Thus, the originally proposed site could not be deemed optimum for the subject Plan. After consultations with officials of the State government, the decision was made to consider an alternate site.

Figure 3.1 Map of the Proposed Site Area



3.2.2. Evaluation of Alternate Project Sites:

Based on the findings of the field survey, among the various alternate sites suggested by State officials, the State government had clear ownership rights to two of the proposed areas. One was located next to the building housing the State DMR and is being used to redevelop an area containing an ice -making facility operated by this Department. The other candidate site was located near the mooring area in the North Inner Basin in a corner of the Commercial Port now being used as a cargo handling area, which would be diverted to Plan use.

There is a site of about $450m^2$, with virtually a triangular configuration, between the DMR building and the CFTI company on the southern side. The area presently contains two ice -making plants with daily production capacities of 3 tons and 1 ton respectively, both operated by the DMR. The area on the jetty side of the site, which includes these ice -making units, extends almost $250m^2$ and is covered by a galvanized iron roof. The site can be entered directly from the main road. On the water side is a jetty about 20 m in length, which is being used by vessels owned by the State government and the DMR. This site presents no problems in terms of constructing the Plan facilities, assuming that the 3 ton ice -plant on the site, which has been in use for over 20 years and is severely dilapidated, is dismantled and removed and that the 1 ton unit, which, though presently out of service, is repairable, is relocated within the site, while the existing temporary roof is replaced and the floor on the site repaved.

The major problem with this site, however, would involve the logistics of supplying ice smoothly to small boats, which is the Plan's primary objective. Careful consideration would have to be given to either allowing these boats to dock at the jetty in front of the site or employ another method to transport the ice produced at the Plan facilities to the mooring area in the North Inner Basin, which is the principal mooring area for small boats. But the crown height at the jetty in front of the property, while suitable for fishing boats in the 15～20 m length class, would be too high for smaller boats. In addition, since the jetty is located in the innermost portion of the Commercial Port, the large merchant vessels docking at this port would pose a major potential hazard to small boats crisscrossing the port to reach the Plan jetty, which would be most undesirable. Thus, if the ice -making units were installed here, a base would have to be newly established, containing ice -storage facilities, in order to deliver ice to the small boats. In addition, supermarkets and other large commercial facilities are concentrated in the vicinity of the proposed site, which has given rise to traffic congestion while damaging the road surfaces. Thus, we consider it undesirable, over the long -term, to build new public facilities which would only aggravate these conditions.

The second new candidate site is located in the northeast corner of the Commercial Port area and is currently being used a cargo handling area. It is owned by the Chuuk State government and is under the jurisdiction of the State Department of Transportation. While the site faces the main highway, it is located farthest from the jetty at the Commercial Port and is currently being used as a small container yard. Since a new container yard is planned upon completion of the expansion project at the Commercial Port, the need for the container yard on the proposed site has diminished. However, since the site is within the Commercial Port area, should there be a need in the future to further expand the functions at this port, care must be taken to ensure that the new Plan facilities will not become a major impediment to any such expansion project. Since the proposed site lies along the main highway and is in a high -traffic area, it will be necessary, in placing the Plan facilities, to make every effort to avoid obstructing traffic flow, which, in FSM, keeps to the right. Further more, since the distance from the proposed site to the mooring area in the North Inner Basin, which is the main moorage for small boats, is only about 15 m, if handcarts are used to transport ice from the ice -making plant to the small boats and a simple pontoon jetty is built for ice loading purposes, we believe that operations will be relatively smooth.

As a result of our evaluation of the above two alternate sites and our discussions with representatives of the Chuuk State government, a firm decision was made to use the second site (12 m wide by 25 m long), in the northeast corner of the cargo handling area in the Commercial Port, as the Plan site. Although the State and Federal governments have both confirmed their agreement to the selection of this alternate site, which differs from the one proposed in the original Request, in view of the fact that the Federal government were not present at our discussions with the State officials, while State officials, in turn, did not participate in the meetings with the Federal government, the BDST requested that documents be exchanged with both governments confirming the site change from the reclaimed area in the original Request to the northeast corner of the cargo handling area within the Commercial Port.

3.2.3 Profile of the Plan Site :

The Plan site includes buildings used by the Department of Transportation and was formerly the site of a workshop and warehouse belonging to the Department of Public Works.
On the north side is the North Inner Basin of Weno Harbor, which is now a moorage for small boats. The western side is bounded by the commercial jetty, and the southern side faces the South Inner Basin across a road, while the eastern side faces a two -lane trunk highway. As of December, 1994, construction was in progress on the Weno Harbor Expansion Plan, funded by a Japan grant -aid and comprising a jetty, with a total length of 300 m ; a container yard of

approximately 7,000m^2, and dredging work to −9 m in the waters in front of the jetty, with completion scheduled for March, 1996. A facility plan has not yet been developed for this area, which includes the Plan site, but, in view of the good access from the main road, it is considered highly probable that buildings will eventually be built on the property to house offices and other administrative functions of the Department of Transportation.

It has been deemed appropriate that the Plan facilities be placed along a wire net fence along the northern perimeter of the site and deployed in a long narrow area, 12 m wide x 25 m long, so as to minimize the impact of these facilities on any future development plans for the Commercial Port. An 8" branch pipe runs from the main water pipe, laid along the site side of the trunk highway, and will follow the road in front of the north perimeter, which leads to the public market and outer island offices. Water supply can be provided via a connection to this branch pipe. In addition, there is a five hydrant on the northeast corner of the site, which is understood to be connected directly to the main pipes, and it will be necessary to secure about 5 m of open space for this section. With regard to the power supply, a 13.8 kv high −tension wire passes on the opposite side of the main road, from which power will have to be brought into the facility complex via a newly installed transformer. As to drainage, the main drainpipe is laid under the main road, to which a direct connection can be made.

The land in the vicinity of the site was reclaimed soil dredged during the construction of Weno Harbor in the early 1960s. While no boring tests were made on the Plan site to determine soil quality, based on tests performed at a point about 50 m from this site, a layer of soft sand, with a high moisture content, extends from the surface layer down to −6 m, while the next lower level is made up of sand mixed with silt, of rather firm consistency. Estimating from these findings, we may infer that the soil at the Plan site from the surface to the sea bottom 5 ~ 6 m below is fine sand. Although the N value is not high, considering the fact that ample time has passed since reclamation, it has been determined that, even allowing an extra margin of safety, the foundation has a soil bearing strength of at least 5 tons perm^2, indicating that there should be no problems geologically with conventional low −rise structures. At the time of our survey, a few containers were stored on the property, owing to a temporary shortage of space in the container yard caused by the jetty extension work. Once these containers are removed, however, the area will be flat and quite suitable as a building site in its present state.

3.3 Facilities and Equipment Contained in the Request :

The composition of the Request facilities and equipment required to implement the subject Plan is as follows :

(1) Support Station Building

1) Ice -making machine room
2) Ice storage room
3) Chilling storage area
4) Working space
5) Office
6) Storage area
7) Toilet

(2) Emergency generator

(3) Ice transport vehicle

(4) Ice -handling equipment (fish containers, pushcarts, weighing scales, and other items)

(5) Rainwater catchment tank

(6) Pontoon (for the moorage in the North Inner Basin)

(7) Data processing equipment

The embankment work in front of the public market, which was included in the original Request, has been eliminated, owing to the site change, along with the office equipment, which will, in principle, be defrayed by the FSM government. On the other hand, owing to the unstable power supply conditions in the area, consideration has been given to adding an emergency generator to the original Request. Another prospective addition will be a pontoon (small floating jetty) to facilitate ice loading operations for small boats, in lieu of a fixed jetty, by providing easy access from the Plan facilities to the North Inner Basin.

3.4 Project Objectives:

In its Second National Development Plan (1992~96), the FSM has set its sights on developing a national tuna fishing industry. This program involves building up the tuna long line fleet and developing landing bases for this fishery. In August, 1994, a processing and shipping station was completed in Weno for fresh tuna exports ; in its first four months of operation (through November), some 1,430 tons of fresh tuna were air -shipped to the Japanese market. Thus high hopes are held for developing the tuna and skipjack fishery into one of the nation's major

industries.
In contrast, artisanal fisheries in the outer islands of Chuuk State, beyond the Chuuk Lagoon, are operated principally as subsistence fisheries to provide a supply of animal protein for fishing households. Within the Chuuk Lagoon, these fisheries provide a source of cash income in addition to family sustenance. Aid to these artisanal fisheries have thus far focused on strengthening the direct means of fish production through the upgrading of small fishing boats and gear, but there is still much room for improvements in the area of freshness retention, which is a vital function whether the fish is intended for home consumption or for commercial sale. The objective of the subject Plan is to revitalize the artisanal fisheries in Chuuk State by provided a stable supply of ice, which is essential to preserving freshness, as well as to achieve long –term improvements in fish distribution.

3.5 Requirement and Scale of the Plan Facilities and Equipment.

3.5.1 Ice –making Facilities :

(1) Ice volume and shape :

The ice to be provided under this Plan is intended to relieve the current supply shortages, as estimated on the basis of fish distribution volume at Weno and ice supplies under present condition's.

There is virtually no data from which to estimate fish distribution volume at Weno. Given the lack of statistics on catch and distribution volume or consumption by fishing families, even the DMR finds it difficult to develop an accurate profile of the artisanal fisheries in Chuuk State. The DMR is well aware of the need to improve the fish distribution network in Weno, which is the main consuming area in the state, and so is anxious to implement its plan to establish a distribution system for reef species. Consolidating the findings of our limited field survey in this connection as well as the opinions of UNICEF specialists, per –capita consumption in Weno of reef species has been estimated by the DMR at 2.2 lbs. / week, which we deem appropriate for use in this project.

The FSM conducted a nationwide census in September, 1994, but the results had not yet been released as of December. The most recent population figure is that from the 1989 Census, which showed the Weno population at 17,674. However, this total includes non –residents temporarily living abroad for employment or other reasons. We estimate, therefore, that, after deducting non –residents and allowing for natural growth and migration from other parts of FSM

during the 5 years since the 1989 Census, the current resident population at Weno is in the order of 17,000.

On this basis, the annual consumption of reef species at Weno becomes :

2.2 lbs. x 0.45 Kg. x 52 wks. x 17,000 persons = 875.1 tons

Since the above estimate is limited to reef fish species, such as surgeon fish, goat fish, parrot fish, and fish of the Wrasse family, an allowance must also be made for consumption of migratory species, such as skipjack, tunas, dolphin fish, and spanish mackerel. While consumption volume is not known for these migratory species, based on sales figures from large supermarkets, their combined market volume can be estimated at about 20% of that for reef species, which raises total annual fish consumption at Weno to :

875.1 x 1.2 = 1,050 tons / year = 1,100 tons

If this market volume is assumed to be immediately consumed, the annual per capita consumption of all fish species at Weno works out to be 64.7 kg, which we consider a reasonable figure for a Pacific island society.

Turning to the ice requirements for preserving freshness, in an area with high outdoor temperatures and a generally low level of chill distribution facilities, it is customary, for purposes of freshness retention from catch to landing, to set ice volume at the same level as catch volume. The amount of ice required to maintain freshness at the distribution stage will, of course, depend greatly on distribution conditions, but, in Weno, where there is a strong public preference for fresh fish and the use of insulated containers is relatively well developed, it should be possible to retain a suitable level of freshness with an additional ice supply of about 50% of catch volume.

Accordingly, the ice requirements from landing through the distribution stage for 1,100 tons per year can be calculated at :

1,100 tons x 1.5 = 1,650 tons

All of the present ice -making facilities in Chuuk State are located inside the Chuuk Lagoon, with 2 units installed on Weno and Tonowas Islands and another small unit on Tol Island. Thus, no ice -making plants exist on the outer islands of the state beyond the Chuuk Lagoon.

The ice plant operated by the DMR on Weno is quite superannuated, with production capacity falling; total ice supply from this facility in 1994 was only about 89 tons. The ice –making unit on Tonowas Island started operations in 1986 but, owing to wear and tear on the generator and other machinery, production capacity has been steadily declining, with the 1994 output only 451 tons. Since there are scant prospects for a recovery in supply capability at the existing installations, estimates of Plan ice requirements will be based on present ice production levels at these facilities: viz.,

Tonowas :	450 tons		
Weno :	90 tons	Total :	540 tons

Accordingly, under present conditions, the supplemental annual ice requirement at Weno may be set at :

1,650 –540 tons = 1,110 tons.

The size of ice –making facility needed to produce 1,100 tons of ice annually, assuming 260 days of operations per year and an average of 10 hours of operation per day, the new plant should have a capacity of :

1,110 tons ÷ 260 days ÷10 hrs. = 0.427 tons / hr.

This would be equivalent to a daily production capacity of :

0.427 hrs / hr. x 24 hrs. = 10.248 tons

Allowing for equipment breakdowns as well as to facilitate maintenance, it would be most logical to install two ice –makers of identical capacity:

5 tons/day x 2 units = 10 tons/day

As to the shape of the ice to be produced in the Plan facilities, the options include block, flake, cube, and crushed ice. We feel that flake ice would be optimum, in view of the simple operations contemplated under this Plan; the need for a facility that lends itself to automatic operation at such time as electricity and water supply becomes more reliable; and the fact that 2 of the present ice –makers in the area manufacture flake ice.

(2) Ice Storage Facilities :

The ice storage capacity has been determined on the basis of the size and ice shape of the ice -making unit as well as the degree of fluctuation in ice demand.

Generally speaking, with a large -size ice -maker, the ice storage capacity is relatively small in relation to the ice -making capacity. As to ice shape, storage capacity lends to run larger for a plate ice facility, which achieves maximum efficiency by concentrating operations within a fixed period of time, than for a flake -type unit, which can operate on a relatively flexible schedule. In order to cope with fluctuations in demand, the ice storage capacity should be sufficient to store an ice supply that is 5~7 times the ice -making capacity. Since the Plan ice -makers will produce flake ice and can cope relatively easily with fluctuations in demand, the ice storage capacity has been set at about the lower end of this range --5 times the ice -making capacity.

Based on 10 hours of operation per day, 4.27 tons of ice can be produced daily. Thus, the ice storage capacity can be set at 20 tons of plate ice, which will require about 50 m^3 of storage capacity. To meet this requirement, a prefabricated insulated storage chest, with a floor area of 24m^2 (5.4 x 4.5 m), has been deemed suitable.
Considering the high outside temperatures and the fact that the doors of the ice storage unit will have to be opened and closed frequently in order to handle small -lot orders, a refrigerator will be provided to maintain proper temperatures inside the storage unit.

3.5.2 Chilling Storage Facilities :

(1) Demand Projection :

The required chilling capacity for Plan purposes has been set by projecting the actual demand for the small companion refrigerator.

1) Temporary storage of fresh fish for export :

It has been estimated that the volume of fish exported to Guam runs at least 100 tons per year, with almost all of this fish shipped by air. But since airline regulations prohibit the use of ice for air parcels, it is vital that this export fish be kept chilled right up to departure of the aircraft. The most common method of shipment is to pack the fish in a vinyl bag, which is then tightly sealed in corrugated cardboard cartons. While these cartons range in gross weight from 50 to 500 kg, the bulk weigh about 100 kg.

As of December, 1994, there were 7 flights per week between Chuuk and Guam, including late – night flights, with service available on five days. The late night flights offer discounted fares and so are heavily booked, while the early morning arrival times in Guam are ideal for selling fresh fish, with shipments particularly heavy on weekends. However, since the fish is caught during the day, the catches must kept chilled until flight time. Between catch and landing, freshness can be maintained with ice but, since ice cannot be packed in the cardboard containers used for air shipments, refrigeration is essential to cover the hours between packing and departure. But, with chilling facilities not yet available, fishermen have only three options : shipping the fish in costly insulated containers; keeping the fish packed in ice until the last possible moment and then repacking the lot into corrugated cardboard containers in irregular, late –night operations, keyed to flight departure times; or simply leaving the cardboard cartons at normal temperatures and accepting the inevitable loss of freshness.

Judging from the above circumstances, it may be anticipated that, if temporary chilling facilities were available, an increased number of shippers would surely shift from the use of insulated containers to shipping chilled fish in sealed cardboard containers.
Since the prices of reef species exported to Guam are higher than those on the domestic market, a sustained increase could then be projected in export volume. Accordingly, it is expected that 60～70% of current fish export volume —60～70 tons per year—could be expected to make use of the Plan chilling facilities for temporary storage.

2) Storage of fish received from outer islands :

An estimated 1,100 tons a year of fish is consumed in Weno. According to the DMR, 460 tons of this total are brought in from outer islands and, based on other estimates obtained during our field survey, each shipment of fresh fish from these outer islands contains 2 tons The outer islands in Chuuk State comprise five areas : the West Islands outside the Chuuk Lagoon, Namonuito, Hall, upper Mortlock and Lower Mortlock islands. Considering the 200～300 km distance between these outer islands and the Chuuk Lagoon, the estimate of 460 tons / year reaching Weno from these islands seems somewhat exaggerated, since there shipments are felt to be considerably inhibited at present by the shortage of ice supplies for freshness retention and by the lack of chilling facilities after arrival at Weno.

In this Plan, therefore, we have postulated that only about 50% of the outer island fish receipts estimated by the DMR will actually be stored in the Plan chilling facility. On this basis, the annual total of outer island fish to be stored at this facility would amount to 230 tons.

(2) Required Size :

As previously mentioned, at the present time, statistical validation of the potential demand for chilling storage is extremely weak.
It is believed, however, that, if a public chilling facility were provided, the annual storage demand would be in the order of 300 tons.
Let us now calculate the required size of this facility, based on this figure.

1) Annual chilling requirement :
① For export use: 60～70 tons / year
② For outer island use: 230 tons / year

2) Daily requirement :
① For export use :
With air service to Guam of offered five days a week, the average length of storage will be 1.4 days.

60 ~ 70 tons x 1.4 tons = 84～98 tons————i)

② For outer island use :
The average length of storage for freshness retention purposes at the chilling facility has been estimated at two days.

230 tons x 2.0 days = 460 tons————ii)

Accordingly, the cumulative annual total of fish stored in the chilling unit will be :

i) + ii) = 544～558 tons.

The average daily storage load becomes :

544 ~ 588 Tons ÷ 365 days = 1.49～1.52 tons ≒ 1.5 tons.

The above average presupposes that constant amounts of fish will be received at the chill storage. But, in order to cope with special conditions, such as peak fishing seasons, poor weather conditions, and a concentration of arrivals, the actual requirement should be set at 1.3 times the average figure. On this basis, the required chilling volume becomes :

1.5 tons x 1.3 = 1.95 tons ≒ 2 tons

Approximately $10m^3$ of space are needed to store 2 tons of fish.
Allowing additional lead space for inbound and out bound movements of storage racks and workers, we have decided to specify a standard $6.6m^2$ prefabricated chilling unit, with external dimensions of 2.7 x 2.7 x 2.2 m and an interior capacity of 13.75 m^3.
Minimum temperature inside the warehouse will be set at −5℃, with the stored fish to be kept at all times at non −freezing temperatures.

3.5.3 Building Facilities

(1) Required facilities :
The individual room areas required for the Plan facilities include an ice −making room, ice storage area, chilling room, working area, office, staff room, storage area, generator room, and toilets.

(2) Room Sizes :
1) Ice −making room :

Two plate −type ice −making units will be installed with a daily production capacity of 5 tons each. Each unit will occupy a space of about $4m^2$, but, allowing for the deployment of 2 units, with adequate working space for maintenance and repairs, the total required area has been set at about $25m^2$. In a flake ice facility, the ice storage compartment is installed in the lower section of the ice −making unit, with the ice falling naturally from the freezing board through the crusher into the ice storage section. Thus, the space for the ice −maker is determined by that occupied by the ice storage compartment.

2) Ice storage compartment :

In order to store a maximum of 20 tons of flake ice, we plan to use a prefabricated adiabatic unit occupying a floor area of about $24m^2$ (5.4 x 4.5 m), an area of $30m^2$ will be allowed for placement of the storage unit. Accordingly, it will be reasonable to allocate $30m^2$ for the above ice −making room.

3) Chilling storage room :

The chilling storage equipment will be a $6.6m^2$ prefabricated unit. While its exterior dimensions will be 2.7 m x 2.7 m, space must also be provided for a refrigerator, which will be installed behind the main unit, as well as between the unit and the front door. The space

requirement for the chilling storage room, In relation to the overall deployment plan, has been set at $22.5m^2$.

4) Working space :

In addition to the space requirement for movements into and out of the ice storage and chilling units, space must also be provided for selecting and weighing the fish and repacking with ice in insulated containers, washing fish and containers, as required, and for the temporary storage of insulated containers. It is expected that a smooth supply of ice from the Plan facilities will increase the volume of fresh fish entering distribution channels, which, in turn, requires that the working area be made as large as possible. The rule of thumb for fish handling operations of this sort is to provide a space of about $9.0m^2$/ worker. Thus, if 5~6 persons work in this area, about $50m^2$will be needed. This, in combination with $30m^2$of space required in front of the ice storage and chilling facilities, creates a total work area requirement of $80m^2$.

5) Office :

The administrative and operating functions at the Plan facilities are to be handled by a staff of 5 person, including a supervisor, accountant, technician, and two workers. Assuming that only 3 of these persons require office space, and figuring a standard $8.0m^2$/ office worker, the total space requirement for the office will be about $24.0m^2$. The Plan facilities are to be positioned as a support station for artisanal fisheries, with multipurpose space requirements, including liaison with facility users, guidance, information gathering, and a reception counter for business discussions. The space for performing these ancillary functions should be equivalent to that of the office. Allowing also for a utility section, and considering overall layout conditions, we have set the total office area at $50m^2$.

6) Staff room :

This room is intended to provide rest space for the two workers coordinating ice sales and chilling storage movements as well as to accommodate guards working at night and on weekends and holidays. No actual operations will be performed in this room, but, considering the nature of the occupants' duties, it should be located close to the ice storage or chilling storage facilities. The space requirement in relation to layout conditions will be $4m^2$.

7) Generator room :

A generator will be installed to cope with the unstable power supply. It will have a capacity sufficient to sustain operation of the ice –maker, ice storage, and chill storage during power failures.
A low –powered starter will be installed an the ice –maker to provide power manually from the emergency generator to each piece of equipment during blackouts. The generator capacity required to satisfy these conditions should be at least 75 kva. The size of a generator in this class will be about 0.8 x 2.5 m, but, after allowing space for a reserve fuel tank, service personnel, and layout conditions, the total area requirement becomes 22.5m^2.
Since a generator produces noise and exhaust, the walls of the generator room will be concrete block, with the exhaust fumes deflected so as to minimize any adverse impact on the surrounding area.

8) Storage area; toilet :

This area will provide storage space for replacement parts for the ice –maker and other equipment, coolant for the chilling unit, and other items. It will be placed next to the ice –making room and assigned an area of 10m^2.

The toilet will be located in the rear of the staff room, where an area of 6m^2 can be provided. It is intended for the facility staff and will be used by both sexes, containing one western –style toilet, one urinal, and one washstand.

9) Water Catchment tank :

In view of the poor water supply in the Plan area, with service currently restricted to certain hours, it will be necessary to collect and store water during the hours of availability. In addition, if reliance is placed solely on municipal supplies, the water requirements of the facilities will, in our judgment, not be met, in which case supplies can be trucked in on water wagons. Annual rainfall at Weno is about 3,550 mm and is abundant, except for the dry season from January~ March. Thus, rainwater will also have to be collected and stored on the building roof. While it is obviously desirable that these catchments be made a large as possible, given the logistical and economic constraints, the catchment capacity will be set at 30 tons. This size should be appropriate, since maximum water consumption at the Plan facilities is expected to run about 6 tons per day and the catchment tank will be able to hold a 5 day supply. In as much as the water reserve will be fed by the mains as well as regular tap water, while storage will not be long –term, there is no particular need for sterilizing equipment. Thus, the catchment tank will be a prefabricated FRP airtight unit.

10) Power and drainage facilities :

Water will be drawn from an 8 " branch pipe laid along the north perimeter of the Plan site. Power will have to be supplied to the Plan compound as AC 220 v, 3Ø and AC 120 v, 1Ø via a step –down transformer, which is to be newly installed at the facilities, from a 13.8 kv high – tension wire running along the main road forming the eastern perimeter of the site. The required transformer capacity will be 100 kva. Both sewage and miscellaneous drainage will be connected to the main sewage pipe running under the main highway on the eastern side of the property. Since public buildings in Weno are generally air conditioned, a window air conditioner will be installed in the office at the Plan facility.

11) Exterior appearance, other aspects :

The Plan facilities are located along the main highway in the heart of Weno's business district, adjacent to the North Inner Basin and inside the Commercial Port and attracting heavy vehicular and pedestrian traffic. For safety reasons, therefore, a fence and entry gate will be constructed. Since ice and fish will be transported in conventional vehicles, considerable traffic can be expected at the facility, and so the entry gate will be made as wide as possible. In addition, an unfloored concrete area will be laid within the Plan site to provide a parking area for the small ice transport vehicle.

(3) Area requirements :

The area requirements for the various rooms at the Plan facility are summarized below :

Plan Room /Area	Required Area	Contents
Office	$40m^2$	for administration and data –processing operations
Staff' room	4	also serving guard personnel
Storage area	10	for repair parts, coolant,and other items
Toilet	6	for staff use
Working area	80	for ice sales and as an overnight garage
Ice –making room	30	housing 2 5 –ton ice –making units
Ice storage room	30	with a storage capacity of20 tons
Chilling storage room	22.5	with a storage capacity of2 tons
Generator room	17.5	housing a 75 kva emergency generator
Total area	240 m^2	
Water catchment tank		with a 30 –ton capacity

3.5.4 Equipment Types and Quantities :

1) Insulated containers :

Ice -packed insulated containers are a widely used method in Chuuk State for preserving the freshness of fish and other perishable foods. Although containers of 80 liters or less for home use are readily available, large institutional sizes are still in short supply. For this project, we plan to use institutional containers with a 160 liter capacity, the size required to transport ice conveniently to outlying islands beyond Weno. Ten insulated containers of this size would be sufficient to deliver some 500 kg of ice to each of 2 destinations (1,000 kg in all).

2) Weighing Scales :

Two Platform scales, each with a 150 kg weighing capacity, are planned for use in selling ice.

3) Data processing equipment for use in preparing catch statistics :

In view of the lack of statistics on fish catches, distribution volume, and consumption by fishing households, it is difficult to make an accurate assessment of conditions in the artisanal fisheries in Chuuk State. Thus, in order to monitor conditions in these fisheries, data collection is an urgent necessity. With completion of the Plan facilities, it is expected that fresh fish distribution channels will be reorganized and that fishery data will become easier to collect.
To properly organize these figures, a personal computer system will be required, including, in addition to the basic computer, a printer, monitor, and other peripheral equipment, as well as word processing, tabular, and other applicable software.

4) Pontoon:

Most of the small boats traveling to Weno from the islands, whether for commuting to jobs or school or for business or other reasons, are moored in the North Inner Basin of Weno harbor. Although the Plan facilities will be built only 15 m away from this mooring area, no boarding or disembarking facilities are provided on the waterfront in this basin for small boat use.

Under present conditions, it is simply not possible to conduct safe manual loading operations for heavy items, such as insulated containers packed with ice. To permit safe operations of this nature, we have concluded that it would be appropriate to moor a pontoon on the southern side of the North Inner Basin, the closest point to the Plan facilities.

In determining the size of the pontoon, we have taken note of the fact that its primary objective

will be to enhance the safety of loading operations, rather than simply to secure a mooring spot; that at least 50 boats are constantly using the moorage, putting pressure on the berthing facilities; and that an installation involving underwater construction would not be appropriate. We will, therefore, use a pontoon 2.5 m wide and 10 m long, which is considered the most standard size among the products on the market. The floating portion of the pontoon is available in steel, concrete, and plastic construction, but we have determined that a pontoon using urethane foam as the buoyant material would be most suitable in view of its durability and ease of maintenance. A connecting bridge will be built between the shore section and the main floating section. As to the mooring method for the pontoon, since construction involving the use of heavy equipment, such as a pile driver, would not be suitable from the standpoint of design economy, on the shore side, we plan to bury an anchor in the existing concrete jetty and stabilize the floating section via a stainless chain, while, on the ocean side, the structure will be moored by means of a marine mooring anchor. The pontoon will be installed on the ladder portion of the jetty, in front of the work area at the Plan facility. This location will be on the southern side of the mooring area in the North Inner Basin. Although the northwest side is a relatively sheltered spot in the exposed mooring area, when oceanographic conditions are forecast beyond those shown under the design conditions in Section 4.2.2 , it will be necessary to either install additional anchors on the ocean side of the pontoon or detach the fixed chain on the shore side and move the pontoon to a safer spot.

5) Ice transport vehicle:

There are about 20 sales outlets for fresh fish in Weno, located along the road that circles 3/4 of the island, while the distance from the Plan facilities to the jetty used by medium –size fishing vessels belonging to the DMR is about 250 m. We have determined that an insulated vehicle should be provided as the means of transporting ice to these locations.

Since the transport distances will be short, it should be sufficient for a maximum of about 500 kg of ice to be carried on a single delivery. As the ice will travel in either insulated containers or wooden boxes, the ice –carrying capacity of the transport vehicle should be in the order of $5m^3$. A pickup truck with a load capacity of 750 kg would provide the requisite capacity in its insulated compartment. While road conditions are presently poor in Weno, the main highways are expected to be improved in the future, and so a normal 2 –wheel drive vehicle, with a diesel engine, will be specified. The truck will not be equipped with a refrigerator.

6) Other items:

We have specified only the minimum complement of equipment needed to operate the Plan facilities. Taking into consideration the level of equipment used in the State government and ordinary offices in the Weno area, we plan to provide a cash register for use in ice sale operations, an office copier, and a facsimile (one unit each).

3.6 Project Implementation Structure:

3.6.1 Implementing and Managing Organization:

While the FSM is a Federation of four states (Yap, Chuuk, Pohnpei, and Kosrae), each state has drawn up its own development plan, and State governments enjoy considerable authority and responsibility in implementing their respective policies. However, the Federal government plays a major role in coordinating policies both among the states and in international relations. In the present environment, considering the difficulties in achieving the goals of national development without the continuing support and cooperation of other countries and international bodies, particularly within the context of carrying out the Compact of Free Association with the United States, the weight of the Federal government can only be expected to increase in the years ahead.

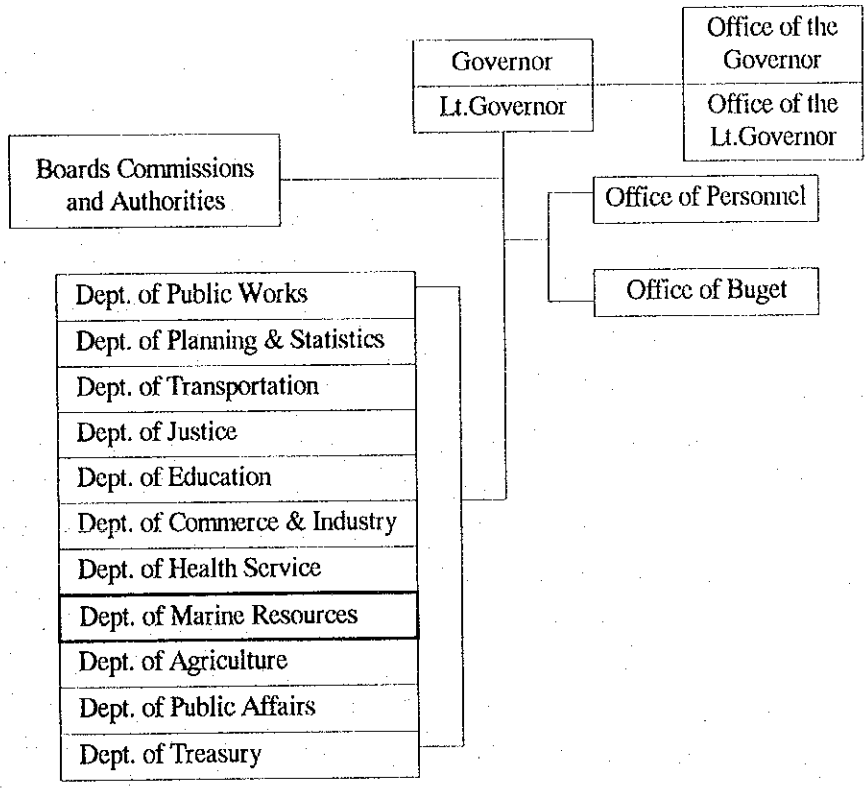
Two agencies in the Federal government are concerned with the fisheries sector. One is the Micronesian Maritime Authority (MMA), which controls fishing permits for, and exercises supervision, over the nation's vast 200 mile economic zone. The other agency is the Department of Resource & Development (R&D), which is composed of four divisions: Agriculture, Marine Resources, Commerce and Industry, and Labor. Fishery relations are administered by the Marine Resources Division.

The responsible body for the subject Plan will be the Marine Resources Division (MRD) within the Department of Resource & Development (R&D) of the Federal government. The R&D has a staff of 22 persons, of whom 5 are attached to the MRD. The principal duties of the R&D relate to the development of all of the country's natural resources along with the commercialization of these resources. technology, and production. The MRD provides technical information, advice, and assistance with respect to the development and management of marine resources and coordinating the activities of the Marine Resource Departments of the individual states as well as international organizations concerned with fisheries in FSM waters.

The operating body for the facilities to be provided through Plan implementation will be the Department of Marine Resources (DMR) of the Chuuk State government, which is far larger in

size than the Federal Government, with over 2,800 employees. The organization chart for the Chuuk State government is shown below

Chuuk State Government Organization Chart



The Department of Marine Resources (DMR) has a staff of 81 persons and is divided into 3 divisions : Fisheries Research, Resource Conservation, and Application and Technology.

The budgets of the Department of Resource Development of the Federal government and the Department of Marine Resources of the Chuuk State government are shown below for the past 3 years :

Budgets of the Federal Department of Resource & Development (R&D) and the Chuuk State Department of Marine Resources. (DMR)

Table 3.1 Budget for FSM Dept. Resources & Development and Chuuk Marine Resources Dept

Fiscal Year(Oct.~Sep.)	1993	1994	1995
Dept. Resources and Development (FSM)	$ 609,626	486,601	550,700
Dept. Marine Resources (Chuuk State)	$ 596,600	521,000	517,000

3.6.2 Operating Structure for the Plan Facilities :

The Plan facilities are intended to function as a support station for artisanal fisheries through the provision of an ice plant and chilling storage. Although the DMR presently operates two ice – making units, with rated daily production capacities of 3 tons and 1 ton respectively, ice supply from these plants has been seriously declining, owing to breakdowns and aging. The Plan facility will serve as replacement capacity for the DMR plants and help to implement DMR's program for improving the fish distribution structure in Chuuk State, particularly for catches from the outer islands. It has, therefore, been determined that it would be most appropriate for the Plan facilities to be operated by the DMR, in view of its experience to date in running the existing ice plants. In terms of the operating structure for the Plan facilities, we feel that it would be appropriate, for the time being, to follow the pattern of the existing facilities. However, once operations at the Plan facilities have gotten firmly underway, the operating organization should be gradually made self –supporting, with a view toward converting it into an independent public corporation at the earliest possible time so as to achieve optimum utilization of facilities and staff. In anticipation particularly of the termination of the Compact of Free Association with the U.S. in 2001, the Chuuk State government recognizes the need for structural reform in order to more efficiently utilize the state's human resources, which have concentrated excessively in the state bureaucracy, and so the operating structure for the ice – making facilities should be conceived in terms of achieving this objective. Accordingly, the operating conditions for the Plan facilities have been established, as shown below, from this perspective.

(1) Number of operating days per year : 260 days

At the existing ice plants, ice is sold, in principle, during normal business hours, Monday through Friday. When special demand is anticipated on weekends or holidays, employees come to work to handle this business. The new Plan facilities will follow the same working schedule and thus will operate 260 days a year.

(2) Operating hours : 8:00～16:30

Operating hours have been set at the normal hours for State workers. In practice, however, since operations will also be required on weekends or holidays or beyond regular working hours during the week, average operating hours have been set at 10 hours per day.

(3) Staffing :

The present ice –making facilities of the DMR are operated by a cadre of 4 persons. Since the plant is located next to the DMR offices, the proceeds from ice sales are collected and processed by clerical employees of this Department. 5 DMR employees will be reassigned to the Plan facilities : a director, engineer, 2 workers, and an accountant. Although the operating staff will remain employees of the State government, their salaries will be appropriated in accordance with current salary scales for regular State employees, on the assumption that the facilities will eventually become self –supporting. Two guards will be employed for nights and non – working days as contract personnel. Annual salaries (including social insurance) will be as follows :

DMR employees		
	Director	$ 10,000 (annual salary, including social insurance and benefits)
	Engineer	$ 7,000
	Accountant	$ 5,000
	Workers (2)	$8,000 ($ 4,000 x 2)
Contract personnel		
	Guards (2)	$8,000 ($ 4,000 x 2)

(4) Ice sales price :

The selling price for ice will be set at the present level : 10 cents / kg (or $ 100 / ton).

(5) Chilling storage charges :

As the chilling storage will be a new facility in the area, storage charges will have to be newly established. The chilling unit at the Plan facilities is intended to encourage the distribution of fish products, primarily those originating on the outer islands, in consuming areas, thereby helping to raise the living standards of outer island residents. It would be proper, therefore, to consider ice sales as the main revenue source at the Plan facilities. Thus, the chilling storage rates will be set at a very low level, no higher than that required to prevent a drain on facility finances. As a rule of thumb, they could be fixed at about half the cost of preserving freshness with ice. The charges should be sufficient to recover electricity and depreciation costs for the chill storage facility. On this basis, we have set the storage rate at 10 cents / 10 kg of catch per working day.

(6) Power costs :

As of December, 1994, the electricity rate in the Plan area for annual consumption of 10,000 kwh or less was $ 0.12 kwh, but this low level is made possible by a huge subsidy from the State government. However, the State is planning substantial a rate increase to have users bear a reasonable shore of power costs . In October, 1994, it established a public service corporation for electricity and water supply and has already initiated the process of transferring electric power operations from the State Department of Public Works to this new entity. It is expected that power rates will be raised as soon as this new corporation is in full operation. While the size of the increase is not yet known, we have assumed, in our calculations, that rates will be increased some 40% from present levels. Accordingly, we have set the Plan power rate at $ 0.17 / kwh.

(7) Water charges :

Water supply in the Plan area is very poor, with service in most districts rationed to only about 2 hours per day. As the Plan facilities will be consuming a considerable amount of water, it would be dangerous to rely solely on municipal water as the basis for a stable ice production program. We plan, therefore, to derive only 40% of total Plan supply from the municipal system, with another 40% to be obtained from water wagons and the remaining 20% from rainwater. Current water rates have been applied as follows :

Municipal water:	$ 1.60/ ton
Water wagon supplies:	$ 8.00 / ton

(8) Gasoline Price :

The cost of gasoline has been set at the current market price of $1.80 / U.S. gallon, or $ 0.30 per liter.

The above operating conditions may be summarized as follows :

Working days / year	260 days
Operating hours	10 hours / day
Operating staff	5 persons from the DMR staff; 2 guards as contract workers

Electricity cost	$ 0.17 / kwh
Water cost	Municipal supplies : $1.60 / ton From water wagons : $8.00 / ton
Gasoline	$ 0.30 / liter
Ice selling price	$ 0.10 / kg
Chilling storage rate	$ 0.10 / 10 kg / day

3.6.3 Maintenance Plan :

The Plan facilities will have a high public service value as a support station for artisanal fisheries. However, since no operating subsidies can be assumed from the State government, it is desirable that all direct operating expenses be defrayed out of sales proceeds from ice produced at the Plan facilities along with revenues from chilling storage. Maintenance costs, operating costs, and operating revenues have been calculated below; with the bases for these projections shown in Appendix v –2, v –3.

(1) Maintenance costs :

Annual maintenance costs for the Plan facilities (excluding equipment) have been set at 0.5% of direct construction costs. On this basis, the annual budget for facility maintenance works out to $1,970. The maintenance budget for Plan equipment — ice –makers, chilling storage unit, generator, ice transport vehicle, personal computer, and other items — has been figured at 2% of the ex –godown price for the basic equipment, yielding an annual total of $ 5,860.

(2) Operating expenses :

The operating expenses for the Plan facilities will comprise power, water, fuel for vehicles and other equipment, and personnel. Annual power costs have been set at $24,128, water at $ 4,688, fuel at $ 963, and wages for the 7 –man staff at $ 38,000.

(3) Operating revenues :

Ice sales revenues, based on an annual production of 1,110 tons and a selling price of $100 / ton,

will amount to $111,000 / year.
Chilling storage revenues are projected at $ 5,800 per year, based on an average of 2 days' storage for 290 tons of fish annually at a rate of $10 / ton / day (10 cents / 10 kg / day).

Summarizing the above items, annual revenues and expenditures for the Plan facilities have been projected, as shown below :

Table 3.2 Annual Project Operating Revenues and Expenditure

Revenues	($)	Expenses	($)
Ice sales	111,000	Power for ice -makers / chilling storage	22,518
Fee from Chlling storage	5,800	Water charge	5,115
		Fuel cost for vehicle	936
		Building maintenance cost	1,970
		Equipment maintenance cost	5,860
		Personnel expense	38,000
Total	116,800	Total	74,399
		Balance	+42,401

As shown above, operating revenues at the Plan facilities can be expected to cover all operating costs, with the surplus contributing to the revenues of the Chuuk State government.

SECTION FOUR:BASIC DESIGN

4.1 Design Guidelines:

(1) While the primary activities of the Plan facilities will be to supply ice and provide chilling storage, consideration has also been given to having these facilities function as a support station for artisanal fisheries, reflecting the importance attached in DMR planning to providing fish market facilities and establishing a fish distribution network geared to the outer islands of Chuuk State.

(2) The ice –making and small –scale chilling storage included in the subject Plan will be similar in scale to existing facilities in Weno, and so the staff of the State DMR, designated as the operating body for the Plan facilities, includes technicians well versed in supervising and maintaining this type of equipment. On the other hand, in view of the highly unstable supply of power and water in Chuuk State, on which smooth operation of the Plan facilities is predicated, the Plan is designed to fully cope with power failures, fluctuations in voltage, and cut –offs in water supply, thereby helping to insure a long life for the new equipment.

(3) Although the Plan facilities have a strong public service dimension, they will have to operate on a self –supporting basis, without benefit of subsidies from the State government. To this end, we have selected facilities and equipment that will operate efficiently while holding maintenance costs to a minimum. Priority in equipment procurement will be given to items for which operational guidance, repairs, and replacement parts are all available locally.
(4) Given the poor transportation infrastructure from major Pacific Rim markets and the limited supply of skilled workers in the Plan area, the construction phase of the project for the building and facilities will have to be carried out within a fixed period. We plan to use construction methods that are simple and easy to implement, while paying particular attention to shipping convenience and shortening the construction period.

4.2. Design Conditions :

4.2.1 Design Accuracy :

Based on the Basic Design of the Plan facilities, the surface, elevation, and sectional plans have been prepared on a scale of 1/100～1/200, while the layout plan uses a scale of 1/200～1/300.

4.2.2 Governing Standards

Micronesia has no particular structural design standards. The Plan site is located in a typhoon zone and so subject to occasional typhoons. Thus, the design wind load has been calculated according to the following formula :

$p = q \cdot c \cdot A$

where :

p : design wind load (kg /m^2)

q : velocity pressure $q = 60h\sqrt{h}$ (h < 16 m) (kg /m^2)

h : height from foundation (m)

A : pressure –bearing area

c : wind force coefficient

Since there is no history of earthquakes in the area, seismic strength has not been taken into account.

Boring surveys have not been made within the Plan site. This site was reclaimed in the early 1960s, using soil dredged during the Weno Harbor construction project. It is known by analogy that the material extending from the surface to the hard sea bottom 5~6 m below is fine sand. Considerable time has passed since the reclamation work, and it has been determined that, geologically, there is no danger of uneven subsidence in the case of conventional low –rise buildings. Based on the boring surveys on soil quality conducted in the vicinity of the Plan area in 1993, the long –term soil bearing capacity has been set at 5 ton /m^2.

The meteorological conditions for the pontoon installation have been determined as follows.

Wave height :	0.5 m
Wind velocity :	25 m / sec.
Water depth :	1.0 m
Current :	1 m / sec.
Tidal variation :	1 m
Surcharge :	100 kg /m^2

Following are the design conditions for the Plan materials :

Reinforced concrete : Standard design intensity: Fc = 210 kg / cm^2

Non –reinforced concrete : Standard design intensity : Fc = 180 kg / cm^2

Re –bars: SD 295 A

Structural steel materials: JIS G 3101, SS 400

The application process for building certification involves the following steps. After a detailed design is submitted to the State Department of Planning and Statistics, the latter discusses the planned construction with the required State agencies, with an inspection conducted, as necessary, by a specialized organization, after which the building permit is issued. 3～4 weeks should generally be allowed for the examination process.

4.3 Basic Plan :

4.3.1 Layout Plan

The Plan site is on land owned by the State government which was reclaimed during the early 1960s. It is a flat parcel which is currently administered by the Department of Transportation. With excellent access from the main highway, the site has been deemed appropriate even for the future construction of offices and other administrative facilities of the Department of Transportation. It has a long and narrow contour (25 m long by 12 m wide), running in an east –west direction, and is bounded on the north by a wire net fence so as to minimize adverse impact from the Plan facilities on any future expansion project for the Commercial Port. Since a fire hydrant is already installed in the northeast corner, this will be left in place, with about 5 m of open space planned from the border formed by the main road. Careful consideration has been given to ensuring easy access to the small boat moorage, which is the target supply area for the ice produced at the Plan facilities, while not impeding the flow of highway traffic, which keeps to the right in Micronesia. Access to the Plan facilities will be provided from the road on the northern side of the site running from the main highway to the public market.

Since the site has a long and narrow shape running along the road, looking ahead to future expansion, it would be ideal, from a functional standpoint, if both the ice plant and chilling storage equipment were concentrated on the eastern side of the site. However, owing to site constraints, these key operations will be divided between the east and west sides of the complex, with the working (handling) area occupying the central portion.

4.3.2 Surface Plan :

The small boat mooring area, which is the intended distribution point for ice supplied from the Plan facilities, faces the north side of the site beyond the highway. If the working (handling) area is placed in the center of the facility, it will be located just in front of the corridor to the mooring area, creating excellent access for small boats. Although the scale of the Plan facility is modest, owing to the confined site area, a two -story building is planned, with rooms that do not have to be on the ground floor, such as the office and storage room, to be placed on the second floor. In the ice -making area, the ice storage unit must be placed under the ice -making equipment, with a required ceiling height of about 6 m from floor level.

Since the ice plant will naturally be on the upper floor, the office will be located next to this area. The storage area will not be given a separate room but will instead occupy a portion of the ice -making room. The office area must include some multi -purpose space for meetings with facility users and other visitors, but this space can be an open area forming part of the office. The stairway to the second floor will be an exterior staircase to permit effective use of the inside space. The first floor will contain the staff room, toilet, generator room, and chilling storage. The water intake tank will be installed outdoors so as to facilitate collection of rainwater from the roof as well as deliveries by water wagons.

4.3.3 Sectional Plan :

High ceilings are desirable, considering the high temperature and humidity in the Plan area. The office will be air -conditioned but the other rooms will generally be naturally ventilated. Thus, the ceiling heights at the Plan facility have been set as follows, based on those provided in comparable local structures.

Room Designation	Ceiling Height	Remark
Office, storage area	2.7 m	
Staff room, toilet, and ice -making room	2.7 m	
Generator room, working area	Open ceilings	(no hung ceilings)

4.3.4 Structural Plan :

1) Structural Method :

The structural method will specify steel frames for posts and beams(spans) and vinyl -chloride (PVC) steel sheets for the walls and roof. Steel frame construction will be most advantageous,

because uniform quality is assured by factory production, while accuracy is easy to maintain during construction. However, since the construction is being done at a location constantly buffeted by sea winds, extreme care must be taken with respect to corrosion resistance, with all steel frame members to be given a paint finish covered by galvanized zinc plating. For the same reason, wide -span members will be provided in the roof and walls, using PVC ribbed and square corrugated sheets for their outstanding anti -corrosive properties.

2) Foundation Structure :

The soil type in the Plan area is presumed to be fine sand, with no indication of unstable foundation conditions, such as uneven subsidence. Since the Plan facility will have a steel frame structure, it will be comparatively light -weight, and we have determined that no danger of subsidence or similar problems exists in the present foundation as a support foundation for buildings. Accordingly, we have specified a direct foundation for the Plan facility. The allowable long -term soil bearing capacity has been set at 5.0 t /m^2.

4.3.5 Finishing Plan :

Particular attention was paid to the following natural and social conditions in preparing the finishing plan :

- As a seaside facility, it will be subject to damage from sea winds.
- Temperature and humidity are high throughout the year.
- Heavy rainfall is sometimes concentrated within a short period of time.
- Since the finishing materials will all be imported, the plan must allow ample time for procurement.
- The construction period is limited

The finishing plan has been prepared on the basis of the above conditions.

1) Exterior finishes
a) Roof :

Galvanized iron roofs are most common in private homes. The same is true generally of public buildings, though tile roofs are also seen.

Roof shapes are almost entirely hipped, hip –gable, and gable, through some new buildings have corrugated iron roofs. In the subject Plan, the roof will be gable, with ribbed sheets used for ease of maintenance and construction.

b) Outside walls :

The wall material used in public buildings in the area is H.C. (hollow concrete) blocks, with the finish applied either directly or with an extra coat of mortar paint. In this Plan, however, we have specified PVC steel sheets, from the standpoint of corrosion protection and the limited construction period.

c) Outer openings :

In local public buildings, the doors are wooden, while windows are virtually all jalousie. In this Plan, the office doors will be aluminum, and those in the machinery room steel, while the windows will use aluminum sash.

2) Interior Finishes :
a) Floors :

The standard floor finish throughout the building will, in principle, be concrete slab with mortar finish. In the toilet, a tile floor will be used for sanitary considerations.

b) Ceilings and walls :

Ceilings will be hung in the office, storage area, staff room, toilet, and ice –making room.
Open ceilings will be used in the other areas.
The following finishing materials will be used, as appropriate, on floors, ceilings, and interior wall surfaces :

- Ceilings : Paint finish on a veneer base
- Walls : Paint finish on a mortar base; paint finish on a veneer base

4.4 Equipment Plan

The equipment required for the Plan facilities will be provided in the following quantities and principal specifications :

(1) Ice-making machine — 2 units

Type:	Air-cooled, plate type
Capacity:	5 tons/day
Power source	220 v, 60 hz, 3P
Refrigerant	R-22
Ambient temperature	35℃
Rated motoroutput	Approx. 19 kw

(2) Ice storage — 1 unit

Type:	Prefabricated type
Dimensions	Approx. 5400 x 4500 x2400 mm
Panel thickness	Approx. 100 mm
Power source	220 v, 60 hz, 3P
Ambient temperature	35℃
Holding temperature	0～-5℃
Rated motor output	Approx. 2.2 kw

(3) Chilling storage — 1 unit

Type:	Prefabricated type
Dimensions	Approx. 2700 x 2700 x2400 mm
Panel thickness	Approx. 100 mm
Power source	220 v, 60 hz, 3P
Ambient temperature	35℃
Holding temperature	0～-5℃
Rated motor output	Approx. 1.5 kw

(4) Insulated container — 10 pcs.

Dimensions	Approx. 1050 x 500 x 500 mm
Capacity	Approx. 160 lit.

(5) Weighing scale — 2 pcs.

Measuring range	Max. 150 kg

(6) Statistical equipment — 1 set

Personal computer, 14" CRT, with software and printer

(7) Pontoon — 1 set

Dimensions	Approx. 2.5 x 10 m
Accessories	Connecting bridge, anchors, cahin

(8) Ice tarnsport vehicle 1 unit

Type	Pick –up type
Seating capacity	3 persons, single cabin
Loading capacity	Approx. 750 kg
Accessory	Insulated van body

(9) Others

Facsimile	1 unit
Copier	1 unit
Cash register	1 unit
Facsimile stand	1 unit
Table and chairs	1 set