

8. Organization for Management and Operation of Power Plant

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8.1. Organization

The comparison of the organization between the existing Sihanoukville Diesel Generator Power Station (hereinafter called “Sihanoukville D/G Power Station”) and recommended Sihanoukville Combined Cycle Power Station in this project (hereinafter called “Sihanoukville C/C Power Station”) is as shown in Fig.8.1-1. According to the organization of Sihanoukville D/G Power Station, its organization consists of “Superintendent’s room”, “Office” section and “Technical” section. “Superintendent’s room” manages “Office” section and “Technical” section. “Office” section consists of three parts (“Administration” personnel, “Accounting” personnel and “Sales and Commercial” personnel). “Technical” section consists of “Production” personnel and “Supply” personnel.

Sihanoukville C/C Power Station is the first large-scale fossil-fired power station in Cambodia, this power station should be properly organized so as to meet its specific property and features. Compared with D/G power station, gas turbine combined cycle power station has differences in the following points.

- (1) Main equipment is a gas turbine, HRSG and a steam turbine.
- (2) A heat cycle by water-steam.
- (3) Demineralized water is applied to the boiler.
- (4) Mechanical, electricity, measurement and control systems have a lot of and these system configurations are more complicated.

Therefore, the following professional knowledges are necessary for maintenance and operation of equipment and system in the plant.

- (1) Professional knowledge for each main equipment
- (2) Application technology of steam system
- (3) Chemical analysis technology of demineralized water for boiler, etc.
- (4) Technology for operation and supervision of complicated system
- (5) Other operation technologies, such as spare management, etc.

To ensure a high availability of the plant, the following organization structure is recommended.

The “Production” personnel is separated into an “Operation” section and a “Maintenance” section and responsible personnel are assigned to each equipment. “Sales and Commercial” personnel and “Supply” personnel should be assigned to Phnom Penh Office, because they mainly work at the consumer area (in other words, Phnom Penh City). The new “Technology” section consists of two new groups. One is the “Technical” personnel which is responsible for making a technical management plan of the Power Station and reporting to the Ministry of Environment, and the other is the “Chemical” section which is responsible for chemical affairs (control of water quality in power station, etc.). “Logistics” personnel in the “Operation” section manages necessary materials for operation of the power station, procurement of fuel and planning of education and training of operators, etc.

The organization of Sihanoukville C/C Power Station and the responsibility of each personnel are shown in Fig.8.1-2.

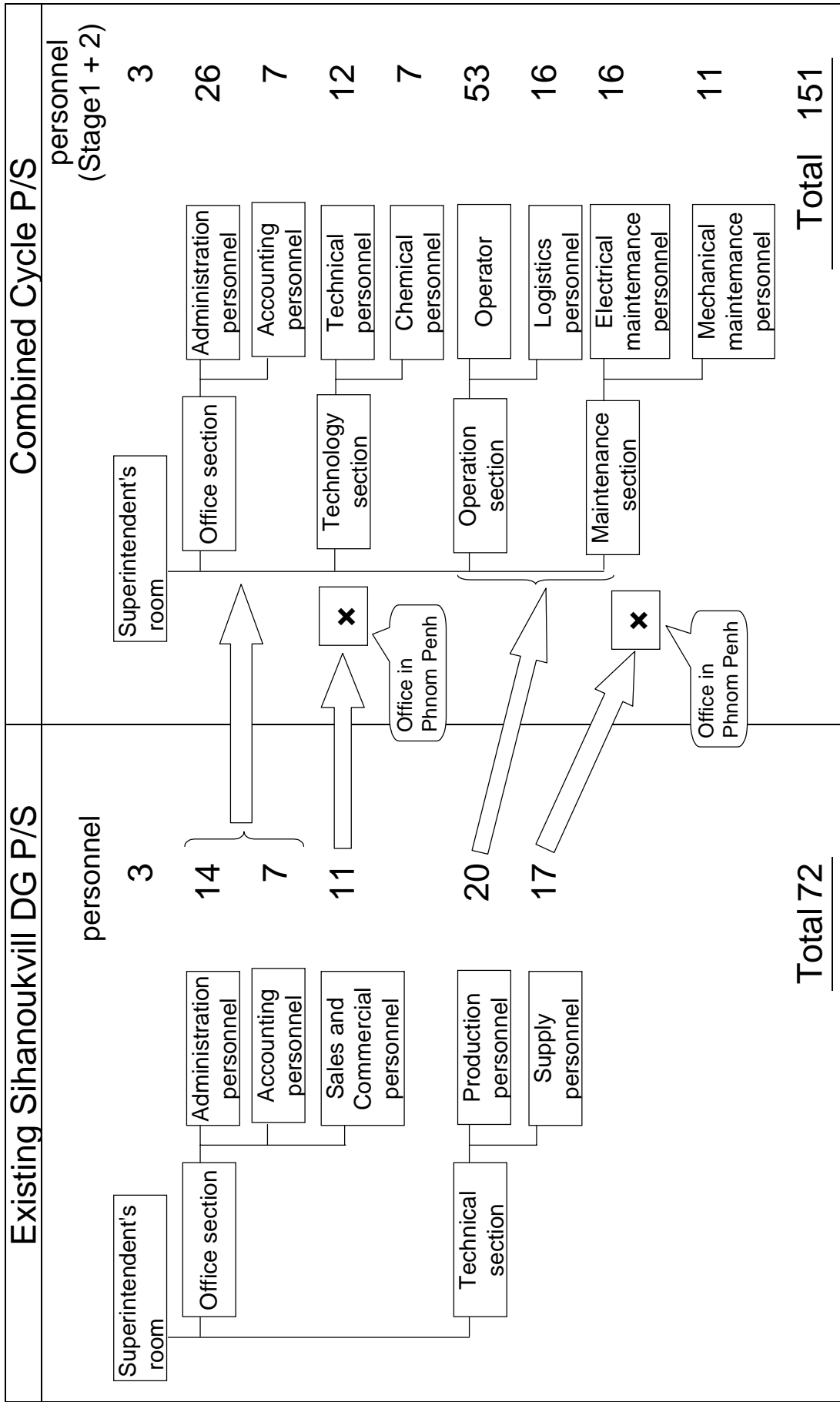


Fig.8.1-1 Comparison of the Organization between DG P/S and Combined Cycle P/S

Combined Cycle P/S	Function
	<ul style="list-style-type: none"> • Overall management (station manager, and 2 vice station managers (administration, technical)) • Administration (Commercial, Personnel matter, Labor management, Education, Health administration, Public welfare, Document management etc) • Others (Drivers, Medical staffs, Security guards, Office workers) • Accounting, Material procurement, etc. • Data Evaluation and Statistics (Environment, Efficiency of the plant etc) • Chemical affairs (Quality control of supply water, Chemical analysis, etc.) • Operation (4 groups on 3 shifts) • Logistics for Operation (Material control for operation such as fuel, disposal control of sludge, sewage & etc., planning an education for operating, etc.) • Maintenance (Electrical & C&I) • Maintenance (GT, ST & HRSG, BOP)
Total	151

Fig.8.1-2 Organization and Function of Sihanoukville Combined Cycle Power Station

8.2. Personal Allocation

This recommended personal allocation for Sihanoukville C/C Power Station is referred to both the personal allocation of Sihanoukville D/G Power Station in EDC and typical organization in developing countries. Study result of the personnel allocation in Sihanoukville C/C Power Station is shown in Table 8.2-1.

Table 8.2-2 shows the composition of "Operator". Operation section has 4 groups of operators. They are in charge in three shifts per day basis, with one group off. Each group consists of 9 operators for Stage 1 and 12 operators for Stages 1 and 2. Total 53 members include 4 members of OJT (On the Job Training). OJT members are assigned for reserves in case of lack of operators due to retirement, invalid and etc. Table 8.2-3 shows the composition of "Maintenance" section. In case of Stage 1 and Stage 2 (total 180 MW), it has three groups (mechanical, electrical, C&I), and consists of 27 members. "Administration" personnel consists of 26 members including 19 members of drivers, medical staffs, security guards, office workers and etc.

In case of Stage 1 and Stage 2 (180 MW) Power Plant, the organization would consist of about 150 members. However, it is necessary to reconsider allotted duties and the numbers of each section personnel according to the actual conditions of the organization management and the capacity of personnel in the EDC.

Table 8.2-1 Recommended Personnel Allocation in Sihanoukville C/C Power Station

	Sihanoukville D/G Power Station		Sihanoukville C/C Power Station (Stage 1)		Sihanoukville C/C Power Station (Stage 1 + 2)		Difference between "a" and "b" b-a	Remarks
	a	b						
Superintendent's room	3	3	3	3	3	0	Station manager, and 2 vice station managers (administration, technical)	
Office section	Administration	14	24	24	26	12	Including drivers, medical staffs, etc.	
	Accounting	7	7	7	7	0	Referring to Sihanoukville D/G Power Station	
Technology section	Sales and Commercial	11	0	0	0	11	Other office in Phnom Penh	
	Technical	20	8	8	12	95	Referring to a typical C/C Power Station	
Chemical	5		5	7				
Operation section	Operation	20	41	41	53	95	Referring to a breakdown list	
	Logistics		11	11	16			
Maintenance section	Electrical maintenance	20	12	12	16	95	Referring to a breakdown list	
	Mechanical maintenance		8	8	11			
Supply section	Measuring	7	0	0	0	7	Other office in Phnom Penh	
	Distribution	10	0	0	0	10		
Total		72	118	118	151	79		

Number of generators	8	4	8
Total output of Power Station (MW)	8.3	90	180

Table 8.2-2 Composition of Operators

(per 1 group for Stage 1)

[personnel]			
Chief of an operating group			1
C.C.R (Central Control Room)	Stage 1	ST & HRSG, GT, E	3
Patrol for main equipment	Stage 1	ST & HRSG, GT, E	3
Patrol for BOP (Balance Of Plant)	Stage 1	BOP	2
Total			9

(per 4 group for Stage 1)

OJT (On the Job Training) trainee	4
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Total number = 9 × 4 + 4 (OJT) + 1 (Section manager) = 41
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(per 1 group for Stage 1 + Stage 2)

[personnel]			
Chief of an operating group			1
C.C.R	Stage 1	ST & HRSG, GT, E	3
	Stage 2	ST & HRSG, GT, E	3
patrol for main equipment	Stage 1	ST & HRSG, GT, E	3
	Stage 2	ST & HRSG, GT, E	
patrol for BOP	Stage 1 & Stage 2	BOP	2
Total			12

(per 4 group for Stage 1 + Stage 2)

OJT (On the Job Training) trainee	4
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Total number = 12 × 4 + 4 (OJT) + 1 (Section manager) = 53

Table 8.2-3 Composition of Maintenance Personnel

(Stage 1 : 90 MW) [personnel]

Manager of the maintenance section			1
Chief of the mechanical maintenance personnel			1
Main equipment	Stage 1	ST, GT	2
	Stage 1	HRSG	1
BOP	Stage 1	BOP	2
OJT (On the Job Training) trainee			1
<i>Subtotal</i>			8
Chief of the electrical and C&I maintenance personnel			1
Vice-chief (electrical)			1
Main equipment	Stage 1	GEN, TR	1
	Stage 1	BOP	2
BOP	Stage 1	BOP	2
Substation	Stage 1	Substation	1
OJT (On the Job Training) trainee			1
Vice-chief (C&I)			1
Main equipment	Stage 1	Boiler Control System etc	1
	Stage 1	BOP	2
BOP	Stage 1	BOP	2
OJT (On the Job Training) trainee			1
<i>Subtotal</i>			12
Total			20

(Stages 1 +2 : 180 MW) [personnel]

Manager of the maintenance section			1
Chief of the mechanical maintenance personnel			1
Main equipment	Stage 1	ST, GT	2
	Stage 2	ST, GT	2
	Stage 1 & 2	HRSG	1
BOP	Stage 1 & 2	BOP	3
OJT (On the Job Training) trainee			1
<i>Subtotal</i>			11
Chief of the electrical and C&I maintenance personnel			1
Vice-chief (electrical)			1
Main equipment	Stage 1	GEN, TR	1
	Stage 2	GEN, TR	1
BOP	Stage 1 & 2	BOP	3
Substation	Stage 1 & 2	Substation	2
OJT (On the Job Training) trainee			1
Vice-chief (C&I)			1
main equipment	Stage 1	Boiler Control System etc	1
	Stage 2	Boiler Control System etc	1
BOP	Stage 1 & 2	BOP	2
OJT (On the Job Training) trainee			1
<i>Subtotal</i>			16
Total			27

8.3. Training Plan of Operation and Maintenance Engineer

A training program is classified into the following three types basically.

- (1) Classroom in Cambodia domestic and other foreign countries
- (2) OJT (On the Job Training)
- (3) Training by advisors after beginning commercial operation

Program of classroom training and OJT is shown in Table 8.3-1 and breakdown of the classroom training ③, ④ and ⑦ are shown in Table 8.3-2. The classroom training are composed of general, project management, design/environment, operation, maintenance & material-control and power station tour. And it is recommended that practical training are lectured by trainers of foreign consultant, manufacturer and/or electric power company. Simulator practice will be most effective for Cambodian operators to understand operation of unfamiliar machines such as gas-turbine, HRSG, steam turbine, and association equipment.

Because some of the electric power companies in Japan have a simulator for operation training of combined cycle power station, Cambodian operator could have training course using the simulator in Japan.

To make an OJT effective, it is important that trainees have experiences of actual site works such as assembling, disassembling, inspection, and adjustment of equipment. Therefore OJT necessary for the personnel of EDC is recommended to be included in the contract with constructors.

It is a tremendous social loss to make a significant high efficiency power plant like a combined cycle fall into unoperational conditions that results in failure of power supply, due to human error, inappropriate maintenance of equipment and inappropriate control of materials.

Therefore, to operate the plant effectively and continuously and to improve operation and maintenance personnel ability, several contractor's engineers of large experience should be stayed continuously at the plant as the advisor after completion of the plant up to expiration of the warranty period.

The following technical experts take charge of the advisor.

- (1) Gas turbine engineer
- (2) Steam turbine engineer
- (3) C&I engineer

The advisors must support a power plant operation staff not only at the office hours in the warranty period (usually, one year) but also at the time of trouble occurrence.

Then, even after the warranty period, the advisors of gas turbine and C&I should be remained at that power plant for six months or one year, and they should continue to train the personnel to be a skilled operator and a maintenance expert.

The schedule of Training Plan is shown in the Fig.8.3-1.

Table 8.3-1 Program of Classroom Training and OJT

Type	Location	Subject	Trainer	Trainee	Duration (Working Day)	Time	Number of Trainees
Classroom		General	Consultant	Managers & Engineers	1	at start of project	3 ~ 4
		Project management			4		
	in Foreign Countries	Design/Environment	Contractor and/or Electric Power Co.	Engineers & Technicians	15 *	during manufacturing	5 ~ 6 personnel × 2 times
		Operation			43 *		
		Maintenance & Material control			2		
		Power Station Tour			2		
at Site	Operation	Contractor	Engineers & Technicians	10 *	during erection	10 personnel × 2 times	
	Maintenance & Material control			5			
	Construction			full time during construction/ erection/ operation			
OJT	at Site	Operation	Contractor	Technicians	full time during construction/ erection/ operation	during construction/ erection/ operation	all operators & maintenance personnel
		Maintenance & Material control					

* Breakdowns of the classroom , and are shown in Table 8.3-2.

Table 8.3-2 Breakdowns of the Classroom , and

Design/Environment		15 days
Mechanical	Gas Turbine	4 days
	HRSG	2 days
	Steam Turbine	2 days
	Balance of Plant	2 days
C&I		3 days
Chemical/Environment		2 days
Operation (in foreign countries)		43 days
Lecture	(at manufacturing co.)	5 days
	(at electric power co.)	12 days
Practice	(using simulator)	26 days
Operation (at Site)		10 days
Gas Turbine Island		5 days
Steam / Water Cycle		3 days
Balance of Plant		2 days

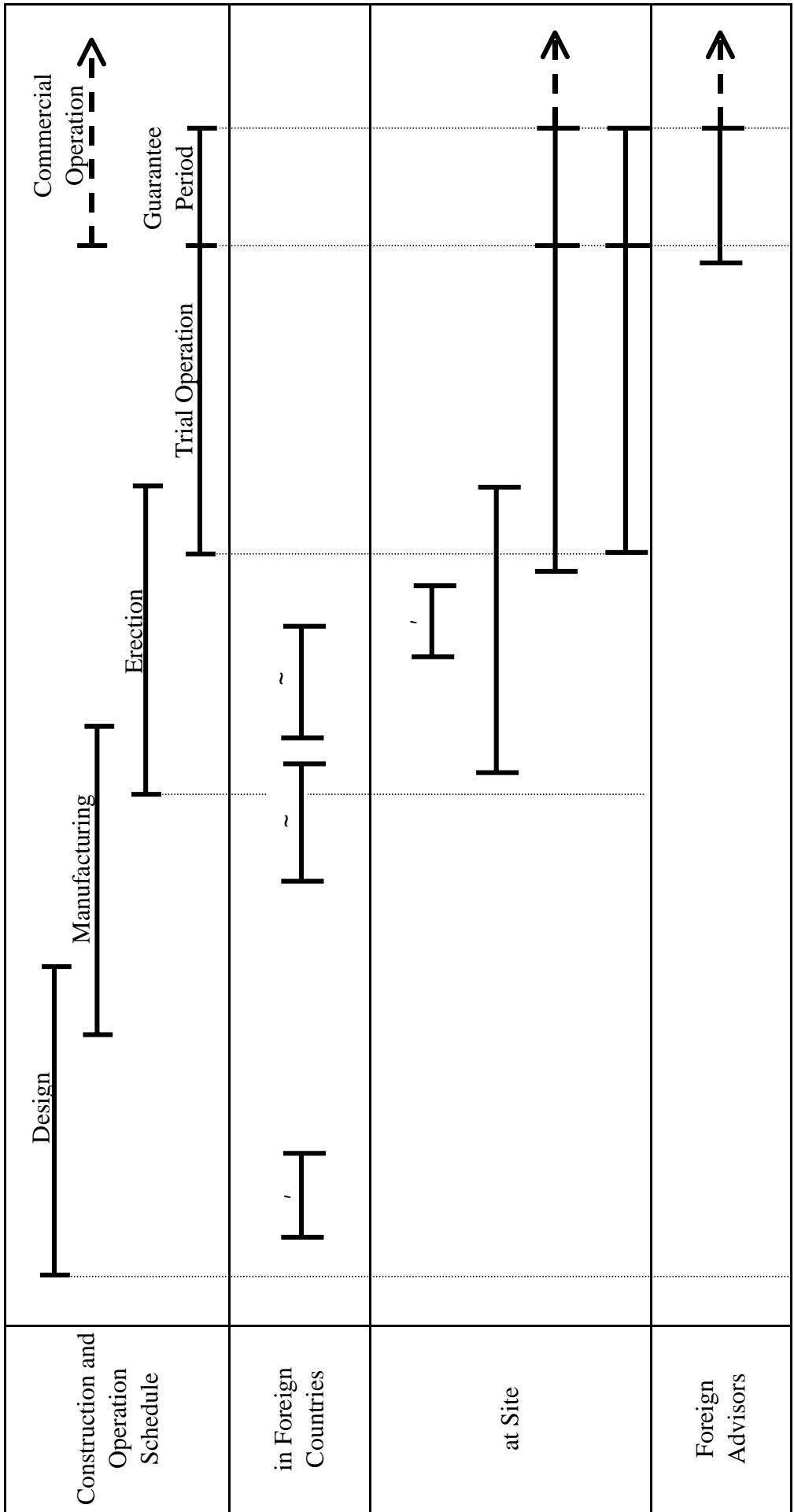


Fig.8.3-1 Schedule of Training Plan