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20050

IN THE NAME OF GOD

MANAGEMENT CONSULTANCY SERVICES

FOR ARAK PETROCHEMICAL COMPLEX, ARAK ISLAMIC REPUBLIC OF IRAN

FINAL TERMINAL REPORT

Indian Petrochemicals Corporation Limited
(A Government of India Undertaking)
VADODARA-391 346, GUJARAT
INDIA

316 p.; tables diagrams maps

IN THE NAME OF GOD

RESTRICTED

FINAL TERMINAL REPORT

JUNE 1992

"MANAGEMENT CONSULTANCY SERVICES"

FOR ARAK PETROCHEMICAL COMPLEX, ARAK
ISLAMIC REPUBLIC OF IRAN

PROJECT NO	:	DP/IRA/87/008
PROJECT CODE	:	J13420
CONTRACT NO.	:	89/114

PROJECT DURATION	:	20th SEPT '91 TO 12th DEC '91
PROJECT TEAM	:	M.V.NAIK & D.C.BHATT
NAME OF ORGANIZATION	:	INDIAN PETROCHEMICALS CORPN.LTD.,INDIA

CONTRACT BETWEEN THE UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANISATION
&
INDIAN PETROCHEMICALS CORPN.LTD.,INDIA
SUBMITTED TO

THE CHIEF
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GENERAL SERVICES DIVISION
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ACKNOWLEDGEMENT

Authors of this report thankfully acknowledge Arak Petrochemical Company (an affiliate of National Petrochemical Company) authorities management and staff members for an active co-operation and facilities extended during this assignment.

But for the co-operation and support from the Planning, Coordination and Control department and the Administration at Tehran office (of ARPC) it would not have been possible to perform our functions as consultants on Management Consultancy Services to the best of our abilities. Equally we received the friendly attitude and approach from the construction and operations departments of ARPC and ARAK site office. We have been successful in our mission at Arak, because of the continuous assistance from, Arak site. We are thankful to all concerned for enjoying the hospitality extended to us and making our stay comfortable.

A special mention deserved to be made of the representative departments of the UNDP office at Tehran for their valuable guidance, advice and providing assistance in carrying out this project in most successful manner and solving local problems from time to time. We appreciate their confidence in us and IPCL and are thankful for the same.

We express our gratitude for acceptance of Draft Final Report by Ministry of Petroleum, Government of Iran and UNDP/UNIDO.

We also acknowledge our thanks to the United Nations International Development Organization for their faith in Indian Petrochemicals Corporation in assigning such a task for ARPC.

We in IPCl would have privilege and pleasure in continuing such association with UNIDO and ARPC in future.

SYNOPSIS

SYNOPSIS

As per the present status of the construction progress of the complex, the plants under Phase-I are likely to be completed mechanically and start commissioning towards end 1992. In view of this, with the consent of UNDP, ARPC advised the consultants-team to provide technical assistance for 'Precommissioning, Commissioning and Start-up operation' under final phase of this contract for 'Management Consultancy Services' of UNIDO with Indian Petrochemicals Corporation Limited, Vadodara, India to M/s.Arak Petrochemical Complex, Arak, in Islamic Republic of Iran.

Based on documents furnished by ARPC, consultants carried out its analysis, held series of meetings discussions and visits to process units, utilities and offsites of ARPC site at Arak. Due to secrecy agreement with process Licensors access to process information and operation manuals and catalogues was limited. With assistance from home-office, for support services like operational safety, tech-services, maintenance engineering services operational control room, training environment and ecology, risk assessment and disaster management areas were taken up to provide basic concept and system development for precommissioning, commissioning and start-up and stabilised operations of phase-1 plants. It will also be useful and applicable for post operational needs like good maintenance practices, technological support to over come teething troubleand also strong safety basis to ensure smooth and safe operation of plants. Separate chapter on each subject is incorporated in report.

Organogram for `Area Management' was developed with complete area responsibility including safety, technical services and for functions of construction personnel. For successful commissioning and smooth take over for operation and maintenance of units, this type of work organization is suggested. As a prerequisite, emphasis was given for safety audit and support services needed for plants. Technical audit by MC and Hazop studies for potential risk area are recommended.

Pre-commissioning, commissioning and start-up schedules issued by MC were examined for its effectiveness, deployment of manpower by UC, MC, Vendors and ARPC. Construction progress status review and analysis made and comments were issued to ARPC. Other important aspects viz. storage and preservation, testing and inspection, checking for completeness, planning of spares etc are also briefly mentioned in the report.

Thus the report provides;

- 'Area Management' concept to take over responsibility of precommissioning, commissioning and start-up by operations and technical services management from construction management in ARPC.

- System development for vital support services to be introduced right from pre-commissioning stage of phase-1 units.

- Specific recommendation for post operative assistance for sustained production.

- Technical assistance as requested was also provided for evaluation of plot plan and arrangement in technical building, chemical laboratory, effluent treatment plant etc.

Based on study and discussion, recommendations given by consultant -team appeared to be acceptable to ARPC and shall be implemented over a due course of time. Given hereunder are some of the areas for which ARPC may like to have consultancy services. This has been divided in (A) short term consultancy services for a period of 3 to 6 months by engaging Consultant having experience in relevant field in specific area and (B) long term consultancy services for a period of 1 to 2 years.

A short term Consultancy Services Area :

1. To set up Maintenance Engineering Services Department for the centralised functions as a support to plant operations. The services from this department will be available for preventive/predictive maintenance and shutdown planning, special care for the rotating machines (monitoring and maintaining the performance), centralised workshop services in each discipline, maintenance procedures/systems in the plants possible development for indigenous substitution, training maintenance personnel, etc.

2. Safety at ARPC site for construction work is not given adequate importance due to lack of knowledge and experience. Therefore, for setting up safety services to suit the need of precommissioning, commissioning, and sustained safe operations and production thereafter, ARPC is advised to avail Consultancy Services from operating company.

3. For Ambient Air Monitoring and stack emission monitoring system along with hardware and software specifications. ARPC should consider assistance from experts in the field. Study should include corelations with meteriological data and EIA study.

4. Risk assessment and disaster management of process plants, utilities and offsite facilities along with drawing up of onsite and offsite emergency plan can be considered for Consultancy Services.

5. Laboratory and Process engineering/technical services can be well organised by associating consultant to have organised approach for the same.

B. Long term Consultancy Area :

1. Looking to prevailing situation at site and as per present status of contracts with UC, CC and MC, these all will be over after performance and guarantee test runs. ARPC will have to take over plants to be operated by their own employees. Although intensive training is provided to engineers and technicians, experienced people are few and difficult to recruit locally. Hence post Commissioning Consultancy Services or assistance for a period of two years from operating company is advisable.

2. In certain specific areas where debottlenecking is identified, during the commercial operations of two years, ARPC may engage expertise from operating companies for a specific period. This will help in improvement of quality and quantity of production.

On approval of Draft Final Report in December, 1992, UNDP suggested to include the following in Final report :

" Effective management of a Chemical Complex operation (like Future Arak Petrochemical Company), appropriate Central Communication System, System's Organizational Structure, its establishment and functioning, Staffing and Duties/Responsibilities of key personnel. "

To incorporate the above requirement in this report a separate Chapter is devoted on level concept of management to build up team work and to reduce Hierarchial Management System. Also it gives typical organizational structure for production/operation oriented management. ARPC may like to engage Management Consultancy Services for providing assistance in setting up organizational structure for all functions related to operations for maximizing plant/unit capacity utilization.

SUMMARY OF DEFINITIONS

: SUMMARY OF DEFINITIONS :

PROCESS UNIT	ABREVIATION
OLEFINS	OL
PYROLYSIS GASOLENE HYDROGENATION	PGH
LINEAR LOW DENSITY POLYETHYLENE	LLDPE
BUTENE-1	B-1
HIGH DENSITY POLYETHYLENE	HDPE
POLYPROPYLENE	PP
ACETIC ACID	AA
VINYL ACETATE	VA
BUTADIENE	BD
POLYBUTADIENE RUBBER	PBR
ETHYLENE OXIDE/ETHYLENE GLYCOL	EO/EG
ETHANOL AMINE	EA
OXO-GAS/2-ETHYLENE HEXANOL	OX/2-EH

UTILITIES AND OFFSITES

COOLING TOWER SYSTEM/COOLING WATER	CT/CW
DEMINERALISED WATER UNIT	D.M.
POWER GENERATION	P.GEN.
NITROGEN AND OXYGEN	N2/02
PLANT AND INSTRUMENT AIR	PIA
STEAM GENERATION UNIT	S.G.
WASTE HEAT RECOVERY GENERATORS	WHRG

AGENCIES :

ARAK PETROCHEMICAL COMPANY	ARPC
CONSTRUCTION CONTRACTOR	CC
UNIT CONTRACTOR	UC
FIELD CONTRACTOR	FC
MANAGING CONTRACTOR	MC
PRINCIPAL CONSTRUCTION CONTRACTOR	PCC
UTILITY PACKAGE UNIT CONTRACTOR	UPC

UNITS :

CUBIC METERS	Cu.m. or M3
KILOMETER	Km
METRIC TON	MT
PARTS PER MILLION	P.P.M.

CHAPTER 1

INTRODUCTION

CHAPTER 1 : INTRODUCTION

A Project entitled " Management Consultant Services for Arak Petrochemical Complex " was approved in September 1985 to provide technical assistance to Arak Petrochemical Complex. The consultants' reports on proposed " mode of Arak Petrochemical Complex were submitted to the government. As a result of these recommendations Arak petrochemical complex requested for further UNDP technical assistance, through access to internationally quilified consultants.

United Nations Industrial Development Organization, Contract Section , General Services Division, Vienna, Austria , requested Indian Petrochemicals Corporation LTD, Vadodara , India to provide technical assistance to Arak Petrochemical Complex .

Any such services is of course made up of the various component : scientific, technical and managerial skills.Each of this has its place ; none is an end in itself. Project management revolve around preparation of fesibility report , tying up technology , purchase of know-how , detailed engineering , construction , commissioning and start-up activities , all these activites are aimed at development and encouragement of indigenous resource utilisation and creating self reliance.

IPCL'S experience in above field and with commissioning of 14 plants in 1978-79 almost at one stroke-a feat that to this day , is acknowledged as a rarity in In ernational Chemical Manufacturing Business. Today operations backed-up by an integrated offsite facilities , energy conservation (average reduction by over 3% per year) , strong base of integrated health , safety , environment and ecology desci-pline , active research and development work , intensified training programme , synchronising in-put of raw materials , chemicals , spares and regular predictive and preventive maintanace planning , have achieved over Ninety percent of installed capacity , and almost consistently handling over one million tonnes of various liquid and gaseous products.

It is with this recognition of actual working of Indian Petrochemicals Corporation LTD , in devevoping countries of the world that IPCL accepted to participate to provide technical assistance to Arak Petrochemicals Complex , Arak.

The contract between the United Nations Industrial Development Organization and the Indian Petrochemicals Corporation LTD , for provision of management consultancy services to the Arak Petrochemical Complex in the Islamic Republic of Iran , was signed in May 1990 .

We trust and wish , this final terminal report on management consultancy services, for Arak Petrochemical Complex.

Arak will be a useful reference source for providing adequate and effective guidance in development and implementation of systems for monitoring and control during pre commissioning , commissioning and start-up as well as post operational need of the Complex .

D.C.Bhatt

M.V.Naik

UNDP Consultants

CHAPTER 2

THE PROJECT

CHAPTER 2 : THE PROJECT

A. GENERAL:

The primary purpose of " Management Consultancy Services " for Arak Petrochemical Complex in Arak , Islamic Republic of Iran , is to help improve its trained manpower, management system and infrastructure-all these of course with-in the terms of the organization plan and its development priorities . It is particularity important that any assistance or individual project must be undertaken within a specific time span , even though it may be necessary on occasion to extend the length of the project because of unaniticipated delays or emergence of new requirements . In effect therefore , it is not to conduct the project actual working , but to help establish the conditions by which Arak Petrochemical Complex activities can do the necessary work by itself and as early as possible .

B. THE AIM OF THE PROJECT:

The aim of the project is to develop and implement a "management control system " to be used primarily during the design , supply , construction and commissioning of the Complex.This system should take into account the fact as stated , in General Back-Ground Information , that a number of different local and foreign companies will be involved in setting up and commissioning of the complex.

This management control system will include :

- Project progress monitering system ;
- Administrative and financal control procedures and manuals;
- Cost control system;
- Procedures for needs estimation , procurement , contracting , installation and commissianing of equipment.

C. PLAN OF TREATMENT:

Under the scope of contract having provision of 20 man - months , consultancy services provided was as under:

- Phase-1 Period was executed by Mr.K.M.Jarivala and Mr.J.D.Jansari (34 man weeks)

- Phase-2 Period was executed by Mr.J.C.Amin and Mr.J.P.Singh (28 man weeks)

  Phase-2 Balance period executed by Mr.M.V.Naik and Mr.D.C.Bhatt (24 man weeks)

Above all consultants were attached to planning, control and coordination department of Arak Petrochemical Complex.Phase-1 and part of phase 2 project work was started from June 1990 to September 1990 and from November 1990 to March 1991 respectively.During consultancy period consultants'team had examined project documents , held discussions and submitted reports on project progress monitering and control system .

IPCL consultant team , arrived in Tehran on 20th September 1991 to complete the balance part of phase 2 and final phase of consultancy services contract and worked from September 1991 to December 1991 (24 man-weeks)in Iran.

Meeting was held on 22/23 September 1991 with Mr.Adnan Soghaier , Officer-in-Charge , Mr.Kabir Asst . Resident Representative and Mr.Akdag Programme Cfficer UNDP Tehran for review of consultancy services provided by IPCL.While briefing Mr.Kabir expressed satisfaction over consultancy services provided by IPCL.

Further he added that a small project have created big impact and offshoot of which was high power government delegation visited IPCL and signed training contract with IPCL to train 300 Engineers in Operation and Maintenance of Petrochemicals Plant.IPCL consultancy services created lasting relationaship with ARPC management (as it was provided beyond the scope of contract).

Normally technical assistance is provided by nationals of developed countries.Now with the advancement of certain 'developing' countries , it is possible to have Technical Cooperation among Developing Countries (TCDC), a form of assistance much encouraged by UNDP.IPCL consultancy services to ARPC , Iran has set an example of successful TCDC in the form of technical assistance.

A meeting was held on 24.9.91 by Mr.Zahmatkesh , ED (planning , Coordination and control) ARPC Tehran for consultancy services under final phase of contract by IPCL to ARPC. In view of near completion of phase-1 plants, consultants were informed to provide technical assistance for pre-commissioning, commissioning and start-up operation of plants. After discussions with UNDP Tehran , consultant team under - took the mission.

Mr. Nazarian, Technical Deputy at site coordinated the information and support. Consultancy services were requested in the following areas:

- precommissionig , commissioning and start-up operations
- Functions of Maintenance Engineering Services
- Functions of operational Central Control Room.
- Functions of Technical services
- Occupational Health Manitoring
- Occupational safety services
- Environment and Ecology
- Risk Assessment and Disaster Management

- Other areas like training need . manpower planning for operation and maintenance. central laboratory arrangement, plan of technical building, effluent treatment.

Method and approach through out the consultancy services adopted was on need base. Active participation and timely suggestions /recommendations were ensured through out the stay of the team, to ARPC management. During this period recommendations given were appreciated , accepted and to some extent being implemented by ARPC, Arak, Iran.

CHAPTER 3

GENERAL BACKGROUND INFORMATION

CHAPTER 3 :   GENERAL BACK GROUND INFORMATION

For a developing country like Iran, the prime objective is to satisfy the basic needs of food, clothing and shelter for people and as a country emerge into the 21st century creating conditions for self-sustaining growth of economy, satisfying the basic needs of a large population as well as enhancing overall standards of people. This would exert tremendous pressure on various resources and their depleting stock would force to search for alternatives. In this context, and to meet the growing demand, Petrochemical products would not only prove to be desirable, but also essential options to our pursuit of achieving better quality of life of people. Moreover products derived from Petrochemical resources-namely synthetic fibres, plastics, synthetic rubber and various industrial chemicals,have formed a part of resource basket supplementing as well as complementing various natural products like cotton , wool , paper, wood, metal, etc, Hence petrochemical industries in Islamic Republic of Iran would have a significant role to play to achieve the objective of meeting the basic needs of millions of people .

Also Iran basically is an oil producing country and has major share in crude oil production in the world. By setting up a Petrochemical industry an attempt is made to achieve an in-Land production of higher value products rather than importing and satisfying the needs of the local people. This is a worthy step towards self-reliance for consumer goods at homeland.

It is with this recognition that the idea of establishing a Petrochemical Complex adjacent to NIOC'S seventh refinery in Arak might have been originated in 1982. The Arak Petrochemicals Complex is located in an area of above 500 hectors at 25 kms south-west of Arak town.

This is one of the most important projects initiated by National Petrochemical Company (NPC) since the Islamic revolution in Iran. The investment proposal amounts to about us $ 975 million and 34500 million riayls. To finance the project, the National Petrochemical Company has entered into a joint-venture with one of the most important national banks in Iran, namely, Bank Melli, Iran. As a joint - venture, the Arak Petrochemical Company (APC) was formed. The core unit of the Complex will be an Olefins plant using naphtha as feed stock from the refinery. The Complex will consist of process units as per Appendix-1. The utilities including power required for Complex will be generated within this integrated Complex, The utilities and offsites details are at Appendix 2. The investment proposal along with the Complex also includes housing for the employees. By 1988, number of major contracts were concluded with local companies for site preparation. Also foreign engineering firms have been awarded contract for process licenses, basic and detail engineering and supply of equipment and materials for some of the process units. Similar contracts for the remaining process plants, utilities and offsites were concluded by-1990. It is envisaged that all the plants of the Complex will become operational towards end 1992.

Temporary facilities for transportation of naphtha is being developed, in view of the delay in commissioning of seventh retinery. Also infrastructure facilities of railways and roads are being developed by government authorities for transportation of materials to and fro for complex.

M/s.Snamprogetti S.P.A. Italy have been entrusted contract for the management, coordination and supervision/consultancy of all the activities of the complex including scheduling (time of completion) and budgeting (total cost for completion) and construction. Also for precommissioning, commissioning, and start-up operations,M/S Snamprogetti have been retained as Managing Contractor for the complex.

Encls : charts

1. Overall Plot Plan
2. Process Units in the Complex
3. Project Organization - relations with contractors
4. International contractors involved in Project implementation.

APPENDIX 1

PROCESSING UNITS

UNIT NO	UNIT	INSTALLED CAPACITY MTA	LICENSOR/ENGG. CONTRACTOR	DATE
10	OLEFINS	Ethylene 247000	Technologie Progetti Loveri s.p.A(TPL)Italy KTI.Holland	8.8.85
11	Pyr.Gas. Hydrog	102000	"	15.11.89
40	Linear low Density Polyethylene	60000	"	17. 3.87
40	Butene-1	7000	"	1 .1 .89
41	High Density Polypropylene	60000	UHDE,Germany	1 .3 .87
42	Polypropylene	50000	Techni-Mont Italy	30.12.87
43	Butadiene/ Poly.BD Rubber	26000 25000	Mitsui Engg Ship Bldg CO.Japan	24.2 .88
30	Acetic Acid	30000	UDHE,Germany	4 .6 .87
31	Vinyl Acetate	30000	"	4 ..6 .87
32	Ethy.Glycol/ Oxide	100000	Tedhnimont,Italy	15.10.90
33	Ethanol Amines	30000	Speichim/Davy Mckee	Jan.1991
34	Oxogas,2-ethy Hexanol	45000	"	Jan.1991

APPENDIX 2

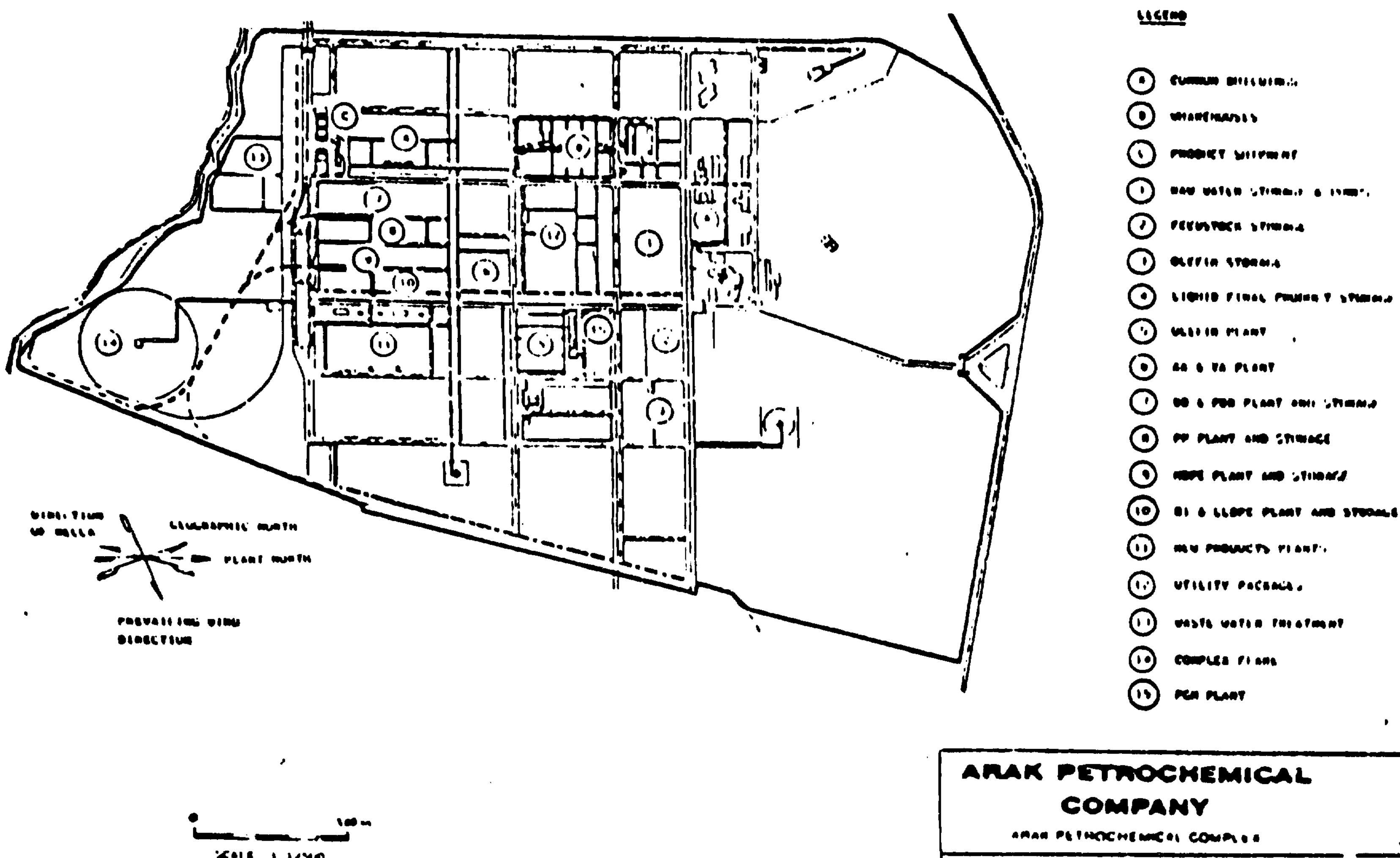
UTILITIES

UNIT NO	UNIT	INSTALLED CAPACITY MTA	LICENSOR/ENGG. CONTRACTOR	DATE
61	Demineralised water unit	3*150m3/hr	Degremont-France	1. 3. 89
62	Cooling water sys	35000m3/hr	Hamon-Sobellco Belgium	15.3. 89
64	Plant & Inst Air sys	5*26000nm3/hr	Ingersollrand Holland	28.2. 90
68	Fired & Waste Heat Recovery Boilers	3*80t/hr 5*60t/hr	Kawasaki-Japan	18.3 .89
65	N2 and O2 Plants	2*3000nm3/hr 2*7000nm3/hr	Airliquid-france	
69	Power Generation	5*38000kw	Alsthom-France	12.3 .89

OFFSITE FACILITIES:

78. Chemstorage sys
79. Cond - reco sys
80. Offsite Inst.sys
81. Raw & pot. wat.sys
82. Fuel gas sys
83. Fuel oil sys
84. Precess buildings
86. Liq.storage sys
87. Fire fighting
88. H2 Storage sys
89. Flare & B/D sys
90. Eff.Treat.Plant
91. Elec.Dest.sys
93. Comm.sys
94. I/C piping ut.2 Process
95. Complex sewer sys
97. Central W/shop
98. Central Laboratory
99. Fire fighting houses 1/2

All offsite facilities are under contract awarded to Snamprogetti S.P.A Italy .



* COURTESY-ARAK PETROCHEMICAL CO.

ARAK PETROCHEMICAL COMPANY

ARAK PETROCHEMICAL COMPLEX

FIGURE 3.5

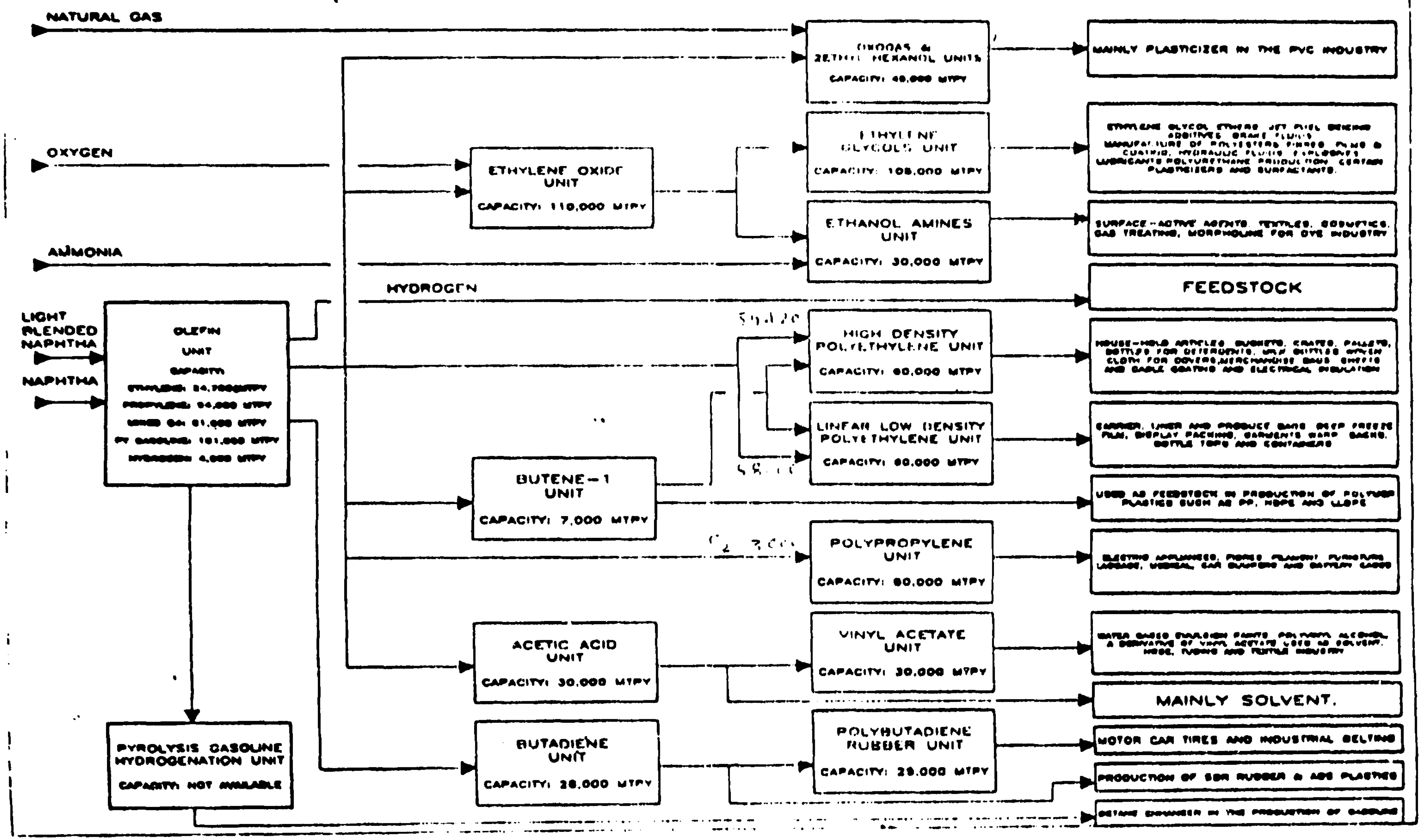
OVERALL PLOT PLAN

...N MPROGETTI S.p.A. ARAK PETROCHEMICAL COMPANY

ARAK PETROCHEMICAL COMPLEX – ARAK IRAN

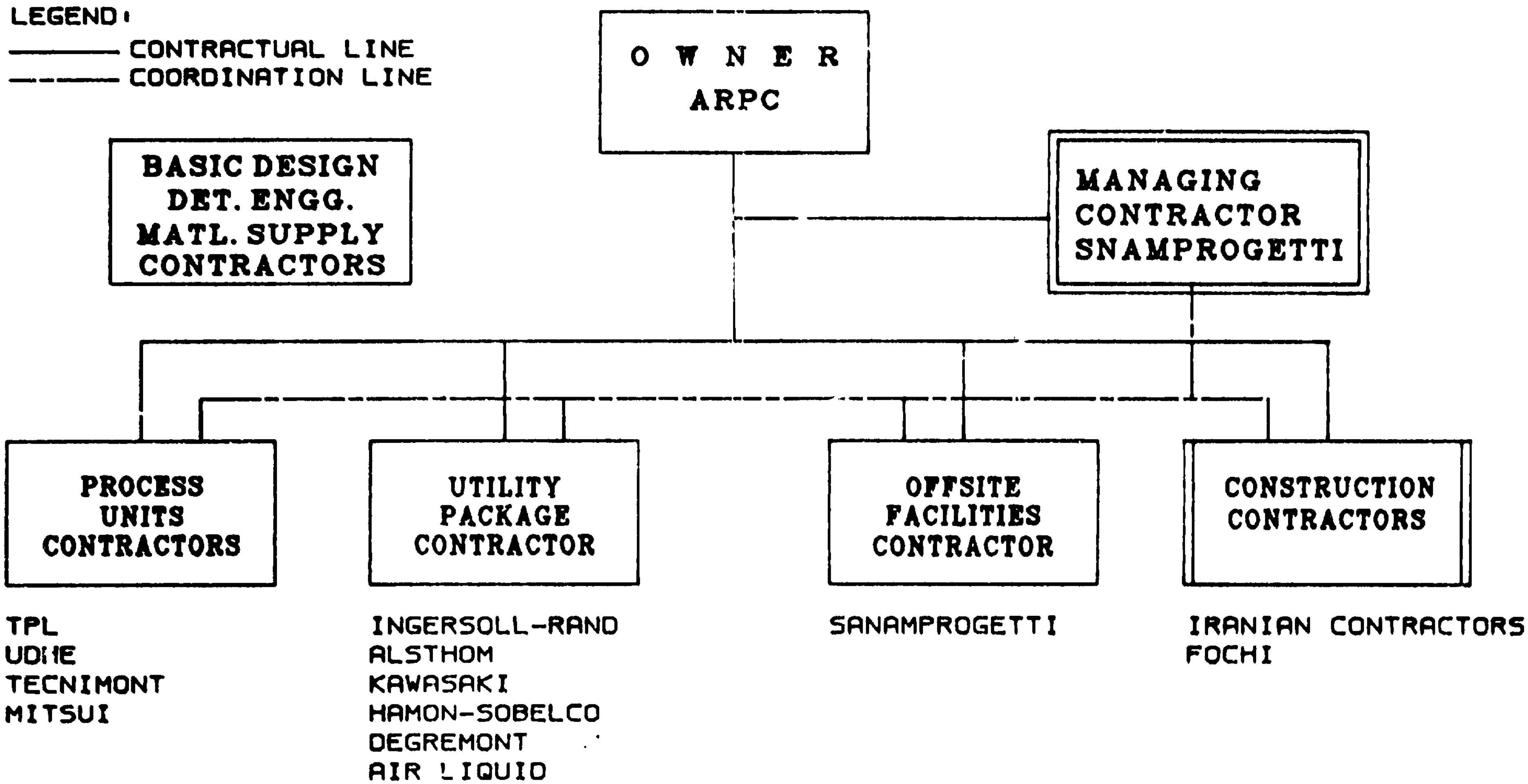
SIMPLIFIED BLOCK FLOW DIAGRAM FOR PROCESS UNITS

FIGURE 2.2



ARAK PETROCHEMICAL COMPLEX – ARAK IRAN

PROJECT ORGANIZATION RELATIONS WITH THE CONTRACTORS



* COURTESY – ARAK PETROCHEMICAL CO.

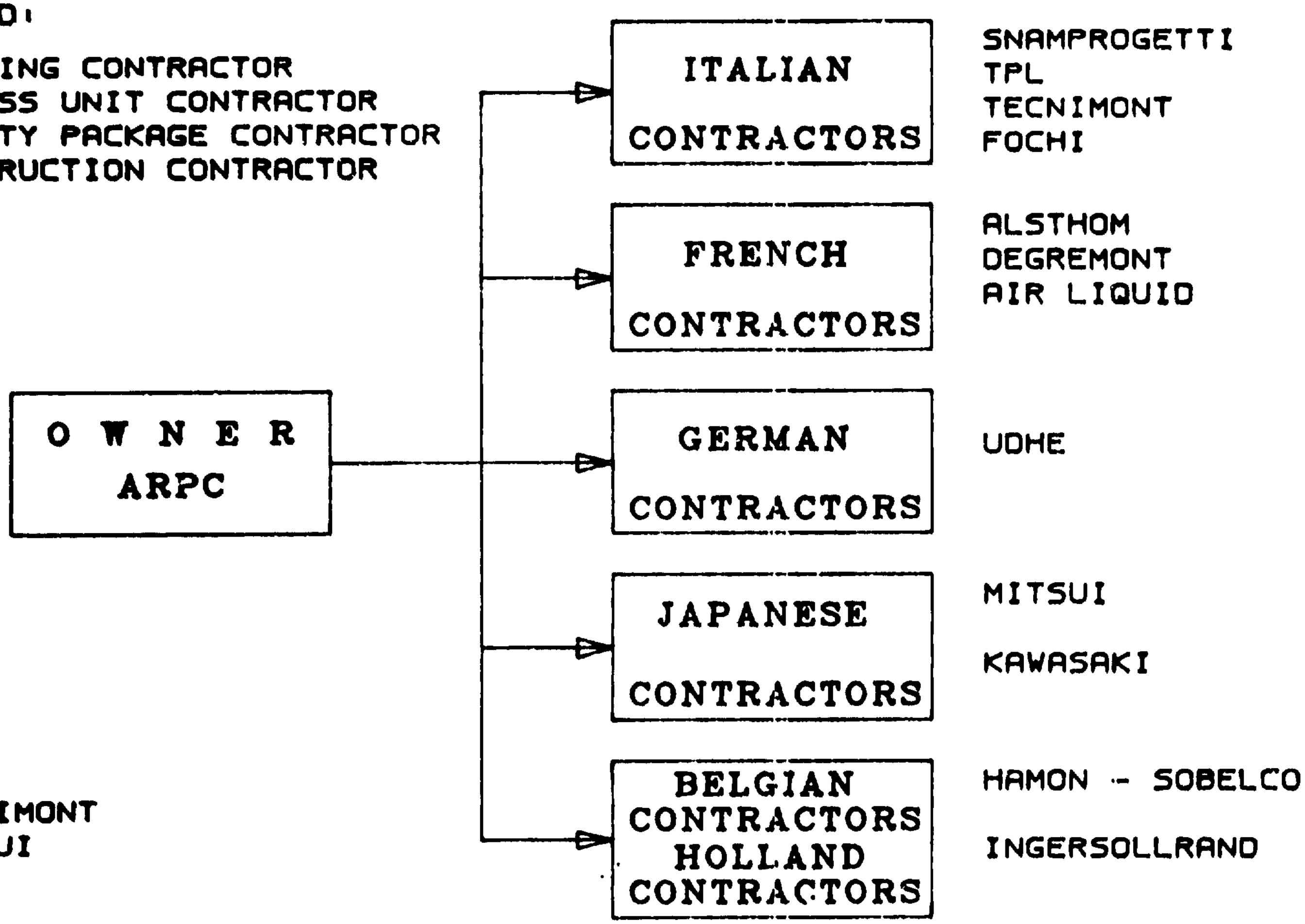
ENCLOSER-3 SH-3

ARAK PETROCHEMICAL COMPLEX – ARAK IRAN

INTERNATIONAL CONTRACTORS INVOLVED IN THE COMPLEX IMPLEMENTATION

LEGEND:

MANAGING CONTRACTOR
PROCESS UNIT CONTRACTOR
UTILITY PACKAGE CONTRACTOR
CONSTRUCTION CONTRACTOR



TPL
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TECNIMONT
MITSUI

■ COURTESY – ARAK PETROCHEMICAL CO.

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CHAPTER 4

PRECOMMISSIONING,
COMMISSIONING
&
START UP

CHAPTER 4 : PRE.COMMISSIONING, COMMISSIONING, START-UP

A.INTRODUCTION :

Arak Petrochemical Co is setting up a cracker complex for producing petrochemicals at a place about 25 km away from Arak town.It has a liquid base naphta cracker, a mother plant, connected down- stream units and an integrated utilities and offsites.

In project implementation, during final stages of construction like mechanical completion, precommissioning, commissioning and start-up operation, have an important role to ensure subsequent trouble-free operation of plants. For meeting this objectives ARPC management have signed contract with M/S Snamprogetti S,P,A, Italy, to provide"Project Control Services ," for the management, commissioning and start-up of the complex.

The statement below indicates the present progress status of the units.

Percent cumulative progress

Units		As on 31.8.91		As on 31.10.91	
Process units	PH.I.A	SCH	ACTUAL	SCH.	ACTUAL
10. Olefins	OL	82	77	92	81
11. PGH.	PGH.	63	61	87	65
30. ACE.ACID	AA	75	69	77	73
31. Vin.Acetate	VA	66	58	65	58

40. LLDPE-B.1	78	66	90	70
41. HDPE	68	62	84	67
42. PP	78	71	90	76
PROCESS UNITS PH.I.B.				
43. Butadiene BD	49	44	53	46
44. P.BD.RUBBER PBR	50	45	54	48
Overal process units PH.I	72	66	82	69
PROCESS UNITS PH.II				
32. ETH.O./ETHG EO/EG	23	NIL	36	NIL
33. Ethy.Amin EA	29	NIL	39	NIL
34. OXO.G.2.EH O.GAS/2.EH	25	NIL	38	NIL
Overall process units PH.II	25	NIL	37	NIL
UTILITIES				
61. DM Water unit	67	46	88	51
62. Cooling water unit	53	37	73	41
64. Plant & Inst AIR	46	27	67	29
65. Nitrogen & Oxygen	50	49	67	60
68. Steam Gen.	51	44	61	46
69. Ele.Power Gen	70	61	83	67
Overall Utility	60.5	50	75	55
Offsite Facilities	64	58	75	66
Offsite General & Common Facilities	82	63	82	66
Overall Phase I incl. Utilities /offsites	71	61	80	65
Overall Phase II	25	NIL	37	NIL
Overall Complex	64	52	74	56

ANALYSIS:

Thus the units under phase I.A are ahead in progress and phase I.B who are the consumers of Olefins are following behind. Even plants under phase II are having NIL progress . These plants are also being the Ethylene consumers . The turn-down capacity of the mother plant Naphtha cracker is 60% and it may be possible to operate at that capacity when commissioned with downstream units in phase I.A.

ARPC have now received document on "precomm. Commissioning and Initial Operation Plan" Rev.0-March 1991 from Snamprogetti. It covers operations schedules for offsites , utilities and process units of phase I. Based on Snamprogetti's experience on similar jobs and schedules prepared by unit contractors (UC). Utility package contractors (UPC), Comm.Sch. has been prepared with the aid of PC software package "open plan" in Barchart form. This document and the charts issued on CPM basis have been reviewed, discussed and comments were given separately.

Following the construction progerss of the process units and utilities, the commissionig schedules as issued on 1.9.91 and 1.10.91 project negative(-VE) floats of -41 and -64 days respectively. The one as on 1.11.91 projects delay of -87 days for Olefins and Polyolefins. Same pattern of negaive trend is seen in case of utilities and offsites. This is natural, since mechanical completion of the units is also getting delayed and having negative trend on progress. Utilities and offsites are still behind phase IA plants and hence precommissioning activities will have to wait for the utilities.

Weekly review meetings have been started by ARPC, with Unit Contractor , Managing Contractor and technical department of ARPC (Not the construction group of ARPC) to review precomm/comm. status of phase I.A process units along- with utilities and offsites requirements of the complex. One of such meetings had been attended by the consultants and suggestions were given :

- Attempts are on to separate and segregate the parts of utilities and offsites which are required first to commence the precommissioning activities in the phase.1 process plants.

- The sequencing and prioritising the precommissioning of the units in utilities and offsites and the process units will be essential to achieve smooth continuation of the activities for comissioning the plants under phase I (A,B) (Ref: Attachment-1)

- The activities should be sequential and follow priorities between groups of plants , between plants and within the plant. Like utilities group should be ready before ole-fins; similarly in utilities- power, water, air and then steam gen , and in plant like olefins utilities hot section , compression and then cold section.

- Accordingly the revised CPM (critical path method) to be followed by the construction group to get ready those units in priority in line with the commissioning/operation requirements.

- Looking to the present progress, the utilities may be in a position to supply requirements of process units from Mar- 92 onwards . However this is optimistic since progress in utilities is quite unsatisfactory. Also the precomm / comm. activities in utilities are yet to be planned/organised.

- Overall the situation is, the precommissioning which is a part of mechanical completion, though scheduled cannot be taken on hand now, but it can be planned and organised to cut the period and complete precommissioning and commissioning in an effective manner.

B. PRECOMMISSIONING

1. PRECOMMISSIONING /COMMISSIONING SCHEDULES:

As per the contract, Managing Contractor have produced precomm/comm and start-up schedules of the individual units and that for the complex overall on CPM .(ref Attach . 2 and 3). The basis of the schedules are the original schedules produced by the UCS(Unit Contractor).These schedules have been carefully examined and suggestions are given to ARPC to take up with MC for the review on the following aspects (Ref communications no. 2,3,4,5 on Attach-4).

- The role and responsibilities of the CCS,UCS/vendors. MC and ARPC

- The duration of activities of precommissioning and commissioning.

- The no.of deployment of personnel of UCS/vendors and MC.

- The duration of the expatriates in each case.

NOTE: In certain cases, schedules drawn by MC are longer than originally shown by UCS . This will need review for reduction wherever possible. Also the no of expatriates and their stay during commissioning need to be discussed with MC and decide considering the recommendations made vide above comunications separately.

2.PRECOMMISSINING/COMMISSIONING CHECKS:

Unit Contractors (the licensors) and the Vendors of package units have for each unit prepared a document named "operating manual" which contains:(example - PP Manual)

SEC.	DESCRIPTION	VOL.
1	Basis of design	1
2	Process technical description	1
3	Descripton of plant control	1
4	Chemicals & utilities required	1
* 5	Preparation for initial start up	2
* 6	Start-up and normal operation	2
* 7	Normal and emergency operation	2
8	Safety equipment	2
9	Instrument data	3,4
10	Equipment summary	5
11	Drawings, P & IDS...	5,6,7
12	Quality control hand books	

Also as per the contract,the UCS have supplied other important Documents like :

+ Mechanical catalogue.
+ Two years and capital spare parts list.
+ Plant maint. schedules
+ "As - built" drawings

The sections viz: 5,6,7(*) in this case on preparation (Precommissioning), start-up, normal and emergency shut-down are quite elaborative and exhaustive. Similar guide- lines and instruciton/check points are available for other units and package units from the UCS/vendors. Strict compliance of the same will bring plants/units to a "Ready for Start-Up" stage and smooth " Start-Up "

3. IMPORTANT ASPECTS:

1. STORAGE & PRESERVANTION

Storage and preservation at site including the period of 'erected stage' is as important as running the plant. Special care taken during this period could help in quicker and easier precommissioning efforts. Its claimed that as good as half the life-cycle of the equipments could be protected by proper preservation during transit and storage.

2. TESTING/INSPECTION :

Testing procedures to be formulated and followed uniformly. No relaxation in testing and inspection by local/field/site inspectors to be permitted. In case of this complex, the owner , ARPC should ensure-,no relaxation' through UC/MC who are going to technically audit the units at the end of mechanical completion.

3. CHECKING FOR COMPLETENESS.

Well before taking up any precommissioning/comm/ Activities in any area, detailed check/punch lists are to be prepared.Ensure availability of materials, monitor and ensure completion of all jobs/check lists, by checking and rechecking. This will facilitate in avoiding any time loss at last moment of checking for commissioning.

4. PLANNING OF SPARES

Thorough checking of the commissioning spare parts lists and their availability at site has to be ensured. In this case UCS are responsible for precomm and comm. spares. However ARPC with the help of MC should ensure the availability.

From the documents of `two years and capital spares list' it is observed that many consumables (like gaskets,packing,bolt,nuts) are also ordered. It is necessary that all are listed and taken in custody and in emergent situation during commissioning, the same can be utilitised at the descrition of ARPC and subsequently ARPC should take immediate action for replenishment. Also it is equally important to check for the requirement of special tools and gaskets and their availability.

5. DEPLOYMENT OF PRECOMM/COMM.TEAM.

For precomm. and comm. period, operational personnel requirement is normally one and half times the normal operating strength. For meeting this situation in most effective manner with minimum number, follwing measures could be considered:

(A) Operating staff meant for other plants can be placed for assistance in plants which are to be commissioned first like Polyolefins to support Olefins , BD/PBR to support Poly-olefins/AA/VA - similarly in the utilities area priority wise and then bulk of the personnel moved to the next unit/group in sequence.

(B) Retaining small no. of engineers, operators/technicians on deputaiton or hire from other similar operating companies from home/abroad. This experienced personnel can be utilised till the performance tests are over and plants accepted. During this period, ARPC personnel can benefit by way of on-the-job, in-house training and gain confidence.

(C) Also some specialists can be utilised from the construction area and available at site, or from those industries in Iran and integrate ARPC personnel with these specialists to overcome the lack of experience.

Thus with the help of proper resource planning,commissioning could be successfully completed in effective, economic manner.

6. CORE MAINTENANCE GROUP

To attend to the repairs and small jobs required during the testing and precommissioning a separate core maintenance group other than the construction group should be fc med .

This can help in (a) residual construction activities for enabling the testing and precommissioning in a planned manner without affecting the schedule (b) maintenance staff gets opportunity to have the experience/feel of the plant and equipments.

ARPC by that time will have enough engineers and technicians and such teams can be formed unitwise. Some of the technical personnel recruited for central maint. engg. services can be also deployed in the plants till operations are stablised.

Also few of the good technicians working in construction can be taken and included in this group for faster and effective service.

7. AREA MANAGEMENT

Area Management concept with ful responsibility and authority to the area manager for coordinating the activities during the period is a must. ARPC can entrust this task to the group or plant head in respective units under whom all the desciplines (including the core maint group) will be working. This head with the help of UC to also command and instruct the MC and CCS to fulfill their obligations in completion (plant ready for star-up).Also he is responsible to satisfy the requirements/obligations from the client/owner (himself) during this period to achieve successful commissioning. (Ref. Attach-5).

8. TRAINING OPERATIONG PERSONNEL

The engineers and operators/technicians already and being recruited are on the class-room training as well as being trained in other plants of refineries and petrochemicals inside and outside the country.

These are to be tuned for in-house plant operations . A simulator training for the process engineers and operators would be more helpful since it will expose them to the unit plant operations and provide a real feel of operationg situation. ARPC with their own facility should ensure this education prior to commissionig to achieve safe and smooth operations.

During such training time, mock drills can be organised off-and-on by which will be known the reflex action of the operators. This will help in identifying and suitably positioning the personnel.

For the safety, right at this stage, a continuous education and training to be imparted to the personnel through short classes and display of safety sign-boards/posters.
Operating personnel should be also educated about the occupational health hazards and use of personal protective appliances.

9. PREPAREDNESS:

Precommissioning activities include taking out equipments from preserved condition and preparing for commissioning runs.

The activities are like:

Cleaning vessels , pumps(flushing of mechseals) rousing valves , flushing pipelines , ensuring blind-ends , checking elec.supply to drives , protection devices , performance and calibrations of inst.loops , cont.valves , checking comm.systems , etc.

Dry and wet test run of the equipments like compressors/pumps to establish sound mech.running .

The activities would invite associations of experts/ engineers from process licensors.In case of ARPC complex,UCS will be available.

At this stage , technical audit by the licensors (UCS) / vendors should be must.This should be better-timed , say at mech.completion of plant at about 95% , so that modifications , rectifications could be managed in time.

Also it is desirable to organise safety audit of the plant by ARPC or through consultant from the operating companies , at this time.This will bring benefit of examining locations and approaches with respect to operational and maintenance approaches/conveniences/safety and take up suitable modifications , corrections at this time itself. The audit observations will be issued in the form of check / punch-lists to be attended and verified before commissioning. Positively the operating personnel must themselves ensure

- Start.up sequences of equipment/plant

- Procedures for normal or emergency suutdown of equipments/plant.

- Completion of all checks as per operating manuals in each case equipment , piping , machines , instrumentation , controls , elec.systems , sewarage , blowdown systems etc.

- Knowledge of all in-built safety provisions/protections on equipment/plant.

- Knowledge and use of safety equipments/gadgets

- operation of fire alarm systems and procedures.

- Procedures for and use of work-permits , hot work permits fire & safety permits , vessel entry permit , electrical lockout , etc .

- Knowledge about raw material , chemicals and catalysts and their handling procedures .

- Prepare and use of :

  (a)logsheets for important hourly/daily records .

    - even in case of DCS controls which will be more useful during this period .

  (b) Operating instructions for the control room and field operators (extracted from the optg mannals) .

Appoint a safety engineer in each plant who can keep refreshing the operating personnel about safety aspects of the equipment/plant and safety procedures.He will be functionally reporting to central fire and safety department.

Ensure availability of following services.

1. Maintenance engineering
2. Technical , fire , safety
3. Medical
4. Administrative like transport , canteen , communication - outside.
5. Central control room
6. Materials (for stores , emergency purchases)
7. Supporting finance .

10. PLANT ACCEPTANCE :

As suggested in one of the communications , when plant is mechanically completed , including the completion of precommissioning activities , MC may endorse the declaration by PCC/UC about the " readiness of the plant for start:up",then owner , ARPC shall issue 'provisional acceptance certificate' .

C:COMMISSIONING :

This stage is achieved when plant is " ready for start-up" and provisionally accepted by the Owner, while commissioning activities are taken up by the owner with the association of UCS. The role and responsibilities of MC, UCS Owner and CCS to be discussed and defined clearly. This will avoid confusion in case any hold-up or bottle-neck is experienced during commissioning and start-up.

Hence again it is emphasised for a joint-approach under the leadership of the plant/group head from ARPC with role and responsibility as explained earlier.

SOME ASPECTS :(commissioning)

- Tight control of input of raw materials and other re sources during commissioning stage can result in substantial savings .
- Foreign expatiates for supervision of precommissioning/ commissioning to be deployed mimimum required for cost saving .
- Organise daily review meeting in the evening. This meeting can be chaired by the operations-head (chief)and all functional section-heads including in-charge planning and monitoring cell would participate in the meeting where all co-ordination problems will be discussed and decisions taken.On the following day , expediting/actions by the concerned should be carried out .

- Safety aspect should be all time ensured to maintain high morale of the work-force (cleaner site/plant and the work-environment will make work.force more conducive to work)

TEST RUNS :

Plants/units will be accepted as successfully commissioned once the test-runs are conducted and concluded.Process licensors/UCS/Vendors will associate till then to complete their contractual liability.Client ARPC on their side while certifying and accepting the plant, should ensure stabilised operations and gain confidence through their operating personnel for better performance.

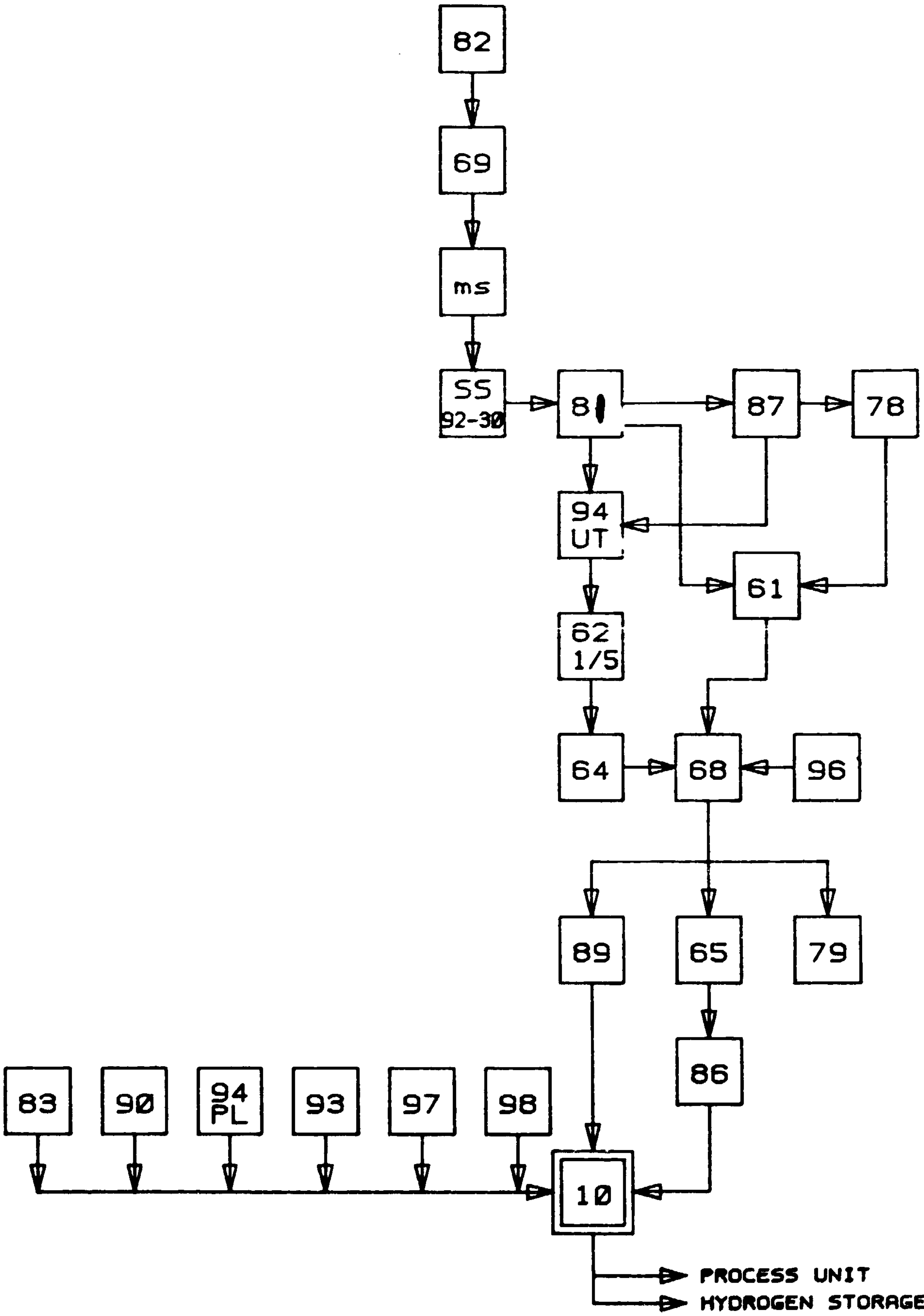
D:RECOMMENDATIONS :

1. The above mentioned document on precomm.comm.and initial operation plan , Rev.0 " of MARCH . 1991 should include technical audit. This will facilitate to take actions on critical areas and safety aspects , if any, before the plants are ready for start up.Technical audit should be taken by the experts from Unit Contractors and Utility Package Contractors .

2. ARPC should also organise , section by section , system by- system hazop studies of the units to identify potential hazards for remedial actions/operational procedures to ensure safety during precomm , and start.up of the complex.

3. Although guarantee test runs are over and plants accepted, client . ARPC may need post-commissioning assistance to overcome teething problems , debottlenecking and known constraints. It may be possible for ARPC to conclude present contracts and under separate arrangement retain consultants from operating companies for a definite issues and definite period . This will provide opportunity and help in gaining self-confidence , self-reliance and absorption of different technologies. Simultaneously developing ARPC'S technology , process-engineering , and services of maintenance safety , fire under the consultants' guidance.

SEQUENCING AND PRIORITISING



J PLAN (tm)

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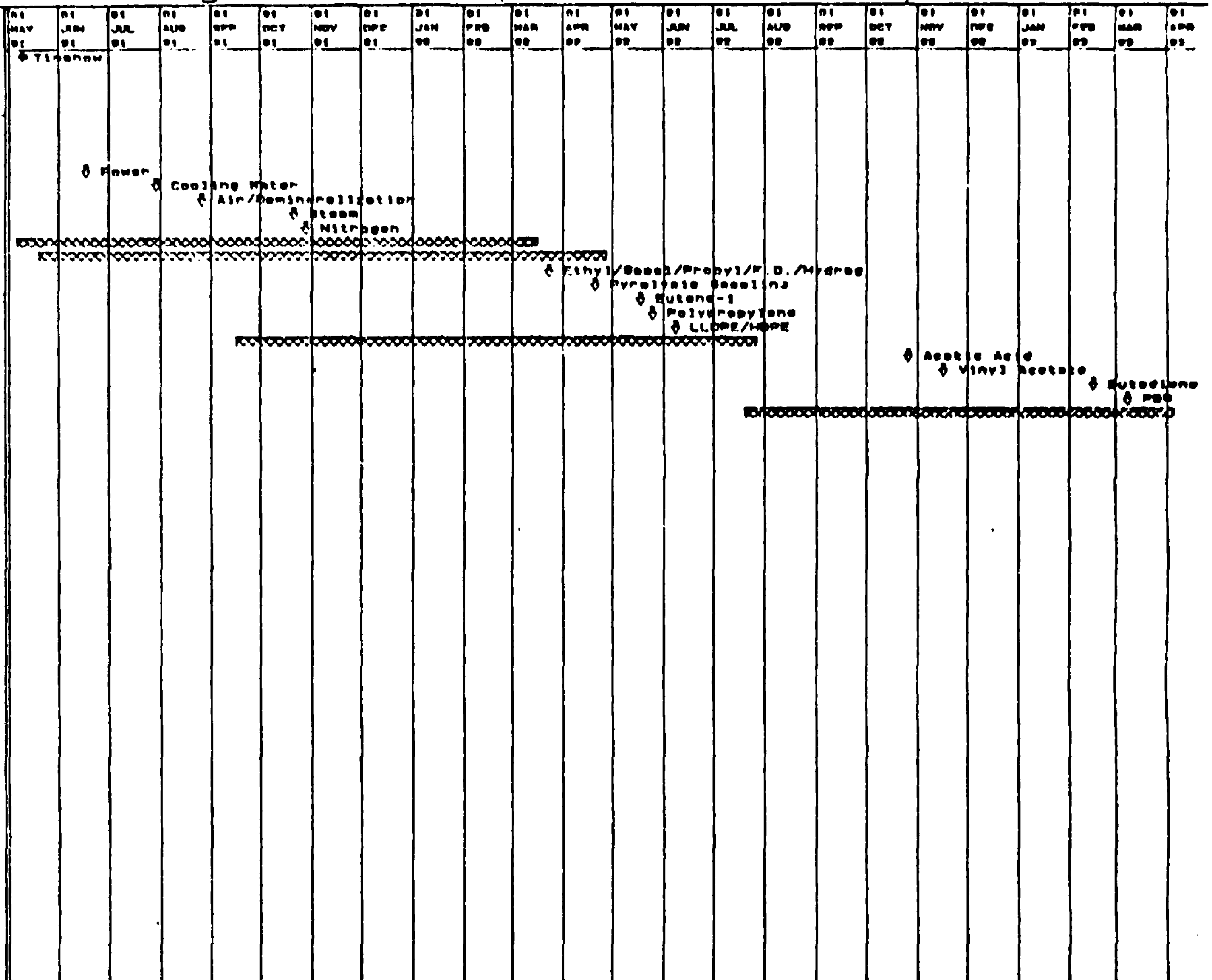
ARAK PE[illegible] OCHEMICAL COMPLEX ARAK - IRAN
Commissioning & Start-up Schedule

SNAM [illegible]OGETTI

Activity	Description	Start	Finish	Dur	Float
******	OVERALL PROJECT PHASE 1 ******				
*** UNIT : ***					
00001	UTILITY UNITS	06MAY91	15MAR92	315	0
00002	OFFSITE FACILITIES	20MAY91	26APR92	343	0
00003	PROCESS UNITS PHASE 1 / A	16SEP91	20JUL92	315	0
00004	PROCESS UNITS PHASE 1 / B	20JUL92	04APR93	250	0



Legend
▬=In progress
▭=Planned
▭=Float
▭=Critical

NOTES :

COURTESY - ARAK PETROCHEMICAL CO.

JOB NO: 178800
Rev :
Date :

ARAK PE ?OCHEMICAL COMPLE, ARAK - IRAN

Commissioning & Start-up Schedule

SNAM ?ROGETT

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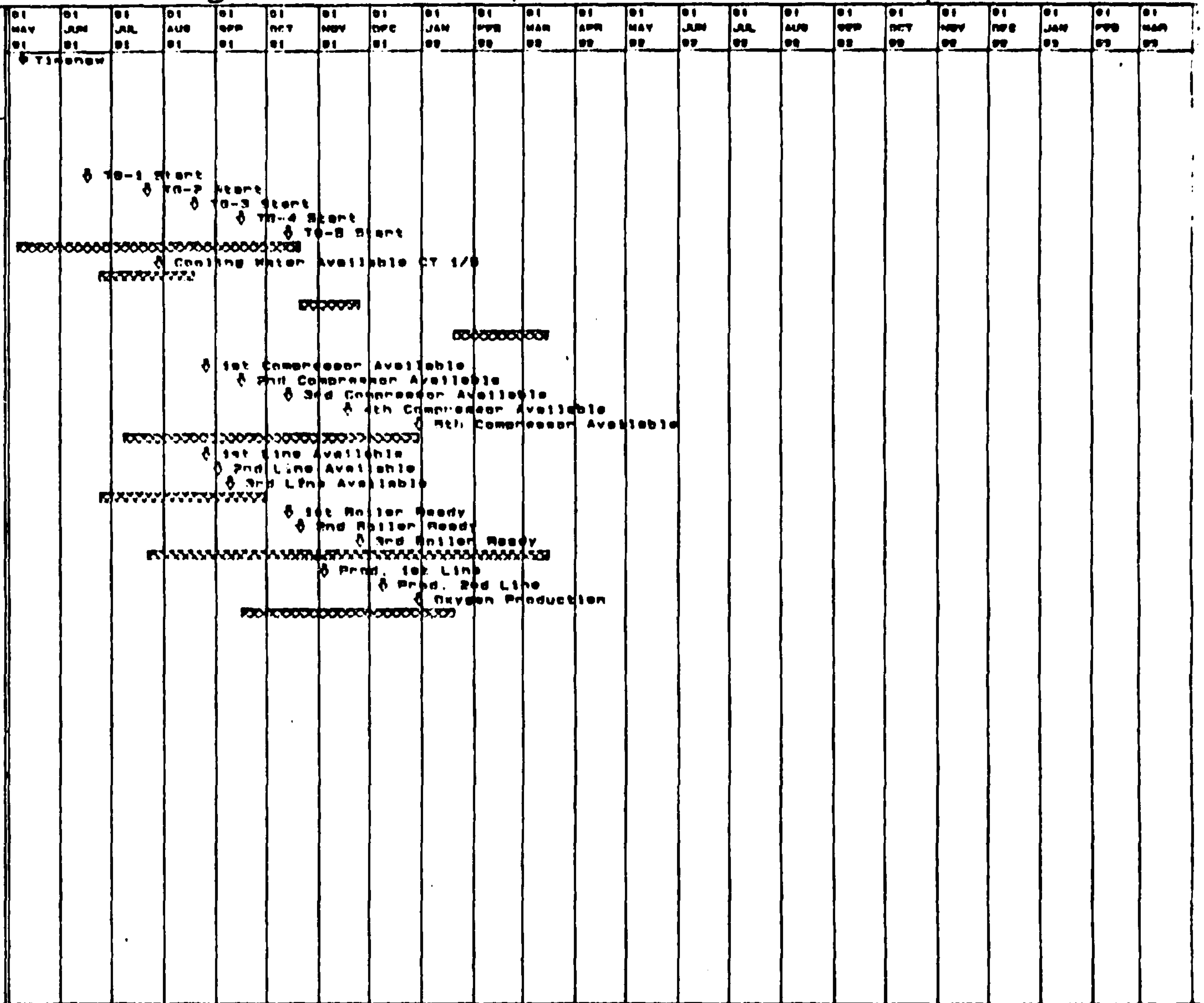
Page: 1

***** UTILITY UNITS *****

*** UNIT : ***

Activity	Description	Start	Finish	Dur	Float
[illegible]	00 - POWER GENERATION	[illegible]MAY91	[illegible]OCT91	180	0
[illegible]	02 - COOLING WATER SYSTEM 1°PART	24JUN91	10AUG91	50	0
[illegible]	02 - COOLING WATER SYSTEM 2°PART	21OCT91	24NOV91	35	0
[illegible]	02 - COOLING WATER SYSTEM 3°PART	20JAN92	[illegible]MAR92	50	0
[illegible]	04 - PLANT AND INSTRUMENT AIR	08JUL91	24DEC91	175	0
[illegible]	01 - DEMINERALIZATION UNIT	24JUN91	29SEP91	90	0
[illegible]	03 - STEAM GENERATION	29JUL91	15MAR92	230	0
[illegible]	05 - NITROGEN UNIT	10SEP91	19JAN92	170	0



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=Planned
=Float
=Critical

NOTES :

COURTESY - ARAK PETROCHEMICAL CO.

JOB NO: 178800
Rev. :
Date :

N PLAN (tm)

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Project: STARTUPH
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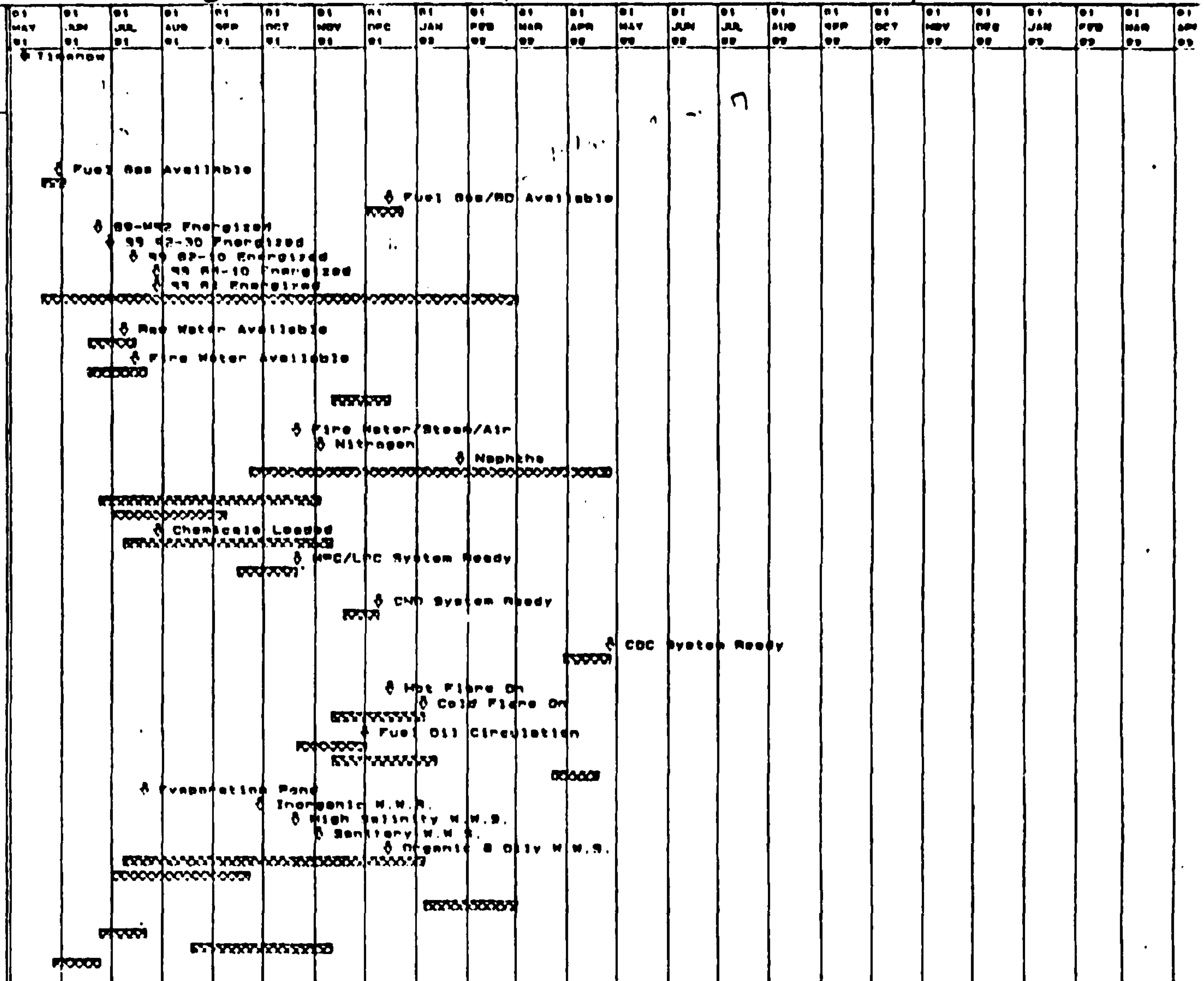
ARAK PE ?OCHEMICAL COMPLE; ARAK - IRAN

Commissioning & Start-up Schedule

SNAM PROGETTI

Activity	Description	Start	Finish	Dur	Float
	****** OFFSITE FACILITIES ******				
	*** UNIT : ***				
[illegible]	88 - FUEL GAS SYSTEM 1° PART	[illegible]	[illegible]	14	0
[illegible]	88 - FUEL GAS SYSTEM 2° PART	[illegible]	[illegible]	21	0
[illegible]	91 & 88 - POWER DISTRIBUT. SYSTEM	[illegible]	[illegible]	287	0
[illegible]	91 - RAW WATER	17JUN91	14JUL91	28	0
[illegible]	87 - FIRE FIGHTING SYSTEM 1° PART	17JUN91	21JUL91	35	0
[illegible]	87 - FIRE FIGHTING SYSTEM 2° PART	[illegible]	15DEC91	35	0
[illegible]	84 - PIP.INTERC. - OFFSITE/PROCESS	[illegible]	[illegible]	217	0
[illegible]	98 - PIPING INTERC.-UTILITIES	[illegible]	[illegible]	133	0
[illegible]	88 - SEWER SYSTEM	01JUL91	[illegible]	70	0
[illegible]	70 - CHEMICAL STORAGE SYSTEM	08JUL91	[illegible]	126	0
[illegible]	78 - CONDENSATE RECOV.SYSTEM 1°PART	[illegible]	[illegible]	35	0
[illegible]	78 - CONDENSATE RECOV.SYSTEM 2°PART	[illegible]	[illegible]	21	0
[illegible]	78 - CONDENSATE RECOV.SYSTEM 3°PART	[illegible]	[illegible]	28	0
[illegible]	80 - FLARE AND BLOWDOWN SYSTEM	[illegible]	[illegible]	56	0
[illegible]	83 - FUEL OIL SYSTEM	[illegible]	[illegible]	42	0
[illegible]	88 - LIQUID STORAGE TANK FARM	[illegible]	[illegible]	63	0
[illegible]	88 - HYDROGEN STORAGE UNIT	[illegible]	[illegible]	28	0
[illegible]	88 - EFFLUENT TREATMENT	[illegible]	[illegible]	182	0
[illegible]	88 - COMMUNICATION SYSTEM 1° PART	01JUL91	[illegible]	84	0
[illegible]	88 - COMMUNICATION SYSTEM 2° PART	[illegible]	[illegible]	56	0
[illegible]	87 - CENTRAL WORKSHOP	[illegible]	21JUL91	28	0
[illegible]	88 - CENTRAL LABORATORY	[illegible]	[illegible]	84	0
[illegible]	88 - WAREHOUSES	[illegible]	[illegible]	28	0



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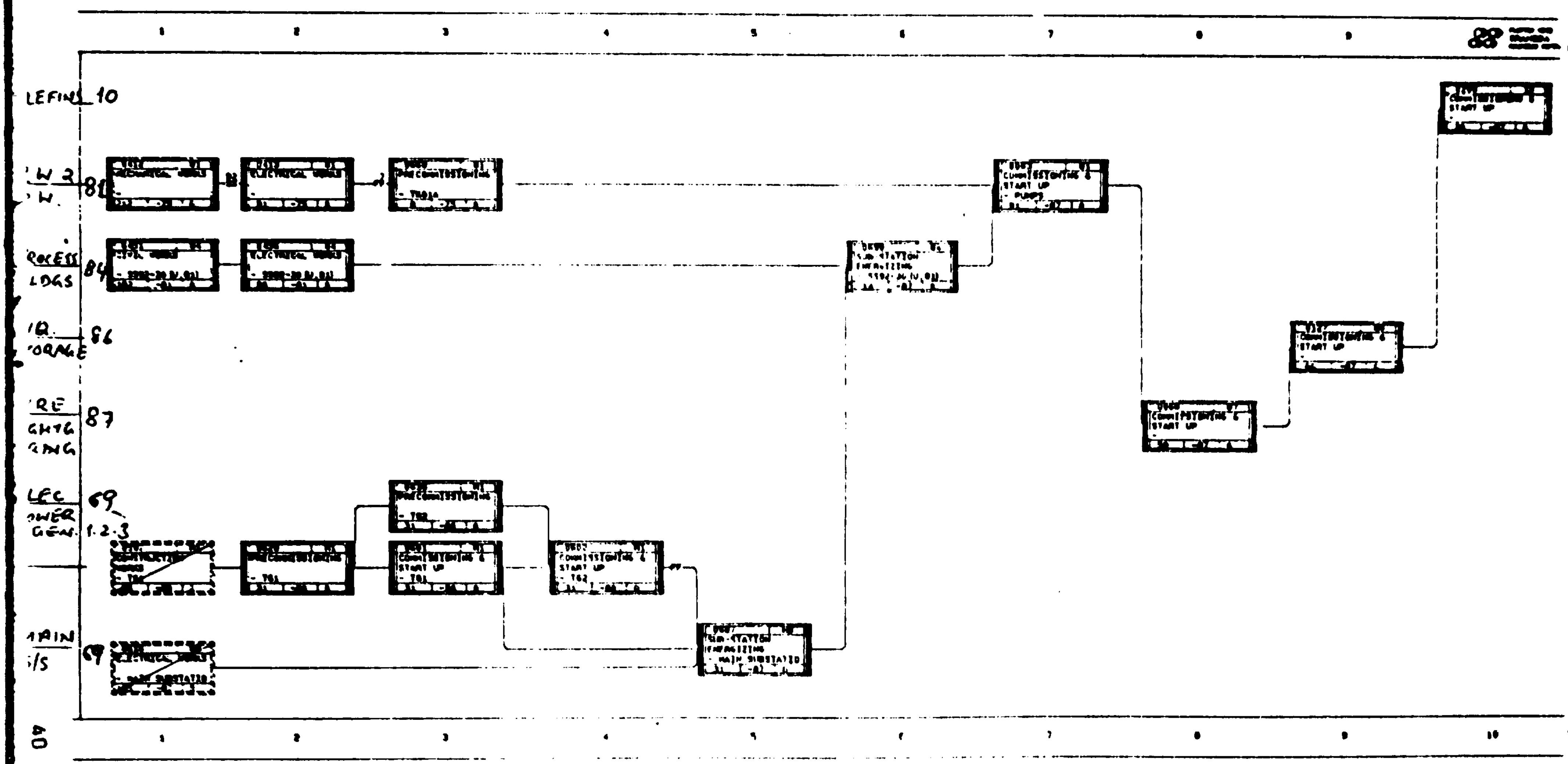
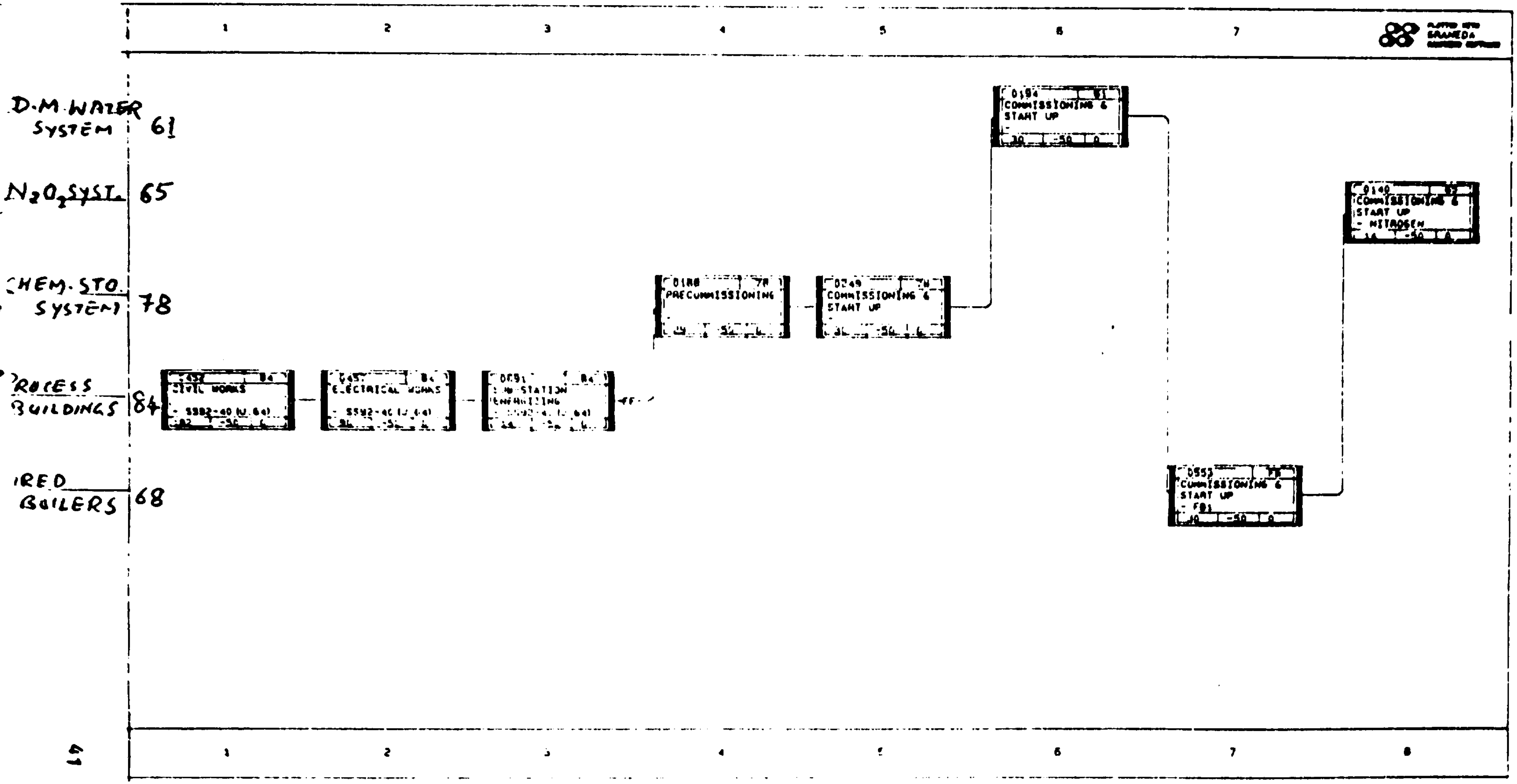
NOTES :

COURTESY - ARAK PETROCHEMICAL CO.

JOB NO: 179800
Rev. :
Date :



LEFINS 10
W 2 W. 81
ROCESS LDGS 84
IQ. STORAGE 86
RE GHTG GNG 87
LEC POWER GEN. 69 1.2.3
MAIN S/S 69
COMMISSIONING & START UP
PRECOMMISSIONING
ELECTRICAL WORKS
MECHANICAL WORKS
SUB-STATION ENERGIZING
MAIN SUBSTATION
COMMISSIONING & START UP - PUMPS
40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N_2O_2 SYST. 65
CHEM. STO. SYSTEM 78
PROCESS BUILDINGS 84
IRED BOILERS 68
CIVIL WORKS
ELECTRICAL WORKS
SUB-STATION ENERGISING
0188 PRECOMMISSIONING
0249 COMMISSIONING & START UP
0194 COMMISSIONING & START UP
0553 COMMISSIONING & START UP
0140 COMMISSIONING & START UP - NITROGEN
1 2 3 4 5 6 7 8

ATTCH-4

From: UNDP consultants
(IPCL)

COMMUNICATION -2
ARAK SITE OFFICE
Dt.15.10.91

SUB: COMMENTS ON ROLE AND RESPONSIBILITIES
REF: Preliminary Document "precomm.comm.and Inital operations plan "issued by MC. in March 1991

COMMENTS/SUGGESTIONS:

1 The scheduled period of commissioning suggested by MC. is longer in some cases (units) than that prepared by UCS- Example : PP.LLDPE
This needs review for getting advantage in shortening (saving some time) commissioning period. May be by revising schedules of MC.

2. When plant is mechanically complete,assuming precommis sioning activities are also to be over,then MC should endorse the declaration by PCC/UC about the readiness of plant for commissioning. Then only OWNER shall issue provisional acceptance certificate (thus MC who have supervised the construction are in better know how of plant readiness)It is also understood that MC at the same time certifies the completion of precommissionig activities at the time of mech completion.

3. While commissioning activities are taken up by OWNER with the association of UCS the role and responsibility of MC is to be defined clearly.

At this juncture of starting commissioning , roles of MC,UCS, OWNER and PCCS need to be defined separately and recorded. This will avoid confusion in case any hold-up or bottleneck is experienced during commissioning and start-up.It is suggested that a joint approach with a leader from ARPC (owner) for that group of plants/ unit could be a solution.

4. The numbers of expatriates to be deployed from MC,UC and Vendors during commissioning and start-up need to be reviewd critically.

5. The retention of PCC'S force during commissioning and start-up is not clear. However for any rework/rectification/modification in the unit PCC will be required to be available on-call during this period. This may be clarified.

6. After completion of performance test, ARPC to issue 'Provisional Acceptance Certificate' with the assistance of MC. In fact MC on behalf of owner, should not only assist but certify the performance in all respects to enable owner to issue the P.A.C.

M.V.NAIK/DC BHATT

ATTACH-4

From: UNDP Consultants
(IPCL)

COMMUNICATION . 3
ARAK SITE OFFICE
Dt.20.10.91

SUB: MASTER SCHEDULES
COMPLEX-Construction & Commissioning
(issued by MC-for 1.9.91 and 1.10.91)
Enclosed Annexure is the extracts from the above schedules for -- % cumulative progress: CIVIL , MECH , ELEC , INST.Precomm/comm.dates as on 1.10.91 . Total floats as on 1.9.91 and 1.10.91

OBSERVATIONS/COMMENTS

1. Construction progress is not satisfactory,shows negative trend w.r.t.Rev (sch)6.

2. Total float in the cracker and downstream process units was -41 days as an 1.9.91 which has gone further negative to -64 days as an 1.10.91 .Thus in a period of just one month the delay in commissioning goes up by 3-4 (23 days) weeks .

3. Units 10 (11,30.31,40,41,42) as per critical path will be waiting for

86 Liq , storage tank farm
86 Naphtha loading pumps
68 Fired boilers (no.one)
90 E.T. (inorganic)

4. As on 1.9.91,there were 4(four)units of offsites & utilities having negative total floats whereas on 1.10.91, there are 17 (seventeen) units having negative floats. meaning more and more numbers of units are contributing to overall delay of the complex.

5. Olefins precommissioning sch.20.5.92 .

To keep up the same following units need close watch:

	SCHEDULED START	
	precomm	comm.
61. D.M.WATER	13.4.92	20.5.92
65. H2.02/N2	14.5.92	27.7.92
64. P & I.Air NO. 1	29.3.92	27.5.92
62. C.Tower No. 1/5	27.4.92	13.5.92
68. Boilers No. 1	4 .4.92	27.6 .92
94. I/C piping (utility)	12.3.92	1 .6 .92

6. Another area need attention :

construction drgs not received for

process units 1.(i,e unit 43)

utility & offsites 11.

material not received completely at site for

process units 3

utilities , offsites 21

7. Thus main areas of concern , even to start with procem-missioning are utilities like D.M. water , Nitrogen , Plant & Inst Air , C.W. Steam and in offsites - I/piping .

Encl : Anexure

MV NAIK / DC BHATT

REF: Master schedule

Annexure
to comm -3

Complex - construction & Commissioning

units PERCENT.PROCRESS AS ON 1.9.91 1.10.91

EXPECTED START FLOAT A5 Date(AS ON 1.10.91) ON 1.9.91 1.10.91

CIVIL MECH ELEC INST

PROCESS UNITS

		Civil	Mech	Elec	Inst	Precom	Comm	Days
10	OL	88	81	77	76			-41
		89	84	79	71	20.5.92	23.11.92	-64
11	PGH	63	34	0	0			-41
		66	38	0	0	26.7.92	8.1.93	-64
30	VA	26	16	0	0			-41
		27	19	0	0	9.9.92	20.2.93	-64
31	AA	34	0	0	0			-41
		36	3	0	0	14.9.92	20.2.93	-64
40	LLDPE	73	56	8	18			-41
		73	52	10	22	25.6.92	24.19.92	-64
41	HDPE	85	58	10	16			-41
		86	61	16	16	25.6.92	24.12.92	-64
42	PP	76	65	18	9			-41
		78	67	32	12	25.6.92	24.12.92	-64
43	BD/PBR	25	0	0	0			-28
		26	0	0	0	--	20.2.93	-51

UTILITIES & OFFSITES - UNITS GETTING DELAYED

64 Main substn	60	0	10	0	--		-36
	61	0	11	0	--	13.3.92	-64
86 Liq storage	41	0	0	0			-39
	41	0	0	0	May/July 92	24.9.92	-64
87 Fire fight	0	0	0	0			-39
	0	0	0	0	31.1.92	27.7.92	-64
81 R.W. P.W.	58	0	0	0			-39
	69	0	0	0	Jan/Mar 92	27.4.92	-64
82 F.G.sys	12	0	0	0			2
	45	0	0	0	8.11.91	8.12.91	-28
61 D.M.W	54	32	0	0			10
	61	39	0	0	13.4.92	20.5.92	-19
68 Blrs (one)	52	33	0	0			10
	64	36	0	0	4.4.92	27.6.92	-19
78 Chemst storage	39	0	0	0			10
	44	0	0	0	30.1.92	25.4.92	
86 Naphtha unload	0	0	0	0			8
	0	0	0	0	28.6.92	24.9.92	-17
90 Eff.t. (inorg)	0	0	0	0			0
	0	0	0	0	27.10.92	10.11.92	-12
96 Com. sewer	13	0	0	0			3
	16	0	0	0	--	25.12.92	-12
64 Pe.&I. Air (one comp)	36	0	0	0			28
	36	0	0	0	29.3.92	27.5.92	-2

62 C.T 1/5	71	0	0	0	--	--	26
	72	0	0	0	27.4.92	13.5.92	-2

CHAPTER 5

CENTRAL CONTROL ROOM

ATTACH-4
COMMUNICATION.4
ARAK SITE OFFICE
Dt:21.10.91

From: UNDP Consultants
(IPCL)

SUB: COMMENTS ON
REF:(1) commissioning and start-up schedule - MC - letter 28.3.91
(2) Complex Master Schedules Constn.and Commissioning by MC - OCT.91

UTILITIES / UNITS /OFFSITES	DAYS(REF MAR. 91 SCH)	
61 DMW	98	o.k.
64 Plant & I.Air	175	Total Days for 1-5 o.k
65 N2 - 02	126	o.k. for both
62 C.T. 1-5	56	o.k.
2/3 part	35,56	o.k.
68 Boilers 1.2.3.	153	o.k.incl.28 days tests
69 Power gen.5 sets	168	o.k.
69 Main s/s	31	o.k.
68 WHRG	181	o.k.
86 Liq.St.incl. naphtha unload	63	o.k.
90 E.T	182	o.k.incl incinerator
96 Comp sewer	70	o.k.
94 I/C piping process	217	o.k. 175 days for comm lines - examine
95 I/C piping utilities	133	o.k.
78 Chem storage	126	o.k.
79 Cond recover - 3part	35,20,28	o.k.
80 Off/S Inst	90	o.k.(ref oct.91sch)
81 R.W. .pott.w	28	o.k.

82 F.gas - 2 parts	14,21	o.k.
83 F.oil	42	o.k.
87 Fire fighting - 2 parts	35,35	o.k.
88 H2 storage	28	o.k.
89 Flare cold/hot	56	o.k.

NOTE:

plant check , precomm activities , commisssioning and performance test period in above units as sch.examined and commented irrespective of start/finish dates .

MV NIAK / D.C.BHATT

ATTACH-4
COMMUNICATION -5
ARAK SITE OFFICE
Dt: 24.10.91

From: UNDP CONSULTANTS
(IPCL)

SUB: Deployment of MCS
CONTRACTORS,VENDORS,ARPC personnel
REF: commissioning and start-up
schedules from MC-(MAR.91)

MC

5.2.1.a/b

MC Operations Coord Team

		NO.	Period	suggestions
1C	ut/offsite coord	0-12	12mths	One of the coord.
1C1	ut/offsite coord	1-12	11 "	should be o.k.
1E	mc opns coord	0-24	24 "	One of the coord.
1B	process units coord	0-24	24 "	should be o.k from 7-24 month=17 mths
1b3	units coord area d	14-21	7 mths	Period should be
1f	process enger " "	16-21	5 "	reduced for AA/VA unit
4	process engr ut/off	3-14	11 "	period could be reduced to 6(SIX)mths

OFFSITES

5.2.2.a/b

Offsites Contractors' Orgn

				suggests
1LA	workshop coordinator	2-14	12mths	Could be reduced to 6
1LB	lab. coordinator	2-14	12 "	(six)mths each,

Note: Could be reduced to six months each since
after establishing coordination between W/S,
Lab and shift oprs,presence not essential

5.2.2.c

Offsites W.W.Vendors' personnel

				suggests
1	process engr	4-8	4mths	2 mths
1A	operation sup	4-8	4 "	3 "
1B	ele/inst engr	4-8	4 "	1 each mths
1C	inst sup. KTI	6-9	3 "	2 " "

PROCESS UNITS

5.2.3 a/b

01 Contractors' personnel			suggests		
1A lab advisor	9-14	5mths	9-13	4	mths
1B process engr	4-14	10 "	4-13	9	"
1C prod.supot	4-14	10 "	"	"	"
1C1 hotsec daily sup	4-14	10 "	"	"	"
1C2 cold sec " "	4-14	10 "	"	"	"
1D maint.supdt	4-13	9 "	4-10	6	"
1D1 mech.engr	4-13	9 "	"	"	"
1D2 elec engr	4-13	9 "	"	"	"

5.2.4 a/b

PGH Contractors' personnel			suggests		
1CB tankage daily sup	8-13	5mths	8-11	3	mths
1D mech engr	7-12	5 "	7-10	"	"
1E elec.engr	7-12	5 "	"	"	"
1F inst.engr	7-12	5 "	"	"	"

5.2.3C

01 Vendors' personnel — suggests no change

5.2.4C

PGH Vendors' personnel

1 Worthington pump	10-11	25 days
1B Nuovo pignone comp	10-11	22 "
1E ABC kent alarm sys	11-12	10 "
1I phillips monit.sys	11-12	7 "

NOTE :

It may be examined whether the same vendors who are visiting for OLEFINS equipments could be utilised for the similser equipments in PGH .

5.2.5 a/b

LLDPE/B.1 contractors' personnel			suggests
1A lab advisor	9-13	4mths	no change
1B process advisor	6-13	7 "	one of the two
1C production supdt	6-13	7 "	can be o.k.
1d maint supdt	6-13	7 "	6-9 3 mths

NOTE :

Production supdt can be a process advisor

5.2.5C

LLDPE/B.1 Vendors personnel

NOTE:

Adjustment possible in some cases, can be reviewed as discussed with Area Manager.

5.2.6 a/b

HDPE Contractors personnel			suggests
1A process engineer	7-16	9mths	11-16 5 mths
1B lab advisor	11-16	5 "	no change
1C poly sec supdt	7-16	9 "	one of the two
1C1 poly sec daily sup	7-14	7 "	for 9 months
1D pallet sec supdt	9-16	7 "	one of the two
1D1 pallet sec daily sup	9-16	7 "	for 7 months
1E maint supdt	7-16	9 "	7-13 6 mths
1E1A2 elec engr	7-14	7 "	7-12 5 "

5.2.6C

HDPE Vendors' personnel

NOTE :

Adjustment possible in some cases, can be reviewed as discussed with Area Manger

5.2.7 a/b

PP Contractors personnel suggests

1B	lab advisor	9-15	6mths	11-15	4 mths
1C	production supdt	10-15	5 "	12-15	3 "
1EA1	mech engr	10-15	5 "	"	" "
1EA2	elec engr	10-15	5 "	"	" "

5.2.7.C

PP Vendors personnel suggest no change

5.2.8 a/b

BD/PBR Contractors personnel suggest

1A	process enger	12-19	7 mths	no change
1B	BD prod.supdt	12-19	7 mths	14-19 5 mths
1C	PBR prod supdt	12-20	8 mths	14-20 6 "
1D	BD lab advisor	12-19	7 mths	14-19 5 "
1E	PBR labadvisor	12-19	7 mths	" " "
1F1	mech engr	12-19	7 mths	12-17 " "
1F2	elec engr	12-19	7 mths	" " "

5.2.8 C

BD/PBR Vendors' personnel suggest no change

5.2.9 a/b

AA Contractors' personnel suggest

1A	process engr	14-19	5 mths	16-19 3 mths
1D	AA startup sup	14-18	4 mths	one of the two
1E	AC startup sup	14-18	4 mths	if experienced
1F	maint supdt	14-19	5 mths	16-19 3 mths

5.2.9 C

AA Vendors personnel

No data availabie

5.2.10 a/b

VA Contractors personnel — suggest

1A	process engr	15-20	5 mths	16-19	3 mths
1D	maint supdt	15-20	5 mths	15-18	" "

5.2.10.C

VA Vendors´ personnel

No data available

UTILITIES

5.2.11 a/b

D.M.Water Contractors´ personnel — suggest

1E1	analyst	3-5	2 mths	one of the two
1E2	analyst	3-5	2 mths	analysts o.k.

5.2.12 a/b

C.W Contractors´ personnel — suggest

1. start-up mgr	2-7	5 mths	no change
	9-11	2 mths	
1A operation sup	2-7	5 mths	May not be
	9-11	2 mths	required

NOTE:

Since start-up MGR is availablle position of operation supervisor may not be essential

5.2.13 a/b

P & I Air: Contractors´ personnel				suggest
1	startup Mgr	2-8	6 mths	no change
1A	operation sup.	2-8	6 mths	May not be required

NOTE:

Since start-up Mgr is available position of operation supervisor may not be essential

5.2.14 a/b

N2 and O2 Contractors personnel				suggest
1	startup Mgr	5-8	3 mths	no change
1A	operation sup.	5-8	3 mths	May not be
1B	operation sup.	5-8	3 mths	required

NOTE:

In view of the vendor´s presence one or both operation supervisors may not be required.If no vendor´s representatione then at least one supervisor can be o.k.

5.2.15 a/b

Steam Generation Contractors´ personnel				suggest
1	startup MGR	3-11	8 mths	no change
1A	operation sup-sor	3-11	8 mths	May not be required

NOTE:

Since start-up MGR is avaliable position of opn supervisor may not be essential

5.2.16 a/b

Power Generation contractors' personnel

1	Start-up Mgr	0-7	7 mths
1A	OPN sup.	0-6	6 mths
1B	OPN sup.	1-5	4 mths
1C	OPN sup.	1-4	4 mths
1G	Vendor	--	--

NOTE:

Presence of three (3) operation supervisor is not clear if they are in shift then o.k Otherwise one sup.visor should be o.k. Its not clear whether vendor is present .

ARPC PERSONNEL:

NOTE:

1. MC have recommended the organi ation required for ARPC personnel separately for process , utilities and offsites.

2. This number of positions may not be possible to deploy as suggested .

3. Depending on the number of operation and maintenance manpower planned by ARPC on regular basis can be organised/deployed.

4. Number required in operations can be reinforced by bringing personnel from process engineering (technical services),R & D during the period of comm/start-up

5. For maintenance , in case of area a i.e. Olefins and PGH , the maint groups can be combined .
Similarly in case of polyolefins there can be one common maintenance set-up and also in case of AA/VA .UTILITIES and OFFSITE - similar arqangement

Encl: Polyol.Examples - Deployment charts (4 sheets)

MV NAIK/DC BHATT.

ATTACHMENT-5
(PCS - 11)

AREA MANAGEMENT.

1- Just before the mechanical completion,soon as the recommissioning activities are on,the organisation set-up under each Area manager will be expanded and will remain expanded till the guarantee / performance test-runs are over for the plants under the AREA manager .

2- AREA manager will report to the Operations Head of the complex.

3- The ARPC engineers working at present under the construction group will functionally start reporting to the Area Manager for tne day-to-day construction and commissioning activities.

4- This engineers on completion of test-runs will be assigned the positions preferably under the Area Manager/Maint. Mgr or will be assigned the position in Central Manitenanes Engineering Services (MES).

5- One of the chemical engineers will be assigned the position of safety engineer who will look after all safety aspects in that area,during this period and during regular operations.He will have continuous liaison with the Central Safely Department.

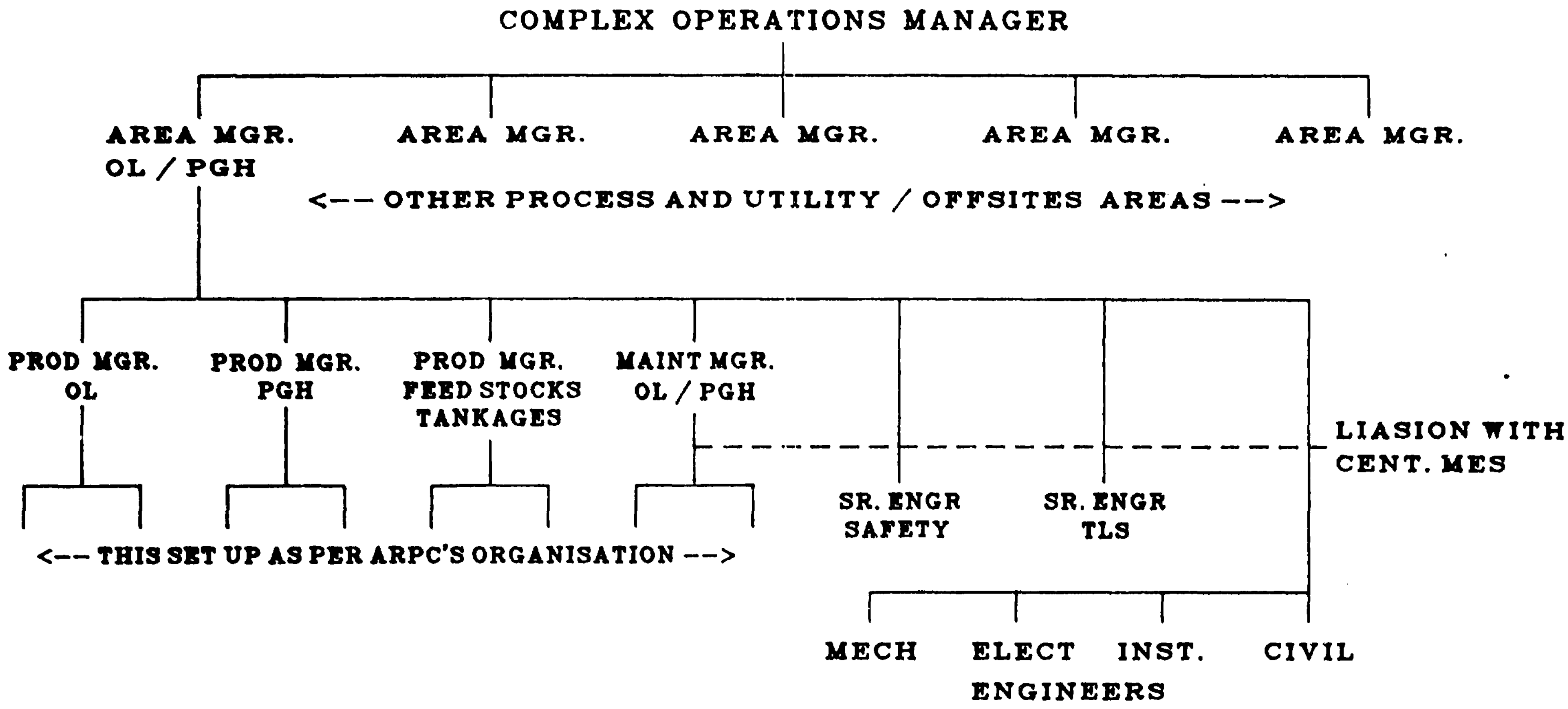
6- Also an engineer at senior level frcm the technical services will remain attached to the Area Manager during the period.He will assist the commissioning team of the plants/group and simultaneously collecting basic information about plant/process operations parameters behaviour etc.

7- For smooth and safe start-up Area Manager will organise daily meeting with all disciplines under him,UC/MC/Vendors and on need-base other department-representatives.This will help in resolving day-to-day problems and keeping up the precommiosining,commissioning and start-up schedules.

8- During this period , the strength of the other operating and maintenance personnel of the Area can be reinforced/increased as suggested/recommended in the write-up.

9- The above arrangement/set . up will have advantage of Unit Responsibillty and unity of command in each Area at such a critical period.

ENCL : A.M. SET-UP



AREA MANAGEMENT – SET – UP

ANNEXURE TO
ATTACHMENT NO.5

CHAPTER NO : 5 CENTRAL CONTROL ROOM

INTRODUCTION:

M/S Arak Petrochemical Co. is putting up a Petrochemical Complex at about 25 km away from the Arak town . The Complex having an integrated utilities and offsites is to produce Ethylene , Propylene , Butadiene and Downstream products like LLDPE.B.1 , HDPE , PP , PBR , AA , VA , in phase I and adding production of EO/EG , EA , 2E.H in phase II .The phase - I plants with utilities and offsites are expected to be commissioned by end 1992 .

The Managing Contractor is assisting ARPC in overall construction co ordination at on shore and with the help of Unit contractors and the licensors' expatriates would assist ARPC in precommissioning , commissioning , start - up and performance test runs of the units in the complex .

The ARPC on the other hand have started employing operation and service personnel and are under process of training them at licensors' similar plants and in the similar industries like refineries and petrochemicals at home and abroad. It is expected that the ARPC operating and service personnel will be closely associated during commissioin-ing and start.up activities .

The nerve centre of controlling the operation of the individual units , is the plant control room from where the remote , semi and fully automatic (like DCS)operations are performed . There is also a well established communication system between the control room and field operators.Thus the unit is selfcontained and independent with regard to unit operations and process controls .

However the unit has a dependency on utilities and other related units,e.g Olefins is dependent on utilities for its operations and on downstream units for its products--consumption, likewise are the downstream units. Also due to storage limitations , of the feedstocks and products , disturbances in operation at one unit will have subsequent cascading effects on the other units . This is very true in case of utilities where an optimal balance in distribution at any time is desired to have economic operations.The timely action and control is of utmost importance in such case .

This can be taken care of by a normal management information system (MIS), but a time lag in communicating decisions cannot be avoided .At the same time optimal use of resources with the complex during continuous operations is the most essential .

Hence it calls for such centralised system with the complex which can take majority of operating decisions in an integrated manner and advise unit operations accordingly.

PROPOSAL:

There can be a central control room (CCR) equipped with a system of information from all units (plant control rooms) of operations including utilities and offsites.

As come to known from the discussion , ARPC have already planned such a CCR which will be manned by a person at the level of manager , round-the-clock . The same CCR can be made more effective and useful by adding further communicating links and connections.

Over and above the plant operations , the units will communicate to the CCR any major accident , fire , sudden industrial unrest , need of medical aids, etc.On which CCR could act for immediate necessary action and advise and alert respective agencies/services .

Management at any time would like to communicate important decision related to production or to know about the plant health , then CCR is the key communication link to and from the units.The CCR would be also a vital link during emergency situations. It may be necessary to take in-house action before the external communication is established.Some of the examples are : explosions , air raids , hazardous gas leakage etc.In such cases people at various locations are to be warned , alerted or activated to combat the situation before external help is arranged.

It has been experienced that a " Central Control Room" become a major and essential 'tool' in such operating complex.

FUNCTIONS:

1. To collect information from various cont.rooms of plant operations, time to time and to strike a balance to contain the undesired build-up of inventories and advise.
2. In case of shortages, to optimise and allocate the avail -able utilities/raw materials/chemicals depending on the priorities of the plants.
3. To exercise administrative control of the available resource round- the - clock of operations more so during silent hours and holidays.
4. To decide the need of external help of plants and making arrangements for the same.
5. Daily to prepare and provide, the operation/production data/information to the management, in the beginning of the day.
6. To collect and disseminate the critical information need -ing for urgent action.
7. To control the emergent situation at plant site during fire, explosion, air-raid , gas\-release,etc. including warning the people at site for danger, till the external help is available.
8. To provide guidance to the plants in deciding about the priorities of operations, safety etc. when asked for

SYSTEM DESIGN:

The Central Control Room should be located preferably within the complex in a room provided with reliable communication system linking cont. rooms, fire stations , medical centre (clinic). It is desired to have more than one system of communication like-telephone , loudophone,or even wireless could be considered. The CCR should be also connected with the top management officials, outside city administration , fire stations of the city and adjoining industries(refinery in this case) with a suitable communication ring.

The CCR also requires small data acquisition system (DAS) which can be linked with plant cont.rooms and with terminals at top management desks for communication of plant operations data/ information.

Astronomical data particularly the wind direction should be available with the CCR. This can be provided by air monitoring stations installed around the complex(may be four or six) battery limit, which can also monitor ambient gaseous effluents and provide information through central monitoring system (with display console) located in CCR.

The CCR can be equipped with block diagrams of unit-operations and the topography of the complex for easy identification of the location of the incidence (Like fire, accident, gas release, etc). An alarm panel in parallel to the one at fire stations can be installed to blink an alarm incase of fire indicating the location of the fire place. The CCR can be provided with vital data of each unit, emeragency handling procedures, few safety equipments (special ones) and a well documented "Disaster Plan " for the complex.

SYSTEM-OPERATION:

1. The CCR can be manned and managed by two persons having good plant operating experience. Also its desirable that these persons have some knowledge about handling safety and emergency situations. The operation of the CCR will be round-the-clock. The responsibility of the personnel will be of the following:

   (A) Routine: Collect information about plant load and constraints , if any.

   : Keep information about the breakdowns of critical machineries/equipments affecting the plant capacity.

   : To check from the plant weather any assistance is required and resource mobilisation to solve the problems.

   : To co.ordinate the issues between the plants for the solution.

   : To communicate to various control rooms the information of importance .

: Daily keep ready and communicate the plant information/data to the management as directed.

(B)EMERGENCY: In case of breakdown of certain utilities, to instruct the concerned plants to reduce / adjust the load/consumption for balancing the available resources till the situation normalises.

: To carry warning signals in case of gas leakages indicating areas of leakage and possible affecting zones depending on the wind direction.

: To dissipate the information by transmitting to higher authorities for the help from exter -nal sources.

: To guide the available manpower of fire, safety , security and operations in handling the situation.

II- DATA:

Following data to be maintained.

1. Plant lay out and control rooms-locations.

2. Telephone/wireless numbers of various control rooms, fire stations, securities, clinic,etc.

3. External communication numbers,as predecided , for civil authorities, neighbouring and other industries,etc.

4. Telephone number(office and residence) of top management required to be notified for emergent events/situations.

5. "Do´s and Don´ts" for emergency operations.

6. List of priorities for unit operations in case of one or more utilities-breakdowns.

7. Sequential procedures of shut.down and start up of plants during emergencies.

8. Rated capacities and raw materials/utilities/chemicals requirements of each plant and of critical equipments: Both requirements normal and critical.

9. Documents for "Disaster Plan" of the complex.

III REPORTING AUTHORITY:

This control room is a vital link and having critical responsibilities. It is essential that the control room is operating directly under the authority of " Chief of Operations" of the complex.

This will also ensure administrative effectiveness required specially during the silent hours and holidays.

IV LINKAGES;

Since disaster plan needs coordination from this cont.room, there should be a communication link with civil authorises, city fire stations, neighbouring industries-cont.rooms, fire stations and other agencies/services as decided by the management.This will help in case any external assistance is called for.

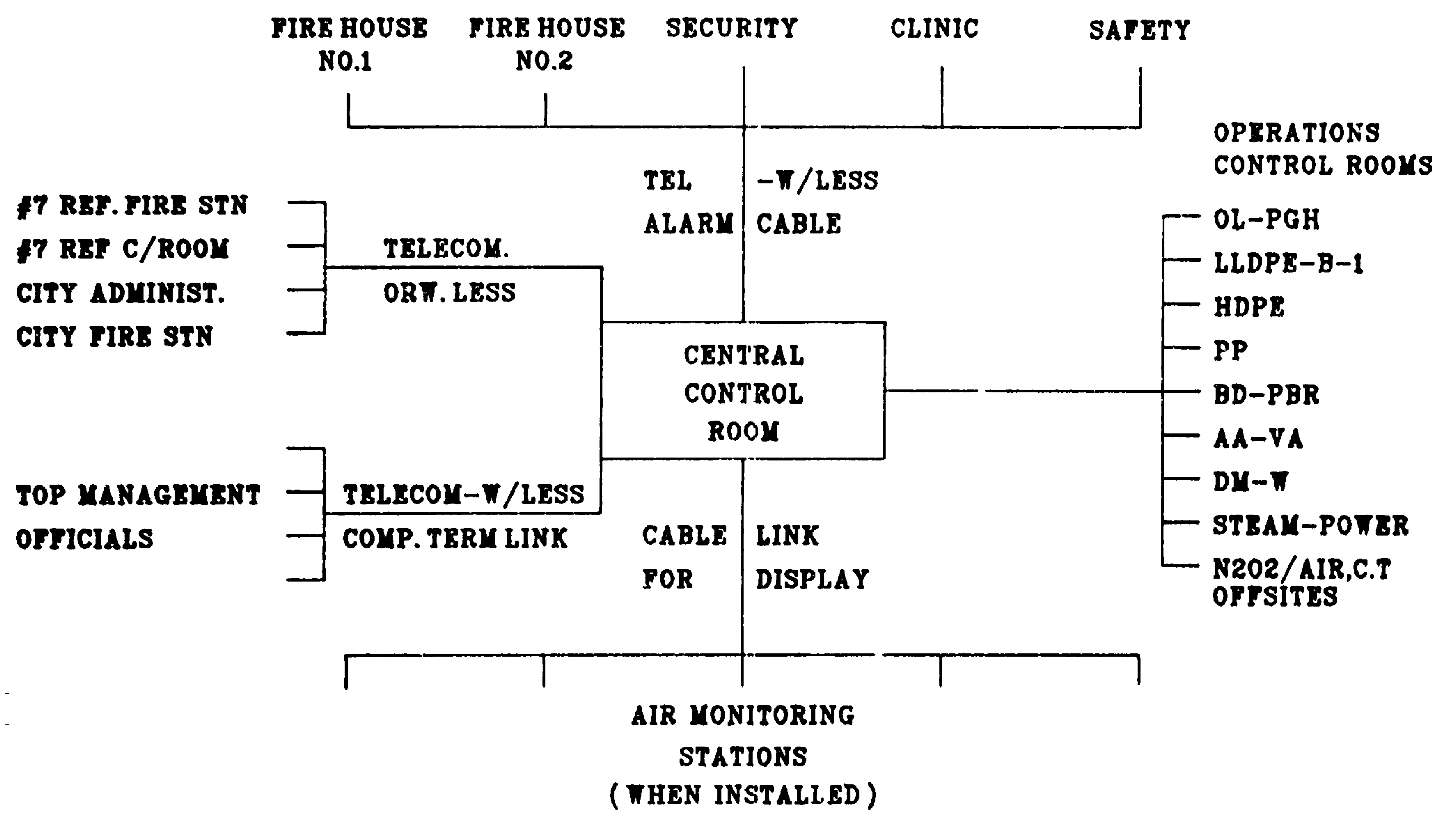
RECOMMENDATIONS;

1. As mentioned central control room is to be manned by an experienced personnel. Its desirable, by rotation, every plant manager is given opportunity to mann the control room.

2. ARPC is at the stage of starting commissioning activities in the complex in near future. Hence it is worthwhile that such control room is established and commissioned immediately. The usefulness and effectiveness of such central control room in the complex need no emphasis.

ENCLOSURE;

Central cont.room. Communication systems.



CENTRAL CONTROL ROOM – COMM SYS

ANNEXURE TO CCR

CHAPTER 6

OPERATIONAL SAFETY

CHAPTER 6 : OPERATIONAL SAFETY

1. INTRODUCTION:

At present ARAK petrochemical complex is at various stages of constructions of its units in phase-out manner. Manageing Contractor M/S Snamprogetti , Italy have projected schedule for precommissioning , commissioning , and start-up of the complex for units under phaseI-A,i-e . Olefins , Polyolefins , Acetic Acid , Vinyl Acetate and under phase I.B Butadiene and Polybutadiene Rubber.Phase-I also includes utilities and offsites . Projects under Phase II , namely , Ethylene Oxide , Glycol , Amine , 2-Ethyl Hexanol , Oxo.Gas are at contracting stage . As per the present indication , projects under phase.I and utilities / offsites will be ready for commissioning by end 1992 .

Therefore ARPC management is more concerned and conscious to establish "safety services" as soon as possible. A beginning is already made in this direction by starting "Safety and Fire Services" department working under construction group of ARPC .

2. ORGANISATION :

ARPC should consider safety organisation at central level termed as "Safety Centre" or "Central Safety Services" to co.ordinate , monitor , promote and enhance the safety , occupational health , fire services and pollution control activities of the complex .

Central Safety Services shall have multi disciplinary team of relevant specialists for technical guidance . advice and direction to the units in the complex. The services shall be manned by professionally qualified persons. (fulfilling statutory requirement , if any) . 'Central Safety Services' will be headed by a SR MGR/MGR who will report to Operations Chief / Technology head of the company. He will be responsible for

- Execution of safety assistance programmes
- Advise and assist plants/units , other departments and heads / executives in all matters of safety
- Ensuring and implementing broad objectives of the company in relation to safety
- Advise and assist for all aspects of safety right from the stage of design , engineering construction / erection , commissioning , start-up till safe operations of the complex - units
- Organise and coordinate hazop-study , Safety Audit of the units
- Budget and control expenses towards safety

- Organise training programme
- Establish appropriate liaison with government authorities

He will perform this functions under the approved policy and guidance of the operations chief / technology head.

The unit level safety branch will be looked after by a safety officer who can be a process , maintenance or a laboratory chemist from the plant. This officer can be on rotation with other plant engineers and his duration for this position could be six to twelve months.He will have central safety services as a focal point.He will ensure plant personnel to fulfil , safety objectives of the company by observing safe working , following safety procedures like work-permits , safety permits and completing the safety schemes .

The proposed basic organisation chart of central safety services is illustrated in the Attachment no : 1

3. OBJECTIVES :

Central safety services to meet broad objectives of

1. Total loss control :
   - No injuries , accidents , fires and damage to equipments and human beings .

2. Better working environment:

- Good house keeping
- Safe working conditions

4. FUNCTIONS AND RESPONSIBILITIES

1. Compliance to statutory obligations:
   - Factory acts / rules
   - Petroleum acts / rules
   - Static pressure vessels , gas cylinder rules/regulations
   - Insurance
   - Safety codes and standards

2. Safety procedures-formulation.compliance and monitoring for :
   - work-permit
   - fire and safety permit
   - vessel entry permit
   - electrical lock-out permit
   - new schemes , safety schemes / modifications

3. Developing safety knowledge and skills through programmes on:
   - for new recruits - safety introduction and orientation
   - employees protection programmes
   - in-plant training
   - specialised training

- safety seminars / workshops (including case study discussions)
- shop - floor meetings
- plant safety committee meetings

4. Safety equipment procurement and distribution:
   - non - respiratory equipment
   - respiratory equipment
   - safety instruments

5. Promotional activities :
   - publication of safety bulletin
   - safety posters , slogan display and audio-visuals
   - safety exhibition
   - circulation of accident case - studies
   - safety competitions / contests
   - manuals and data - sheets

6: Studies & reports:
   - mishap reporting , recording and investigation
   - plant safety inspection survey and audit
   - accident reporting
   - safety study visits to other units
   - hazard and operability study / report
   - risk assessment study / report

5. **SAFETY PLAN** :

Central safety services should prepare every year draft 'safety plan' which includes previous year safety performance in terms of no.of accidents , frequency rate , severity rates , etc., Unitwise plan for conducting more safety programmes for supervisory , non-supervisory and contractors' employees - to keep up awareness ; with due emphasis on safety observance , inspection , audits , hazop analysis etc. to improve safety standards . Draft plan should reiterate the safety objectives. On approval , plan should be issued by the technology / operations chief /head and given wide circulation . All efforts should be made for its successful implementation during the year to achieve desired results .

6.**SAFETY MANUAL** :

Safety manual is prepared by central safety services for each unit and for entire complex . This is issued under the authority of technology/operations head for strict compliance by respective units and employees of the complex. It consists of all aspects of safety in detail for safe operation and maintenance of the units . It is compendium of information mainly drawn from operating and maintenance manuals issued by process licensers , engineering contractors and vendors.It also provides information on use of safety appliances and procedures for safe shut-down and start-up. It establishes uniform code of safety rules and regulations , procedures and practices for the use throughout the complex.

It is particularly important for each newly recruited employee to familiarise himself before starts working in the plant/unit.

The manual will be updated and revised from time to time as required and each operating and maintenance individual should have his copy , up-dated one .

7. SAFETY PROCEDURES :

Safety procedures will be formulated after envisaging all possible risks and mishaps and steps to eliminate the same will be advised through the procedures . It will also draw attention to precautions to be observed.

All such safety rules and regulations should be written in simple language so that all employees understand clearly.
As a procedure , permit system has to be essentially followed for carrying out all specific works in most safe manner. The system will identify and fix the responsibility of the employees working in the plant. Normally the permits are issued in duplicate. Through such written permits , following rules and procedures , can lead to (ensure) safe

working.Hence any violations of this system should be seriously viewed . It should be clear to all concerned that on this account no compromise for any unsafe act .

This procedures and systems should be introduced right from construction stage.

Sample forms at Attachment -2

8. SAFETY TRAINING :

Central safety services should prepare 'yearly plan' on safety training:

This plan should base on.

- Type of course , duration of course , topics to be covered , selection of faculties , frequency of refresher training (need) training budget.The typical topics which can be covered - like:
- Statutory requirements
- Role of supervisors in chemical industries
- Various permit procedures
- Accident prevention policy
- Safety during repairs, (incl.welding) and maintenance
- Hazards of chemicals , electricity , air , water , steam , etc
- Safe transportation , storage and handling of hazardous , toxic , inflammable chemicals and Hydrocarbons
- Fire and risk management

- Safe furnace and boiler operation
- Handling of nature I and nature II emergencies
- Accident reporting procedures
- Accidents-case history discussions
- Hazop studies , safety audit
- Knowledge and use of safety appliances
- Good house-keeping concept

This programme should be also arranged for contractors' superiors/workers , transporters and others concerned.

Steps to be followed for the programme:

- Titlewise budgetary and programme approval
- Correspondence with institutes/consultants to engage faculties.
- Issue circular inviting nominations .
- Co.ordinate and follow-up for nominations
- Conducting programme-issue communication for time schedules , faculty -names , details of programme
- preparation and running programme
- Conclusion and review on programme

9.SAFETY PROMOTIONAL ACTIVITIES :

In view of the importance of safety in petrochemical complex for accident prevention , safety communication in a systematic manner by central safety centre needs to be established from construction stage of the complex.

Communications in the form of :

1. Safety campaign month :

In a year , one month is selected based on no.of accident in a unit and organise safety activities on a large scale in that unit .

2. Safety day celebration:

In a year one day is selected to name as 'safety day' and various safety promotional programmes are organised that day .

3. Inter-unit safety contest :

Safety contest is organised , twice in a year based on 'no loss time accident' performance by a unit.Winner unit receives safety trophy and each employee of that unit gets a safety gift or a token amount (say about 2500 riyals)

4. Good house-keeping contest :

This contest is organised twice a year . A committee consisting of members from operation , maintenance , personnel & administration and central safety services goes round each and every part of various units/ departments and assesses rating by filling form .(giving marks itemise) .Unit ranking highest is a winner to receive good house-keeping trophy and each employee of that unit gets a good house-keeping gift or a token amount.Copy of 'good house-keeping norms' form enclosed. Attachment-3

5. Special programme on accident prevention:

In a year two or three units /departments are selected based on poor performance in safety , to conduct 'safety drive programme' for improvement in safety performance.

6. Safety seminar :

once or twice in a year , safety seminar is organised in the complex , for a duration of one or two days . Leading chemical industries like refineries , fertilizer , & chemicals are invited to depute participants. Reputed faculties are invited to read paper on safety .

SAFETY COMMITTEES :

These committees are formed at three levels (A) Unit (B) Group and (C) Apex.

(A) UNIT SAFETY COMMITTEE :

At unit level safety committee is formed and presided by unit head. Alongwith plant engineers workers' Representatives are also invited to participate in committee meetings. Periodicity of such meetings could be once in two months. Agenda items are drawn up and follow up actions are decided and recorded. Minutes are circulated for necessary action by concerned .

(B) AREA SAFETY COMMITTEE:

On similar lines as above , this committee would be lead by Group Head.Group can be of 2 or 3 units like Olefins , Ployolefins ...

(C) APEX SAFETY COMMITTEE :

This committee is high level one and headed by Operations Head.In this higher level management committee , workers representatives would also participate and issues like policy , statutory , major constraints/requirements would be discussed .

All above committee meetings would be convened by safety manager.Committee members will be also nominated from occupational health , fire, materials , technical , finance , engineering services. Such meetings are quite productive and ensuring safe working of the complex .

B. SAFETY PUBLICATIONS :

In order to create and sustain interest amongst the employees towards safety , the safety bulletin should be published in English and Persian language once in three months . Safety topics should also include case histories of accidents/mishaps occurred in -house and in other industries This will enlighten employees about seriousness of the hazards and lead them to safe working .Central safety services should also organise display of sign-boards and posters on safety like "no-smoking" identifying hazardous zones in new projects as well as in operations area . Also for the public awareness on safety , programmes in neighbouring villages/town can be conducted by way of exhibition , leaflet distribution , audio/visual(video) communication with the help of local/district authorities.This will help for preparedness of the public in emergency-situations .

10. SAFETY REPORT SYSTEM :

(A) Safety Survey Report :

Safety officer from central safety services and unit safety officer will jointly carry out survey of the unit once in three months and report about all aspects of safety requirements including statutory working of permit systems , detectors , fire-alarms , safety valves , etc .

(B) Plant Safety Engineer's Daily Report :

This report to central safety services would cover plant position , permits/clearances , fires/mishaps/ accidents, if any , good house-keeping , unsafe conditions , etc.(proforma enclosed... Attachment-4)

(C) Safety Audit Report :

Conducted once in a year by senior safety officer from centre with plant operations , and technical services.

(D) **Hazard and Operability Study-Hazop (details follows)**

(E) **other reports like:**

Accident investigation (Ref.Attach ... 5)

Inspection of customers' installations

various survey reports for examples;

sampling points (critical ones)

lifting tool & tackles

drain/vent nipples

breathing air cylinders ...... (Ref.Attach ... 6)

11.FREQUENCY AND SEVERITY RATES :

These are important parameters to evaluate the safety performance of each unit and of the complex as a whole.These (F.R.&S.R) are accepted internationally for safety rating .

$$F.R. = \frac{\text{reportable accidents} * 1,000,000}{\text{total manhours worked}}$$

$$S.R. = \frac{\text{maydays lost} * 1,000,000}{\text{total manhours worked}}$$

FR and SR are calculated from the data of one year and plotted graphically - FR,SR on x-axis and year on y.axis . Similarly loss of time accidents and mandays lost plotted yearwise for trend analysis . Accident free 'one million manhour' spells can be also recorded in form of bar charts Such "records " maintained by central safety services can be forwarded in standard form for participating in "international safety award" for safety performance of the complex/company .

Winning of such awards (like experience of IPCL) by company improves /boosts up morale of employees and better safety performance next year :

12. HAZARDS AND OPERABILITY STUDIES (hazop)

Right from the technology / process selection stage this study can be taken up at different phases of the project-like design , construction , commissioning and operations .

This study provides valuable technical information and suggests alternatives to minimise risks. It also identifies major and specific hazards and operability problems .

Study should be carried out by trained hazard analyst or safety manager with multi-disciplinary , team of process , mechanical , instrument engineers , chemist and if required including other specialists. Documents required are- well developed P & ID , plant lay-out site plan , operation/maintenance manuals , etc.

Having identified major operational hazards , its credible causes and consequences , operability problems can be recognised. Interaction at this point , with process licensers would be necessary to eliminate/reduce hazards , consequences and operability problems. Also to develop protection and control systems to contain residual hazards within risk targets.

Hazard indexing of each unit (Dow/Mond Index) is required to check adequacy of off-setting elements of the unit. To keep domino effect to practical minimum , distances between plants and inflammable liquid storages should be maintained. Commissioning time hazop study review should be taken up by commissioning manager/leader with contractor prior to commissioning , to ensure updating of all plant-documents and implementation of all recommendations of hazop study (earlier) .

After physical inspection , verification and assurance of commissioning manager, safety manager would also satisfy and certify compliance of this recommendations .

During normal commercial operation- phase of the unit/plant, between 3 to 6 months , operations manager would organise hazop study .He would ensure that all design intents of safety management are being realised in practice . If there are major defects , plant manager records the need to raise "plant modifications authorisation" as per procedure adopted by ARPC to initiate the rectification .This rectification/modification is then "hazop-ed" by works-based team led by safety manager before plant management is allowed to proceed .

Enclosed-simplified model of hazard source and procedure-diagram. (Attach ... 7)

CENTRAL SAFETY SERVICES

SENIOR MANAGER / MANAGER

- ASST. MANAGER PROCESS UNITS
  - SR. SAFETY OFFICER OLEFINS
  - SR. SAFETY OFFICER POLY OLEFINS
  - SR. SAFETY OFFICER AA / VA BD / PBR
  - SR. SAFETY OFFICER EO / EG EA 2EH / OXO
  - <----- SAFETY OFFICERS ----->
  - PLANT SAFETY OFFICERS
- ASST. MANAGER OFFSITES & UTILITIES
  - SR. SAFETY OFFICER OFFSITES
  - SR. SAFETY OFFICER UTILITIES
- ASST. MANAGER TRG.STATU.LIAISON PROM. ACTIVITIES
  - SR. SAFETY OFFICER TRAINING
  - SR. SAFETY OFFICER STATUTORY LIAISON
  - SR. SAFETY OFFICER OTHER DEPTS
- <----- SAFETY OFFICERS ----->
- PLANT SAFETY OFFICERS

AT UNIT LEVEL SAFETY BRANCH EACH SHIFT ENGINEER FROM EACH UNIT SHALL FUNCTION AS SAFETY OFFICER DESIGNATED TO WORK FOR SAFETY REQUIREMENTS AND MAINTAIN CLOSE COORDINATION WITH CENTRAL SAFETY SERVICES

ATTACHMENT.1
REF. P.S

INDIAN PETROCHEMICALS CORPORATION LTD. ATTACH

ATTACH – 2

FIRE STATION

FIRE & SAFETY PERMIT

(HOT WORK AND VESSEL ENTRY)

Nº 024906

FORM No. SD/F/6R

Date of Issue _ Time ________Hrs

Permission is hereby granted to Shri ________________________

Designation ________________________ of ________________________ Section/Deptt.

Description of Work ________________________

Plant ____________ Area ____________ Equipment ____________ Location ________

Nature of Work ☐ Flame ☐ Spark producing ☐ Repair ☐ Cleaning ☐ Vessel entry ☐

THE FOLLOWING PRECAUTIONS MUST BE TAKEN BEFORE THIS PERMIT CAN BE AUTHORIZED

Item	Yes	Not required	Item	Yes	Not required
1 Equipment properly drained and blinded.	☐	☐	11 Proper portable ladder provided.	☐	☐
2 Equipment water flushed.	☐	☐	12 Suitable scaffolding provided	☐	☐
3 Equipment properly steamed and gas freed.	☐	☐	13 Means of exit available.	☐	☐
4 Elect. Isolation Lockout No .... Date	☐	☐	14 Proper ventilation available, air hose provided.	☐	☐
5 Mechanically blocked to avoid rotation.	☐	☐	15 Proper illumination available 24V F.P. hand lamp.	☐	☐
6 Surrounding area hot line checked/covered.	☐	☐	16 Equipment properly tagged: i) Blind tag. ii) OK to enter tag. ii) Danger tag.	☐	☐
7 Sewer opening covered/protected	☐	☐	17 Area operator informed.	☐	☐
8 Control of welding sparks provided i) Outside vessel. ii) Inside vessel.	☐	☐	18 Standby person/fireman provided	☐	☐
9 Return earthing cable provided & welding cable insulated.	☐	☐	19 Following safety equipment provided. ________ ________	☐	☐
10 Following precautions taken against release of oil, gas or solvent. ________ ________	☐	☐	20 Following fire equipment provided. i) Running water hose. ii) Fire extinguisher.	☐	☐

GAS TEST Hydrocarbon ________________ % Lower limit

Toxic gases ________________ ppm

Oxygen content ________________ %

We have checked the above and consider it safe to proceed with work.

The permit expires at ____________ Hrs. Date ____________

Shift incharge   Plant safety engr.   Authorized area incharge

I have gone through the above check list and I abide by the safety precautions.

Engineer incharge executing the job.

Permit is hereby returned after completing job and ensuring safe removal of men & material.

Date :

Time : ____________

Engineer incharge executing the job.

Accepted   Shift incharge

The permit is void if the conditions in the area becomes hazardous from conditions not existing when this permit was issued and in case of FIRE ALARM/SIREN.

IN QUADRUPLICATE: WORKSHOP, FIRE DEPT., SAFETY DEPT., INITIATER

Form No SD/F/4

ATTACHMENT (2)

(Ref P.7) -1

INDIAN PETROCHEMICALS CORPORATION LTD.

Date ____________ Time ____________ Hrs Shift ________ B № 460812

WORK PERMIT

From ______________________________ To ______________________________

Please undertake the following job ______________________________

____

____

Pertaining to equipment No ____________________ Section/Area ____________________

Following safety requirements checked ( ) are essential to render this permit valid for work.

Item	Yes	Not Reqd	Item	Yes	Not Reqd
1. Elect. Lockout & line clearance permit No.. .... taken	☐	☐	8. Proper scaffolding to be provided	☐	☐
			9. Ladder to be provided properly	☐	☐
2. Equipment properly drained & blinded/isolated with valves.	☐	☐	10. Following safety appliances to be used.	☐	☐
3 Equipment properly taged	☐	☐			
4. Under ground cables over Head wires & ware.	☐	☐	(i) Eye & Face Protection	☐	☐
			(ii) Body protection	☐	☐
5. Muffler to exhaust provided	☐	☐	(iii) Hand Leg protection	☐	☐
6. Water hose provided to keep area wet.	☐	☐	(iv) Respiratory Protection	☐	☐
			(v) Safety Belt	☐	☐
7. Use of Steel Hammer not Allowed/Brass Hammer Allowed.	☐	☐	(vi) Head/Ear Protection	☐	☐

Special points for compliance : 1.

2

3

The Permit expires at ____________ Hrs ____________ Date

Work completed date ____________ Hrs ____________

Note : In case job is not taken-up within the same shift of issue of the permit it must be renewed by endorsement of incoming Shift in-charge by incorporating necessary charges.

____
Sign and name of the Shift Engineer
Shift-Area Incharge

____
Signature and name of the Engineer
returning the permit

This permit is not valid in the event condition in the immediate are become hazardous from conditions not existing when this permit was issued.

Permits must be returned to the originator after completion of job.

IN DUPLICATE

INDIAN PETROCHEMICALS CORPORATION LIMITED 3

ELECTRICAL LOCKOUT PERMIT

ATTACH 2

DATE № 8706

A

SHIFT

A1 Plant__________ Section / Area__________

A2-Equipment on which Shutdown required__________

A3 Reason for shutdown & duration__________

A4 Name & Signature of the Person Agency :__________ Time__________ Hrs.
requiring shutdown.

NAME & SIGNATURE OF AREA INCHARGE—Sign. :__________

Name : (__________)

B. ACTION TAKEN TO DE-ENERGISED (ISOLATION) FOR SAFE WORKING

(Tick Mark Applicable)

ITEM	YES	NOT REQD	ITEM	YES	NOT REQD
B1-Switch Made off	☐	☐	B8-Caution board placed	☐	☐
B2-Main fuses removed	☐	☐	B9-All connected interlocked equipment isolated. if yes, mention number of equipment.	☐	☐
B3-Control fuses removed	☐	☐			
B4-Main breaker racked out in test position.	☐	☐			
B5-Local Switch put on / off & local position locked.	☐	☐	1. __________		
B6-Any padlocking done	☐	☐	2. __________		
B7-Earthing done. if necessary.	☐	☐	3. __________		
			4. __________		

I declare that the equipment mentioned above is safe to work and the same will not be made alive for operation until this lockout permit has been cancelled by the agency taking, shutdown, Name of Technician isolating :__________ Date :__________ Time__________

NAME & SIGNATURE OF SHIFT INCHARGE [ELECTRICAL]—Sign. :__________

Name : (__________

C

C1-I declare that the work has been completed, men and materials have been removed from the place of work and the equipment can be started if no other agency is working, the Lockout permit is hereby returned

Person returning Lockout Permit : Sign :__________

Name : (__________

C2-I declare that the equipment is safe for starting and no other WORK PERMIT has been issued on this & connected interlocked equipment.

NAME & SIGNATURE OF AREA INCHARGE—Sign. :__________

Name : (__________

Date__________ Time__________

D. THE EQUIPMENT MENTIONED ABOVE HAS BEEN ENERGISED AFTER CHECKING FOLLOWING.

	YES	NOT REQD
D1-Checked, No other Lockout Permit is/are pending on this or interlocked equipment.	☐	☐
D2-All connected interlocks restored.	☐	☐
D3-Field Tag received.	☐	☐
D4-Caution board removed.	☐	☐

Name of the Technician Energising__________ Date__________ Time__________

NAME & SIGNATURE OF SHIFT INCHARGE (ELECTRICAL)—Sign. :__________

Name : (__________

Date__________ Time__________

Adroit Printers 2 x 1 x 100 x 800 ( ) 1 x 86

IN DUPLICATE

"GOOD HOUSE KEEPING NORMS" FORM

ATTACHMENT-3
(Ref-P-10)

UNIT/~~AREA~~/DEPT. ________________

DATE/MONTH ________________

VISITED BY ________________

Sr. No.	~~HOUSE KEEPING ASPECTS~~/POINTS HOUSE KEEPING ASPECTS/POINTS	MARKS OBTAINED OUT OF ~~10~~ 5
1	General appearance neat and tidy.	
2	All walkways, approaches clear and free from obstruction.	
3	No leakages or spreading around of products manufactured or used in that area. No wastage.	
4	No leakages of Utilities, i.e. Steam, Water, Air, Inert Gas, Fuel etc.	
5	All drains clean and properly covered.	
6	All materials & spares stored in neat and orderly manner.	
7	All machines/equipment free from oil/grease dripping.	
8	Cotton waste, snacks (Nasta) packets, papers etc. not scattered.	
9	Service hoses, tools, equipment, drums, etc. kept neatly and orderly manner.	
10	All Safety & Fire appliances kept at specified place and in order.	
11	All caution/sign, display boards and notice boards in position and kept up-to-date.	
12	All furniture and fixtures in good condition.	

....2

2 SHEETS

Sr. No.	HOUSEKEEPING ASPECTS/POINTS	Marks obtai[illegible] out o[illegible]
13	Up-keep of the entire area and offices with aesthetic sense.	
14	All equipment, appliances etc. painted and have good look.	
15	Roof, fixtures, and fittings free from cobwebs.	
16	Collection of scrap and garbage in proper containers and dust bins and cleaning done at regular intervals as necessary.	
17	No loose and hanging electrical wires. All electrical fittings in order.	
18	No accumulation of unwanted equipment, pipe & fittings, scrap, packing cases and bags, unwanted material etc. around the buildings/area.	
19	Gardening, lawns etc. around area is well kept and in pleasing condition.	
20	Lavatory block, wash basins, water cooler etc. clean and in good condition.	
	TOTAL MARKS	

Final Grade:__________________

Signature:__________________

PLANT SAFETY ENGINEER'S DAILY REPORT

DISTRIBUTION :
PM
SS
Office Copy

Date ____________________

Plant/Area ____________________

Name of the Safety Engineer ______________________________ Sign ____________________

A Plant Position

Running Normal
Partly shut down
Shut down

Important sections/areas/equip-down

____
____
____
____
____

Safety checks on specific hazards in these down areas

____
____
____
____
____

B. Permits/Clearances etc.

1. No. of hot work permits checked and issued

____

2. Important hot works carried out

____
____
____
____
____
____

3. Any abnormality in work permit, Elect. lockout etc.

____
____
____
____

C. Mishaps, Fires, Accidents etc.

Fire	Yes	No.
Mishap	Yes	No.
Accident/ Injury	Yes	No.

[If yes, give details on other side]

D. Important points from plant shift log for follow up investigation etc.

____
____
____
____
____

F. Safety Good House keeping round/ meeting/contact etc.

____
____
____
____

F. Unsafe Act/conditions observed and corrective actions taken

____
____

G. Scheduled Daily check/weekly check/Monthly check – Details

____
____

(Use reverse side for more on any point of the report)

Attachment : 4
(Ref P-13)

2

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ATTACH- (5)
2

Form No. : SD/2

ORIGINAL
for Safety Dept.

INDIAN PETROCHEMICALS CORPORATION LTD.

ACCIDENT INVESTIGATION REPORT

To :

Safety Department

Type of accident

☐ INJURIES (Personnel including Casuals/Contractors)

☐ NARROWLY MISSED ACCIDENTS

☐ DAMAGE (Equipment/material)

From :

Dept. ______

Div. ______

Plant/Project ______

Contractor ______

1. Name of the Injured / equipment ______
2. Empl. No. ______ 3. Age ______ 4. Designation/occupation ______
5. Date & Time of accident ______ Hrs.
6. Hrs. at which Injured started work ______ Hrs.
7. Location of accident ______
8. Length of service with company ______
9. Nature of Injury/damage ______
10. Type of Injury ☐ MINOR (First-aid) ☐ MAJOR (Lost time case) ☐ FATAL
11. Will injured remain away from work ? ______ If so, how long ? ______
12. What job was being done ? (Also indicate tools, materials machines used by injured)
13. Description of accident ______
14. Cause of accident ______
15. Give here code Nos. of accident causes from the list printed overleaf ______
16. What Steps were taken to prevent similar accident ______
17. What other Steps should be taken to prevent reoccurrence ? ______
18. Names of two witnesses along with designation & Empl. No.
   1 ______
   2 ______

Date

Sign. ______

Name ______ (Supervisor)

Date

Sign. ______

Dept. Head/Div. Head

Name ______

IN QUADRUPLICATE: ORIGINATOR, SAFETY DEPT.
PERSONNEL DEPT., MEDICAL CLINIC

CAUSES OF ACCIDENTS

1. **FAULTY SHOP-PLANT LAYOUT/DESIGN**
   a. Wrong position of machine/equipment
   b. Inadequate space-exits-walkways sharp bends
   c. Insufficient light
   d. Insufficient ventilation
   e. Excessive heat
   f. No safe access to remote or high places
   g. Unsafe process
2. **FAULTY CONSTRUCTION**
   a. Non standard construction
   b. Insecure foundation
   c. Uneven floors
   d. Slippery working surface
3. **DEFECTIVE TOOLS/EQUIPMENT**
   a. Unguarded/Inadequately guarded machinery
   b. Faulty equipment/tool
   c Elect. tool/Equipment not grounded
   d. Live electric wire/connection
4. **FAULTY OPERATIONAL METHOD**
   a. Failure in complying Elect. lockout procedure
   b Make Shift arrangement
   c. Working with guards removed opened
   d. Use of underrated equipment/material
5. **SUPERVISION FAILURE**
   a. Lack of adequate instructions (None, not enforced, Incomplete, wrong)
   b. Inadequate Supervision
   c. Inadequate Training
   d Bad House Keeping (Congestion, Improper storage, Slippery floors etc.
6. **HUMAN FAILING & BEHAVIOUR**
   a. Non compliance of rules/Instructions
   b. Failed to wear Personal Protective Equipment (Safety helmet, goggles, face shield, Apron, gloves shoes etc.)
   c. Operating without authority
   d. Taking Chances/Short cuts
   e. Failure to recognize potential hazard
   f. Horse-play
   g. Haste
   h. Lifting/Storing improperly
   i. Physically unfit (weak)
   j. Incompetent (Unexperienced, unskilled)
   k. Over confidence/faulty Judgement
   l. Negligence, Inattention
   m Improper attitude
   n. Action of fellow employee
   o. Mental disturbances.

---

for Safty Dept use only]

Accident Reference No. ____________

Type of Accident

☐ Minor (first-aid case)

☐ Lost time/Disabling injury causing loss of Less than 48 Hrs.

☐ Lost time/Disabling Injury causing loss of More than 48 Hrs.

☐ Fatal

☐ Damage ☐ Dangerous occurrences

☐ Total Days Lost

This is reportabe/Non reportable accident case. As per Rule 103 of Gujarat factories Rule 1963 requires/does not require action for reporting to Govt. authorities.

Sign ____________________
Safety Dept.

1. Acc. Report received by Safety Dept. on __________ at __________ Hrs.
2. Acc. Report sent to Factory Inspectorate on __________ at __________ Hrs.

ATTACH- ५
6

FORM No. 21

(Prescribed Under Rule 103)

Notice of Accident or Dangerous Occurrence

1. Name of Occupier :

2. Address of works where accident or dangerous occurrence happended. : Indian Petrochemicals Corpn. Ltd., P. O. Petrochemicals, Dist. Baroda. PIN - 391 346.

3. Nature of Industry : Manufacture of Petrochemicals.

4. Branch or Department and exact place the accident or dangerous occurrence happended. :

5. Injured person's name and Address :

6. (a) Sex (b) Age (Last Birthday) (c) Occupation of injured person. :

7. Date & Hour of accident or dangerous occurrence. :

8. Hours at which he started work on day of accident. :

9. (a) Cause or nature of accident or dangerous occurrence. :

   (b) If caused by machinery :
   - (i) Give name of the machine & part causing the accident &
   - (ii) State whether it was moved by mechanical power at the time.

   (c) State exactly what injured person was doing at the time.

10. Nature and extent of injuries (e.g. fatal, loss of finger, fracture of leg, scald, scratch followed by sepsis.) :

11. If accident is not fatal state whether injured person was disabled for 48 hours or more. :

12 Name of Medical Officer in attendance on injured person. :

I certify that to the , of my knowledge and belief the particulars are correct in every respect.

Date & Place :

(Factory Manager)
Indian Petrochemicals Corpn. Ltd.

Date of despatch of report :

SURVEY OF SMOKING PRACTICES

Plant/Area : ______________ Month/Year : ______________

Sr. No.	Provision of Smoking Booth			Condition of Elect. lighter			Observation of Abnormal practices mentioning the location too.	Remarks
	Yes	No.	Nos. of smoking booth	Operative	Non-Operative.	Under repair		

Name of Safety Engr. ______________

Signature : ______________

Attachment. (6)
(Ref P 13)

7 SHEETS

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2

INDIAN PETROCHEMICALS CORPORATION LTD.

SAFETY DEPARTMENT

Survey on Portable Electrical Tools/Welding machine Hand Lamp etc.

✓ OK

X Not Satisfactory

Plant :

Date/Dates of Survey

Name & Sign. of Safety Engineer

Sr. No.	Type of Tools	Make/Identification No.	Quantity	Location
1.	2.	3.	4.	5.

3

INDIAN PETROCHEMICALS CORPORATION LIMITED

SAFETY DEPARTMENT

PLANT :________ SURVEY REPORT OF TRIPS/ALARMS MONTH/YEAR________

Sr. No.	Tag No.	Description	Set Value Alarm/Trip	Checked on	Reason if bypassed	Remarks

INDIAN PETROCHEMICALS CORPN. LTD.

SAFETY DEPARTMENT

Survey of Sample Bombs in Laboratories

Month ________

Area ________

Period of Survey ______

Sign. of Safety Engr. ______

✓ Satisfactory

X Not Satisfactory

S Stanehopeseta

N None

Suppliers test is for 1600 psi

Sr. No.	Make	Service	Capacity	Working Pr.	Valve I	Valve II	Rupture disk	Tested	Remark.

SURVEY OF LIFTING TACKLES/HOIST/CRANES/LIFTS

✓ OK
X Not OK

Plant :__________
Deptt/__________
Sec.
Period of Survey__________

r. o.	Type of lifting tackle	Capacity	Identification No.	Location	Year of installation	Year of periodic Testing/ Inspection	Upkeep maint. practice	Present condition	Remarks

Signature & Name of
Safety Engr.__________

To, SM
SPM/SR.MGR.

SURVEY OF LIFTING TACKLES/HOIST/CRANES/LIFTS

✓ OK
X Not OK

Plant :
Deptt/
Sec.
Period of Survey

Sr. No.	Type of lifting tackle	Capacity	Identification No.	Location	Year of installation	Year of periodic Testing/ Inspection		Upkeep maint. practice	Present condition	Remarks

Signature & Name of Safety Engr.

To, SM
SPM/SR.MGR.

103

SAFETY DEPARTMENT

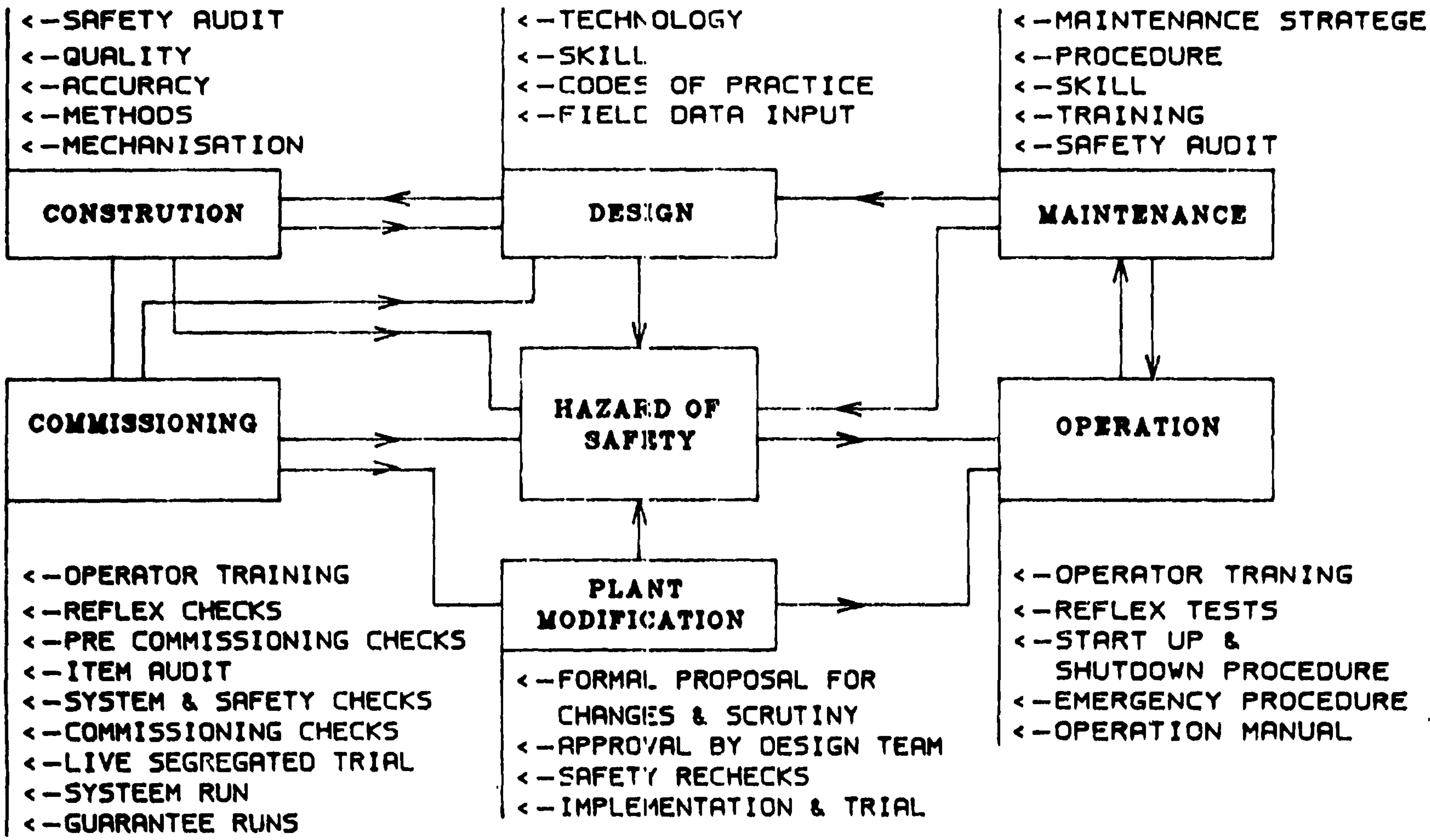
SURVEY OF NIPPLES

PLANT/AREA : _____

MONTH/YEAR : _____

Sr. No.	Location/ Line	Service	Nipple Size (dia.)	Pressure kg/cm^2g	Temp. ^oC	Type of plug (internal/ external/ cap/flange etc.)	Condition of nipple (corroded/ burried/ open/in pit	Condition/ position of upstream valve	Approach for maint/ repair/ survey	Remarks
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.

SIMPLIFIED MODEL OF HAZARD SOURCE OF AN INDUSTRIAL PLANT



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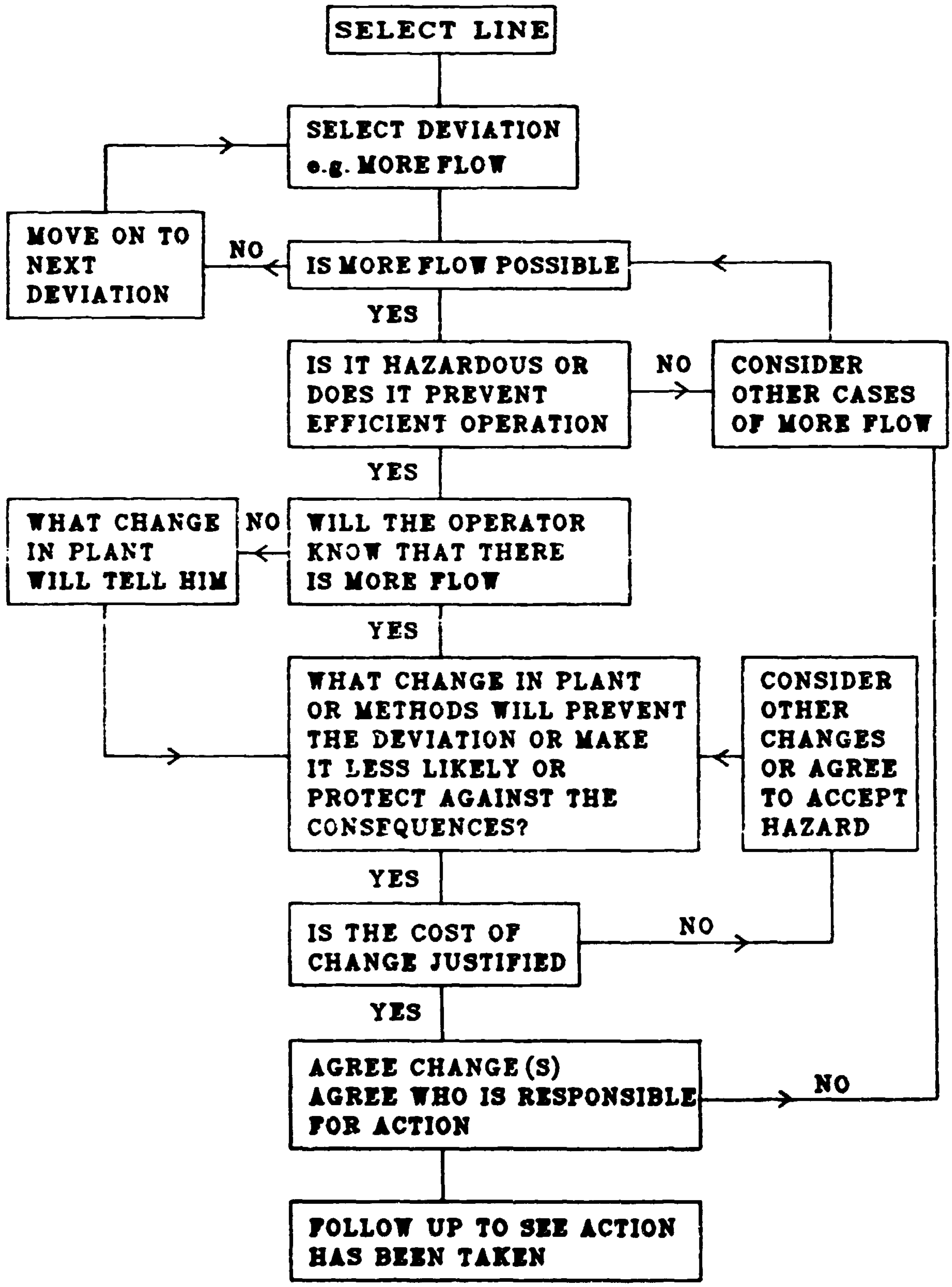
HAZOP PROCEDURE



CHAPTER 7

MAINTENANCE ENGINEERING SERVICES

CHAPTER 7 : MAINTENANCE ENGINEERING SERVICES

INTRODUCTION :

Arak Petrochemical Complex is located at about 25 km from the Arak town and having only the neighbouring industry the seventh oil refinery of NIOC being set up at the same time. Around the town there are other engineering industries like AZARAB , Machine Sazy Arak , Wagon Sazy Arak , which are basically fabrication shops .

Thus such a pertrochemical complex is being set up at a relatively remote place. It is expected that once commissioned (around end 1992) the complex will have to operate round the clock and turn out desired products. Apart from the raw materials , chemicals and other inputs, the complex will need essentially the back-up services like Maintenance , Technical , Materials , etc. Maintenance Engineering Services (MES) will be one of the important and essential one , to ensure steady - state run of the complex . Not only it will ensure the uniterrupted operations of the complex , but also will take care for the long term health of the plants.

AIM OF MES :

: To ensure high level of equipment availability in a process plant , since the opportunity cost of downtime is very high .

: To ensure constant review and control of maintenance costs of equipments .

: To ensure safe and efficient operation of the equipment and with longer life.

: To optimally utilise scarce resource and build up high level of expertise/skills in selected areas of specialisation under the centralised services(function).

: To develop vendors for the resources and services.

: To achieve productivity improvements and cost control measures .

APPROACH :

The Maintenance Engineering Services (MES) can be partly decentralised for making it more effective and useful.That means the routine day-to-day maintenance can be taken care of by the plants/plant-group (supported by a maintenance group/task force under the plant management) whereas the specialised services and functions can be centralised under the maintenance head.ARPC'S approach in establishing the MES is in the same direction . In the organisation structure (ref Attach. NO.1) although the field Maint. Head is shown reporting to the Central Maintenance head , virtually the maintenance staff working in the field will be taking instructions for the day-to-day activities from the Plant-In-Charge (Manager or a Senior Manager) and satisfy the need of operations on the spot .This not only will save time in communication but will result in performance improvement.

ADVANTAGES OF SYSTEM:

1. Allows for a united command under the in-charge of the plant or group of plants. The incharge is also fully responsible for the production as well as routing maintenance of the plant/plants. As a result,many of the traditional production/maintenance conflicts get resolved at the local plant level itself.
2. The dedicated maintenance personnel of a plant-group develop a good understanding of the plants and their Operations. This familiarity and the interfunctional (Mech.Elec,Inst)team working under the Manager (Maintenance)helps in producing better Maintenance Managers as well as Plant In-Charge(irrespective of their discipline). In fact, this brings in maintenance personnel interaction and identification with the plant almost complete.
3. Interaction and continuous interaction between production and maintenance results in cutting down the formal communication. (Paper work , other than work-permits) leading to much faster response time.
4. In this arrangement/system emergencies are quickly and efficiently attended to. Similarly major shutdown and overhauls are efficiently managed due to close co-ordination/interaction.

5. The engineering services at the centre can develop unique expertise in the areas like :

- Rotating Machines : special maintenance
- Quality Assurance-NDT service
- Maintenance of heavy construction equipments
- Maintenance and up-keep of DCS-system

6. The MES plays an important role in laying down long-term targets and strategies of the complex.

ORGANISATION - STRUCTURE:

To ensure and provide effective service to the operations and in turn to the complex, the MES can function as per the organ. structure proposed in the Attachment-1 . The structure is mostly in line with that planned at ARPC with slight modificaiton-suggesting decentralised working arrangement.

The maintenance group in the plant will be administratively under the Plant Group Head and functionally responsible to the Central Maintenance Engineering Head.

ROLE AND RESPONSIBILITY

1. Plg Activities
   - Scheduling of shutdowns / turnarounds
   - Preventive Maint. Scheduling/planning
   - Spare parts, Plg and Control
   - Standardisation
   - Documentation
   - Annual Rate Contracts

2.	Expert Services	- Rotating Machinery monitoring, over hauls - Corrosion Control/Inspection NDT - Problem Analysis and solution in maintenance and equipment per- form ance.
3.	Plant Insp. Servuices	- Quality Assurance Function - Static and Dynamic Equipments
4.	Common Facilities	- Central Workshops (M,E and I) - Instrumentation-Calibration - Computer (systems) - Electrical Repairs - Maint of Cranes,Heavy/Light Vehi- vehicles, Const. Equipments
5.	Project Mgmt.	- Design, Detail Engg. Constn, Commissioning - Modification Schemes in consultation with Technology (Process Engineering)

MAIN FUNCTIONS OF MAINT ENGG

(A) CENTRAL

1. Planning and issue of P.M Scheduies to plants and main tain maintenance records.

2. Maintaince and overhaul of Critical Machines.

3. Ensure availability of equipments and control costs as per target (cost including plan for Repairs, Renewals, Replacements)

4. Plan for major shutdowns at complex level.

5. Operate and maintain centralised facilities like Work Shops, Cranes,Const. Equipments.

6. Co-ordinate Materials Function for complex level Spares , Materials with respect to Standardisation , Inventory control (of engg spares), Vendor Development, Insp, etc.

7. Maintain link with neighbouring and other industries to share facilities/expertise.

8. Maintain information/data on local services, facilities/ developed vendors/suppliers.

9. Monitor and maintain performance data of A & B Class equipments and plan their renewals/replacement.(classi fication on the basis of value and criticality)

10. Data bank on maint schedules, spares (including insurance spars) management etc, for A,B equipments.This wil be computerised and tailor made.

11. Lay down annual rate contracts (possibly for heat exchangers cleaning, valve repairs, rigging/scaffolding A/C maintenance, civil maint. Jobs , C/V repairs, etc. etc.)

12. Engineering and Project Management for plant-level modifications jobs/schemes alongwith Process Engg.

13. Provide complex level feed-back for new projects.

14. Develop and maintain system engineering group as a support to plant operations.

15. Manpower planning for maintenance engineering including rotation and placement of engineering personnel.

16. Training plan in consultation with HRD, for engineering personnel.

(B) PLANT LEVEL

1. Day -to- day maintenance of all equipments within plant in close coordination with production/operations.

2. Operate the annual rate contracts of the services as lined up by central group.

3. Day- to -day link with other services like technology (Process engg), Materials.

4. Provide data to specialists at centre and avail assistance on need basis.

5. Liaison with centralised facilities like workshops, critical equipments/items repairs, inspection, testing modification(proj) group, etc.

MES - INTERACTION WITH :

A.MATERIALS :

: Level of stock items and inventory monitoring and control particularly for engineering spares

: Levels of insurance spares and their replenishment of

: Spare parts manuals(SPM)

: Vendor development/approval.

: Standardisation,Inspection (engg)

B.TECHNOLOGY (PROCESS ENGG.):

: Common approach to trouble shooting,analysis and solution to plant problems.
(examples-diagonise and solution for repeated hex.tube failures - may be due to faulty design, faulty matl,or faulty operation)

: Monitoring equip. performance. scheduled testing of the performance.

: Modification, Modernisation of plants.

: Renewal, replacement of equip. with better material of construction.

: Approach to efficient and energy saving operations.

C.NEW PROJECTS (SCHEMES) :

: Input and feed-back from the accumulated experience and help in selection of equipments or machines from the reliability and maintainability angles.

: Keep interface with main suppliers of large-equipments works and service-contractors,engineering consultants, vendors of various work-shops, services,etc.

COMMUNICATION:

Liaison and communication is very important in performing the services more effectively. This would maintain close co-ordination and keep up inter-relations between the concerned groups with better understanding. Following forums of meetings and participation may help:

1. Regular weekly meeting chaired by Maintenance Engineering head and attended by sectional head of central engineering and maintenance leaders (Manager) from the plants/plant groups.

2. Participation of Maint.Engg.Head in a regular production, planning meeting called by the Operations Head.

3. Participation ofthe Maint. Engg.Head and the sectional heads of central engg in co-ordiantion meeting called by materials , technology and personnel/administration/ finance heads.

4. Twice a month meeting called by section heads of the central engineering with respective discipline representatives and the maintenance leaders(manager)of the plants/plant-groups.

5. Maintenance leader/Manager of the plant to attend regular meetings called by plants-in-charge or head of the group of plants.

6. Planning head to have regular meetings with materials department for monitoring and control of spares, inventory and critical requirements.

7. Any other meetings can be arranged on need basis.

RECOMMENDATIONS:

1. ARPC due to its relatively remote location have to overcome the problem of trained and experienced/expert manpower availability. There will be a need to attract or develop service anciliaries/agencies (or to look for competent service organisation) who can provide

experts,diagnostic maintenance contracts. ARPC can then sub.contract such service jobs.

2. Also with the coming up of adjoining refinery, there is a possibility of sharing the services expertise in the field of maintenance. It may be possible to jointly sponsor/promote(since ARPC is part of NIOC/NPC) service anciliaries.

3. As mentioned earlier, ARPC have planned to organise the maintenance services with the right approach, however, the services from this functions will not be available during the period of precommissioning, commissioning and start-up of the complex, since they will not be established by that time. ARPC may retain services from the construction contractors of their skilled personnel for this time.

4. As soon as possible, the appointed engineers and technicians, on completion of training, could be attached on priority with the plant construction/operation/maintenance commissioning groups so that they get tuned to the type and nature of maintenance activities of the plants. This will facilitate to provide on the job training to the engineering personnel and take over of the plant more confidently on completion of performance test runs.

5. The plants are located at quite a distance from the central workshop facilities, hence to attend to minor jobs, it may be considered to install small plant workshop facility with each group of plants. This facility can provide minor machining, grinding, welding, testing of elect/inst. etc. type of jobs.

6. In living with the present modern trend and for faster, easier, effective and correct communication and control efficiently , ARPC can plan to have computerised data bank/record and system for :

a) All Drawings and Data sheets
b) Maintenance Record and maint.Management
c) Critical spares and Inventory control
d) Shutdown maintenance and record and planning
e) Engineering Standards
f) Engineering personnel personal data files
g) Training record and plan
h) Information on vendors and services

7. It is good that shift manning of the maintenance is centralised.The number required during commissioning and start-up will be higher which can be reinforced by hiring contractor's personnel and regular number can be organised once the plants achieve normal operation.

8. On regular interval basis engineers and technicians working in plants and central engineering could be interchanged /rotated so they can have better apprecia - tion of the services on the other side .

Exception to this will be specialists and expert groups/engineers , technicians .

9. At present following services are planned from the centre , operating under central maintenance work-shops

   a) Forging

   b) Refractory-Insulation

   c) Painting-equip

   d) Painting-building

   e) Rubber lining

   f) sand blasting

   g) Carpentry

   These and the other centralised maint.services mentioned earlier are the occasional requirements of the complex.Most of the time the regular staff for this services is likely to remain idle. Hence ARPC may like to hire the services from outside agencies,This will help reducing regular number of manpower .

10. Central Maint.Engineering can formulate and advise the plant maintenance to follow the work procedures like

    - Work - Permits
    - Hot Work Permit
    - Work Orders to respective workshops
    - Electrical lock out permit

11. Central maint.Engineering can prepare budget for :

    - Annual maint.expenditure including consumables/spares- in consultation with plants

- Modification schemes including renewal, replacement-inconsultation with plants/technology and monitor with the help of finance.

Normally this should not exceed 3.5% of the costs of equipments being capitalised.

12. From the discussions on the maintenance set-up it is known that following numbers (approximate) of engineers, technicians and labourers are to be employed.

a) Engineers

	Level I	Level II	Level III	Level IV
Qualified Graduates and experience of	>10	10	5	3 years

b) Technicians

	Senior	Junior
Higher diploma and experience of	5 Years	3 Years or fresh
Diploma and Experience of		3 years or fresh

C) Labourers

Supervisor/forman - primary and experience in special skill

Technician Gr I - primary and specially skilled

Technician Gr II - primary and semi-skilled

These technicians are such as welders , pipefitters. Milwright fitters , Lubricators . etc.

Numbers	Engineers - 90	Total	380
(Approximate)	Technician - 290		
	Labourers	- supervisory	250
	Non.sup	-	490
	Total		740

Looking to the number of engineers/supervisors or the non-supervisors i,e technicians or labourers (helpers) . it is felt that the ratio of supervisory to nonsupervisors is between 1:2.5 to 1:3.0 which is not desirable. In proportion the no of supervisors is higher.

ARPC may like to examine this aspect and adjust the recruitment and organise the structure accordingly. Ratio could be 1:5 or 1:6 .

13. In the set.up of maintenace it is not clear how ARPC is going to administer or exercise maintenance function when

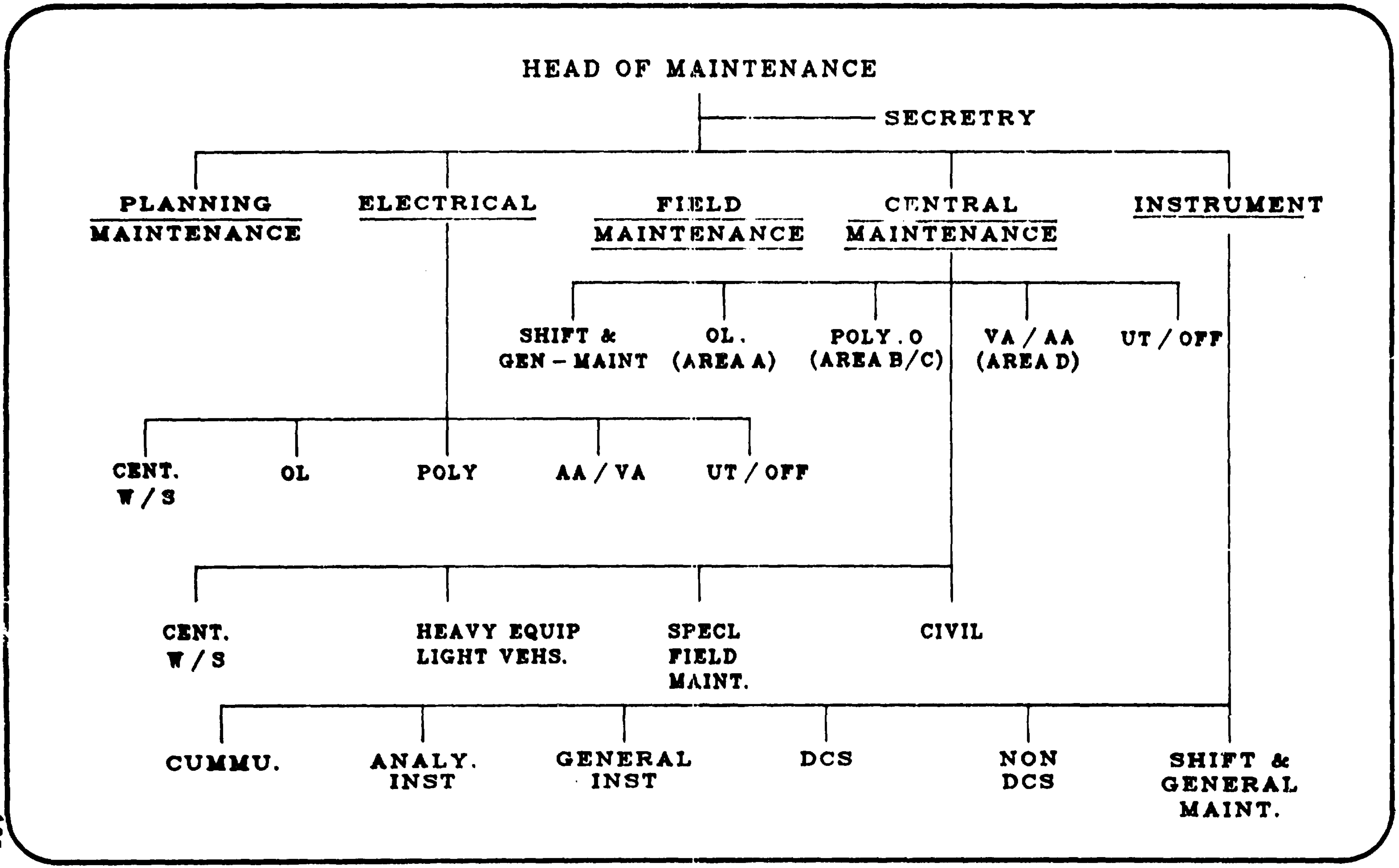
1. There are engineers (graduates - qualified) who are supervising and also there are foreman / supervisors (specially skilled) under " labourers" category .
2. Similarly there are SR./JR. technicians (higher diploma and diploma qualified) and simultaneously there are cat.i and cat.ii fitters , welders , etc.(skilled semiskilled technicians not qualified)

semiskilled tech nicians both these - 'qualified' and 'underqualified' (under labourer's category) are to work with their own hands and will be reporting to whom ?

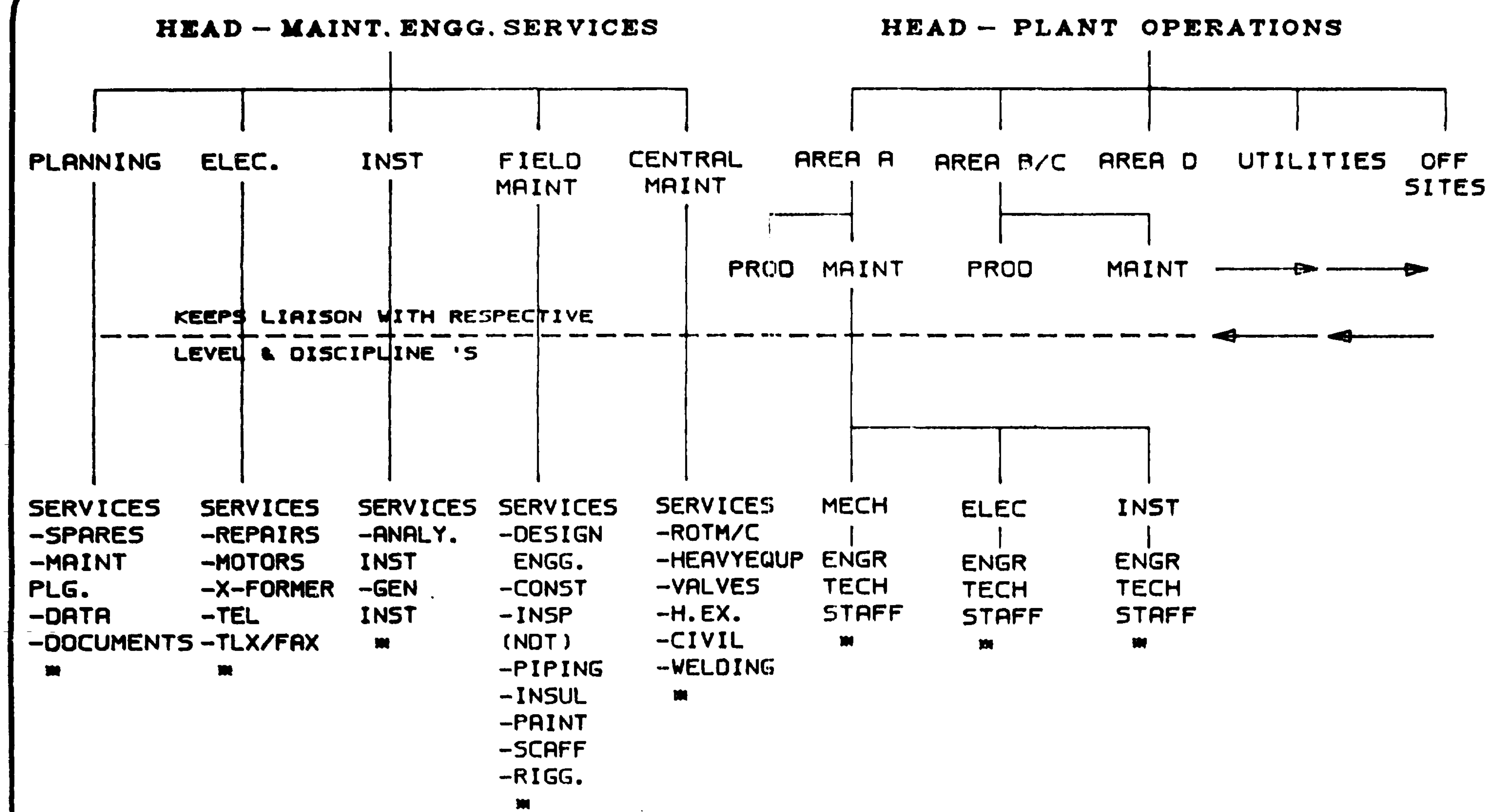
Engineers - supervisors

and/or Fromen - supervisors

To administer and operate smoothly the maintenance services - function at the centre and in the plant ARPC will have to seriously consider and reorganise working of this personnel , if necessary , in consultation with consultant , to sort our role , function , job description and responsibilities in ref to 1 and 2 above



ATTACHMENT.1



* – INCLUDES TECHNICIANS, PIPE FITTERS, WELDERS, FITTER, HELPERS. SKILLED, SEMI-SKILLED AND UNSKILLED.

ATTACHMENT.2

CHAPTER 8

TECHNICAL SERVICES

CHAPTER 8 : TECHNICAL SERVICES

INTRODUCTION:

ARAK petrochemical company is setting up a petrochemicals complex at a place about 25 km from the town of Arak.

Its main cracker plant will produce Ethylene (247000 MTA)Propylene (94000 MTA) and have downstream units of PGH, Polyolefins (LLDPE , B.1 , PP , HDPE ,BD , PBR) , AA , VA - units in phase.I and EO/EG , EA , 2E-H in phase II . The complex is having required integrated utilities and off-sites.The complex is located relatively at remote place.However the seventh oil refinery of NIOC is coming at the same time in the neighbourhood.The complex is expected to be commissioned tow rds end 1992 and once commissioned is expected to continue with stabilised operation and turning out desired products.Looking to its location , the complex will have to be self-sufficient particularly with respect to having the supporting services like maintenance engineering technical, materials , R & D , training facilities. Technical services is one of the key services without which the complex cannot sustain its optimised , efficient operations .

AIMS / OBJECTIVES :

- To achieve design capacity of the plants in shortest period after the start.up .

- To ensure safe , economic and efficient operations of all the units in the complex.
- To develop with the help of R & D , chemicals and catalysts for achieving self-sufficiency.
- To overcome obsolescence , if any , and develop and implement new schemes towards modernisation of the plants.
- To ensure quality assurance through technical audit and inspection .
- Develop over the period the 'process engineering and technology group' (capable for process design and basic engineering) for future needs.

ORGANISATION SET-UP:

It is understood that ARPC have already planned to set-up process engineering group for the purpose of technical assistance to plant operations. The same can be organised as proposed as per the attachment (enclosed).

- The technology head will independently report to the chief-executive of the complex (like in case of operations-head and engineering head)
- Technology head will have three areas under his functions namely .

  a) Technical services

  b) Fire & safety

  c) Health , Environment and Ecology

This set-up and functions of last two (b&c) have been explained separately .

- The technical services manager or a senior manager (position depending on ARPC overall organisation set-up) can be in charge of the technical services and will have following areas under his command

  a) New schemes , new projects

  b) Process plant operations - services to

  c) Central Laboratory

  d) Process Engineering and Technology

  e) Corrosion - Inspection and Quality Assurance

  f) Energy conservation - proposed for feature

The individual Manager or Asst.Mgr. responsible for the area will have qualified engineers with experience and in certain cases having special knowledge and experience / expertise as required (in case of central laboratory a qualified chemist /analyst) .

These engineers will be at intervals rotated with engineers from process operations (depending on suitability),except in case of lab-in.charge , or metallurgist and like .

ROLE AND RESPONSIBILITY :

1. Expertise services - Debottlenecking study
   - Trouble shooting analysis
   - Failure analysis

2. Audit functions	- Plants - technical audit	
	- Plants - safety audit (alongwith safety section)	
3. Development	- Plant modernisation study	
	- Substitute for catalyst & chemicals	
	- Plant/systems - modifications	
	- Modified process operations	
	- New processes	
4. Quality assurance	- Corrosion insp & control	
	- Improved metallurgy	
	- Product quality monitoring	
5. Others	- Laboratory services	
	- Energy conservation studies	

FUNCTIONS :

1. To monitor and advise on operating parameters for optimum operations of the plants .

2. To monitor and ensure quality of raw materials , chemicals and products with the help of laboratory and advise on operating instructions/parameters.

3. To monitor consumption of raw materials , chemicals , catalysts , utilities and energy and advise process operations to minimise cost of production without any disregard to safety .

4. Assist plant operations in achieving design/maximum capacity in production

5. Ensure centralised laboratory services to plants and provide laboratory assistance to plant-level

6. Organise analysis and trouble shooting of plant problems

7. Provide expertise in debottlenecking process problem

8. Monitor performance of key equipments and suggest modifications

9. Occasionally arrange with the help of plant operations, test-run of equipments/plant to check performance level and identify areas of improvement

10. Provide assistance in renewal and replacement plan of the plants.

11. Analyse equipment/item failure and advise remedial measures like change of material of construction , design , change in operating parameters , etc .

12. Monitor corrosion with the help of inspection and develop corrosion control method or suitable treatment to combat corrosion.

13. Regularly monitor the health of the equipments through inspection and predict failure , if any , in time.

14. Analyse metallurgy failure and advise better/new material of construction .

15. Provide on-line, off-line NDT inspection services .

16. Monitor performance of central waste water treatment facilities and suggest necessary improvements/modifications to achieve effective treatment .

17. Occasionally carry out technical and safety audit of the plants with the help of safety section to achieve safe and efficient operations without any loss of man or materials

18. Up.date operating manuals of all the plants

19. Design and implement with the help of engineering - any modifications or new schemes in the plants.

20. Provide technical feed-back in the design of equipments/plants for the new projects/new schemes .

21. Maintain and update the information/data on new developments of processes , technology , etc.

22. Document and maintain data related to development , inspections , etc .

23. Develop soft.ware programmes for the unit operations and keep updating for optimisation .

24. Train and develop in-house experts to achieve desired goals in plants/complex performance.

25. Organise seminars and lectures-from outside experts/ consultants-related to process operations , process technology , safety , etc .

26. Arrange rotation of qualified engineers at some intervals with engineers from process operations to have better appreciation of the respective functions and achieve maximum benefit on either side .

RECOMMENDATIONS :

1. Complex is likely to be ready for commissioning activeties in near future , hence ARPC should immediately set up technical services .

2. The process/chemical engineers , graduates and post.graduates who have been associated earlier during design/basic engineering stage can be transferred for constituting this group.

3. During commissioning stage, the services should be fully geared up and involved with the plant operations - to take advantage of knowledge about equipment performance/behaviour which can be useful as basic data for future studies .

4. Establish laboratory services and start sampling and analysing during commissioning. This will give better ideas about the on-spec/off-spec utilities , R.M , chemicals and products .

5. Also commission the laboratory equipments in time-to say that-before the plants goes on stream for regular operations .

6. Laboratory officers and staff should be trained and tuned with plant opens. simultaneously .

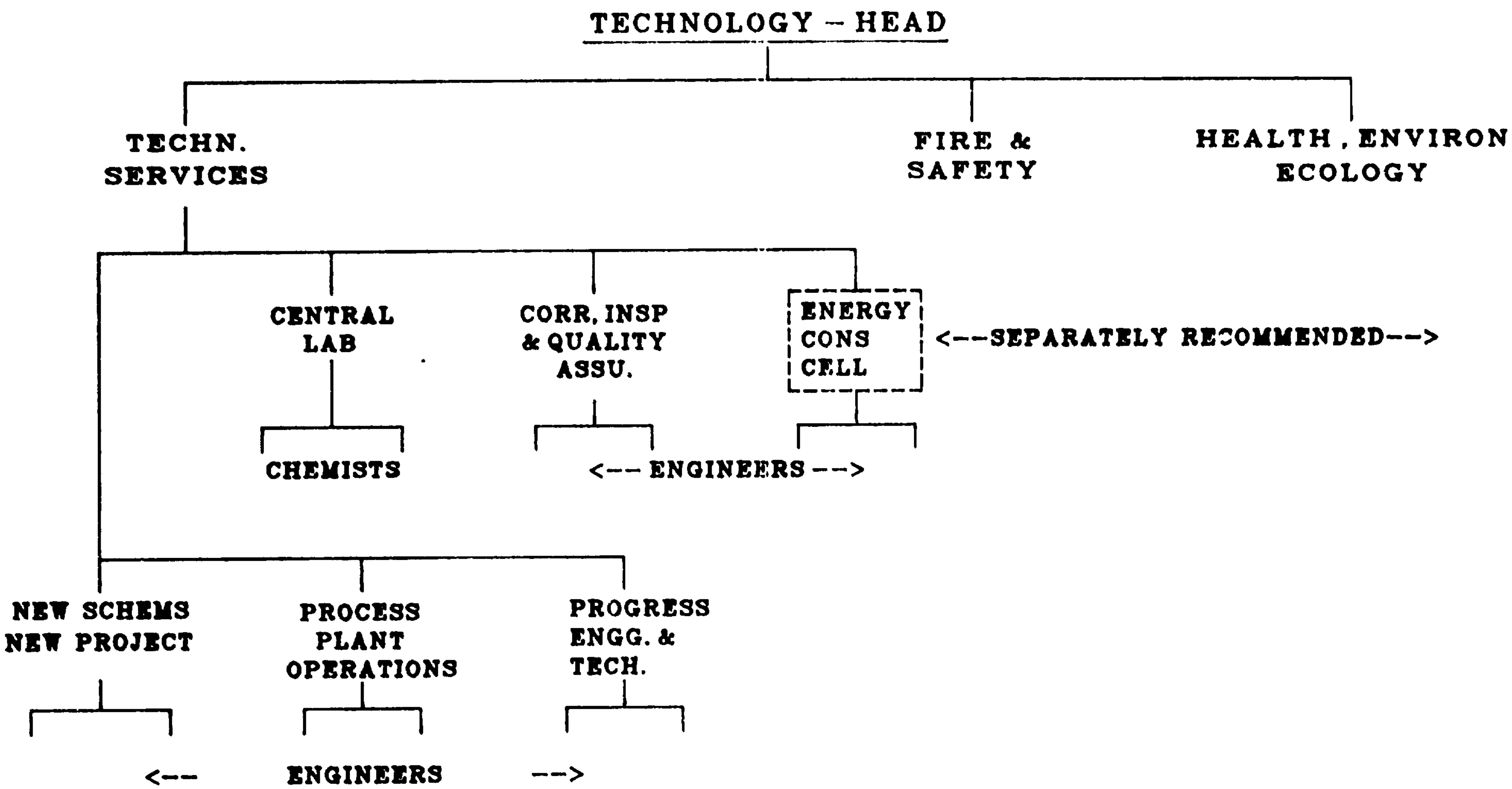
7. Technical and operations heads to meet regularly- starting from commissioning stage - with their seniors to ensure safe , economic and efficient operations .

8. Any plant - operation need to have energy-consciousness . ARPC may consider constituting a small cell under technical services which can specifically look into the areas of 'energy conservation' and 'energy - efficient operations' .

ENCL : Attachment on orgn.set-up

ATTACHMENT 15

PROPOSED ORGANISATION SET – UP TECHNICAL – SERVICES.



CHAPTER 9

TRAINING

CHAPTER 9. TRAINING

PREAMBLE:

ARPC is setting up a petrochemical complex at a place (relatively remote) about 25 KM away from the town of Arak. Its having mother cracker unit producing Olefins and the down-stream units of Polyolefin , LLDPE, B.1, PP, HDPE, BD/PBR, AA/VA in phase I. and EO/EG,EA,OXO.GAS and 2-EH in phage-II alongwith integrated utilities for Steam Air,Power,C.W, Oxygen and Nitrogen and Offsites for material/product handling and storage and the Waste,Water/Effluent Treatment Facilities.

Its a multi-technology complex where for the above units, the technology and plants/equipments are being imported for the first time in the country, from different countries. The licensors of technology are from Italy, Germany, Holland, France, U.K. and Japan.

The whole project management is co.ordinated on behalf of client-ARPC by M/S Snamprogetti, Italy and the main construction contractors are from abroad.

As per the present status the units are likely to go for commissioning and strat-up towards end 1992. The utilities may be available from May 1992 onwards. Thus the precommissioning activities are likely to start though optimistic, from April-May, 1992.

During construction, some of the ARPC personnel are coordinating the activities with MC, UCS, CCS and Vendors, on the other side the operations group is busy in establishing operations and services sections and simultaneously preparing/training the operations-personnel.

TRAINING NEED:

Such a petrochemical complex with an integrated utilities and offsites is being set up for the first time in the Islamic Republic of Iran. And the prime objective will be to achieve smooth,safe, effecient and effective operation of the complex once it is commissioned and taken over.(accepted from the licensors-unit contractors).By that time the operation and maintenance personnel have to be educated, trained and tuned for complex operations. The adequate and intensive training will bring in capability of the personnel to absorb technologies with confidence.

ARPC is facing problem of employing qualified persons with experience particularly in the petrochemicals area. About 1400 persons will be employed to operate the complex. As per the present status about 90(ninety) percent of the recruitment is over and out of which 80 percent of them are fresh without any experience. About 300 will be professionally qualified engineers and other non-supervisory will be higher diploma , diplama and others will be in the "labourer" category (sup. and non-sup.) partly educated and having experience in specific skills (like pipe fitters, machinists, welders)Operations of such petrochemicals is of hazardous nature and requires specific skill in operation and maintenance. Thus ARPC have a hard task in preparing the force before-hand to take over the complex operation without any external assistance.

TRAINING PLAN/SCHEME

With the sketchy information available about ARPC'S training plan and schemes, its learnt that in general ARPC is going on the following pattern:

1. Batch of trainees - a composite group of engineers and operators, engineers and technicians in respective deciplines.

2. Class room training for each batch for 6-8 weeks.

3. Following above 8-16 weeks training at licensers plants or similar plants of other operating companies abroad and at similar plants in home-country.

PROPOSAL :

To the above,following pattern of training scheme is suggested :

B : Supervisory Employees Training

Its meant for semi qualified, under qualified in the technical field and having long working experience in the chemical plants .

C: Non-Supervisory Employees training :

This training is for operators.

A. Management Trainees :

1. Batches to be formed:

   like - Chemical -instrumentation-incl.system engineers

   - Mechanical -Laboratory chemists
   - Electrical -Fire & Safety engrs

2. Induction Training (duration -one week)

   This will be common for all the above desciplines and will comprise of lectures on following topics:

   - Organisation- Plants and products
   - Functions of various departments
   - Rules and regulations and other facilities

A. Central Workshop: (6 weeks)

The following areas will be covered :

a) Valve repair Section

b) Machine Shop

c) Fabrication/Welding

d) Crane Section (Plant Construction Equipment)

B. Plant Maintenance : (12 weeks)

The trainees will be posted in plant to learn the maintenances of plant equipments like valves, pumps, agitators, changing glad packing/mechanical seals attending small leakages, lubrication systems and routine lubrication, removing equipments for maintenance in the plant maintenance shop.

C. Planning : (3 weeks)

To understand functions of planning wing, preventive maintenance schedule, lubrication charts, turn around schedule, history cards.

D. Corrosion and Inspection : (3 weeks)

To understand role of inspection, inspection methods, Instruments and equipments used, preparation of inspection reports.

heatexchangers, columns, boilers, etc.)

- Power generation and distribution
- Process control instrumentation
- Plant maintenance
- Laboratory testing
- Effluent treatment and pollution control
- Fire and safety related aspects
  : Safety of man, machines and use of safety appliances.
  : Knowledge and use of fire fighting equipments.

4. On-the job Training(Duration 16-20 weeks)

After orientation/ class-room training of 8-10 weeks, groups to be formed for the practical on the job training. The group should be a composite one as later on these engineers are going to work in their respective plants (like OL/PGH, LLDPE.B.1, etc) as one team. The group will have chemical, mechanical, elect; inst. engineers with a leader (of any discipline) having few years of practical experience in the plant.

a) **Instrument Repair Shop : (34 weeks)**

- Repair/Maintenance/ Celiberation of pnumatic, electrical and electronics instruments like controllers, transmitters, indicators, analysers, control valves etc.

b) **Plant Maintenance : (10 weeks in any two plants)**

- The trainees will be attached with skilled technicians in the plant to carry out small jobs on repair/maintenance/ installation/dismentling of control instruments like temperature pressure, level and flow indicators, controllers/ recorders, and analysers etc.
- Removing and fixing of control valves and transmitters etc.

c) **Place of final posting : (12 weeks)**

This is the last phase of on-the-job training and the trainee will be placed in the department/section where he will be post after his absorption.

During this period, the trainees will be able to carry out jobs like repair, maintenance, installation/dismentaling, caliberation of control instruments in the plant/ workshop independently as well as along with skilled technicians

The group will take on the job training abroad at the licenser's plants or at the plants of the similar operating companies or at home in the refineries/petrochemicals. The group will also have training in offsites & utilities at the same complex .

At the complex where training is imparted , the group can be together or separated discipline wise as per the detail training plan of that organisation/company. The leader will co-ordinate.

5. Specialised training (duration-as suited in each case): Apart from the above training, in certain areas specialised training/courses should be considered for the engineers.

The examples are:

- Rotating machines: Monitoring and maintenance
  : Vibration analysis
- Corrosion and inspection : NDT.
- Special alloys/metals: Welding
- Special fabrication
- Refractory and insulation
- Safety and safety appliances
- Fire & fire fighting equipments
- Instrumentations, Microprocessing systems
- Energy saving programmes/workshops

6. Trainers:

For class-room training, university professors, retired experienced engineers or specialist/experts and consultants in respective areas could be retained.

7. Period :

Total one year period can be allowed for

- Induction
- Orientation
- On-the-job training
- In-house, in-plant training
- Feed back and performance evaluation

B. Supervisory Employee's Training:

Particularly these persons who are employed by ARPC are coming under 'labourers'catagory and they are either under or less qualified having longer practical general or specific experience of the chemical industries. These supervisors are mainly for the field or central engineering services. Following training programme can be considered for this category:

1. Induction training: (Duration- one week)

   It may be desirable to conduct this programme in local Farsi / Persian language. This will be common programme for all categories and on following topics lectures could be arranged.

- Organization , particularly the maintenance set-up
- Plant and production
- Functions of various departments in general and particular rly of the engg. services
- Rules, regulations and other facilities.

2. Orientation programme: (Duration 8-10 weeks)

   Class-room lectures will be conducted on the subjects relevant to the category like

   - Equipments (compressors, turbines, pumps, agitators, heat exchangers, columns, etc)
   - Process control instrumentation
   - Power generation and distribution
   - Plant maintenance
   - Fire fighting equipments
   - Safety equipments/appliances
   - Films on technical subject.

3. On- the - job training: (Duration 12-16 weeks)

   For such personnel having experience of general or specific nature, the duration can be curtailed.

   The supervisors for the respective field maintenance would be deputed to similar petrochemical plants in the country or abroad. They may be clubbed with the engineer's group and subjected to maintenance training.

   For the specific areas like the following the supervisors may be sent for the special training courses :

- Rotating machines maintenance.
- Welding of special metals and alloys
- Testing and inspection
- Valve repairs
- Instrumentation: DCS control systems
- Relay testing
- Safety and fire equipment for supervisors of this section

4. Supervisory development:

In order that this supervisors can provide effective services they should be subjected to supervisory development programme of 1-2 weeks.

C : Non-Supervisory Training :

The in house training plan of one year duration for the non-superivsory employees has been recommended earlier(ref first interim report) . The details are enclosed under the title"one year training scheme") (annexure-1). This plan is implemented at IPCL, the petrochemical complex in India and found to be very successful.

PERFORMANCE EVALUATION:

In all the above cases, the performance evaluation at the end of the training is important. The assessment written and oral in case of fresh graduates and diploma holders should be organised. Final placement could be considered on such evaluation so that right man is fitted in right place.

TRAINING FACILITIES:

Following facilities recommended.

1. The computerised simulator for process operations
2. Audio-visual training aids
3. Bench scale model of equipments
4. Plant model (to the scale)
5. P.C. with CADD attachments.
6. Films on-fire fighting,
    - Safety , safety equipment handling
    - Overhauling of machines
    - On technical subjects

RECOMMENDATIONS:

1. ARPC may like to modify their training programme in view of the above suggestions.

2. After the training is over and if time permits, the engineers and technicians should be attached to construction team of ARPC to get them acquainted with their plant and start taking up precomm and comm-jobs. The process engineers and operators can associate with the commissioning engineers of UCS and start preparing/working for the precomm/comm. activities.

3. After the training in case of fire fighting and safety personnel, mock-drills should be organised to build up confidence in this services. Such training is also must for the plant operation and maint. personnel.

4. For continuing education and training an establishment of regular training centre with the facilities as mentioned above is the immediate need.

Annexure I
(21 sets)
Training

ONE YEAR TRAINING SCHEME

THE TRAINING

Training Objective

The training of fresh Diploma holders in Chemical, Mechanical, Electrical, and Instrument discipline and Degree holders in Science is being undertaken to achieve the following objectives :

- To familiarise the trainees with industrial environment.
- To develop skilled manpower for safe and efficient operations of our plants.
- To cast the foundation for development of future supervisors.
- For achieving organisational objectives like
  - Higher productivity and efficiency
  - Safety of Men - machines - materials
  - Harmonious industrial relations.

Categories of trainees - Short form & Code :

SR. NO.	DESCIPLINE	SHORT FORM	CODE
1.	Technician Apprentices (Chemical)	TA (Chem.)	A
2.	Technician Apprentices (Mechanical)	TA (Mech.)	B
3.	Technician Apprentices (Instrumentation)	TA (Inst.)	C
4.	Technician Apprentices (Electrical)	TA (Elect)	D
5.	Technician Trainees (Laboratory)	TT (Lab.)	E

NOTE : The candidates engaged under the Apprentice Act will be called Apprentices whereas those engaged under the Corporations training scheme will be called trainees. However the training programmes will remain same for apprentices as well as trainees.

TRAINING SCHEMES

For gradual skill development of Technician Apprentices, one year period is divided as under :-

Period	Programme	Location	Duration
I	Induction/Orientation	Trg. Centre	Five weeks
II	Rotational, on-the-job training in different plants/areas.	Plant Area	12 weeks
III	On-the-job training at the place of final posting	Plant Area	34 weeks
IV	Employees Development	Trg. Centre	1 week

TRAINING PROGRAMMES

Period - I (5 weeks)

a) Induction Training Rogramme (1 week)

b) Orientation Training Programme (4 weeks)

a) Induction Training Programme : This will be common for all categories and will comprise of lectures on following topics.

1. Organisation
2. Plants and Products
3. Functions of various departments
4. Rules/Regulations and facilities.

b) Orientation Training Programme

1. Class room lectures will be conducted on theoretical subject relevant to the category. A typical list is given below :-

   1. Plant processes
   2. Equipments (Compressors, pumps, Agitators, heat Exchangers Columns, spheres, boilers etc.)

3. Process Control Instrumentation
4. Power generation.
5. Maintenance of Plants
6. Laboratory testing
7. Effluent treatment and pollution control
8. Films on technical subjects.

II Safety Training Programme (1-week half day programmes) This will cover various aspects related to safety, Men and Machines and use of safety appliances.

III Fire Fighting training programme. (1-week half day programmes) This will cover the description and use of fire fighting equipments.

During the Safety and Fire Fighting training programmes, the trainees will be undergoing half day practical training in their respective disciplines as under :

Sr.No.	Category	Practical training at Trg. Centre
1.	TA (Chem.)	Computerised process simulator at Training Centre.
2.	TA (Mech.)	Mechanical workshop
3.	TA (Inst.)	Instrumentation Lab
4.	TA (Elect.)	Electrical Workshop
5.	Laboratory Technician Trainees.	Chemical Laboratory

Period-II Rotational on the job training (12 weeks)

During this training period the trainees will be rotated two to three Plants/Departments/Laboratories acquire adequate operating experience, knowledge in their discipline.

The rotation of trainees in their respective discipline will be broadly as under :

Category of Trainee	Plant/Dept./Lab	Period
A. Tech.App.(Chem.)	Any two plants (6 weeks each)	12 weeks
B. Tech.App.(Mech.)	-Central Workshop (2 plants)	2 weeks
	-Plant Maintenance	6 weeks
	- Planning Group	1 week
	-Corrosion and Inspection	1 week
	-Rotating equipment Cell	2 weeks
C. Tech.App.(Elect.)	-Power Plant	2 weeks
	-Substations	3 weeks
	-Elect. Repairshop	6 weeks
	-Planning	1 week
D. Tech.App.(Inst.)	Inst. Repairshop	4 weeks
	-Plant Maint. (2 Plants)	6 weeks
	-Planning (Inst.)	1 week
	-Communication System	1 week
E. Lab Technician Trainees	Qty. Control Lab	2 weeks
	-Polymer Lab	4 weeks
	-Chemical Labs.	4 weeks
	-Fibre Lab.	1 week
	-R&D Lab.	1 week

During this training programme, trainees will be required to work in snifts depending upon the nature of the job. The trainees will be attached to senior Operator/Technicians for the purpose of field training.

Laboratory trainees are required to work in shifts while they will be undergoing their training in Plant labs.

A detailed programme will be worked out by the respective training officer in consulation with respective head of Departments/Section/ Plant.

Period - III Intensive on-the-job training (34 weeks)

This is the most important phase of training. During this period of 34 weeks, the trainees are expected to develop enough skill to enable them to perform their job independently at the completion of this period.

During this intensive training a rigorous follow-up, both from area in-charge and Training Centre staff is necessary for effective on-the-job training of Technician Apprentices to enable them to develop their skill to a considerable level, to achieve ultimate objective of their training.

Category (A) - TA (Chem.)

During the course of this intensive training of 34 weeks, the period will be broadly divided as follows :

a) Familiarisation - (4 weeks)

The trainees will be rotated in all the sections of the plant to understand the systems inside battery limit of the plant like, different sections and the purpose of each section, equipment with tag number, control room activities, communication system, hazardous areas of plant safety precautions, location of fire fighting equipment, fire alarms, sub-station, testing lab. and connected services group outside battery limit also.

b) **Intensive Training in various sections of the Plants (30 weeks)**

The trainee will be required to thoroughly understand the following :

- Equipments, pipelines, tag numbers on the equipments, closing/opening of the valves, various operating parameters like level, temperature and pressure.
- Filing up of log sheet of the Section.
- Taking instructions and giving information to control room in-charge from the field.
- Pump operations (start/stop) Changing over of pump
- Reporting of abnormal conditions in the sections to control room in-charge.
- Start-up/Shut-down of the section - following the check list.
- Handling over of equipment for maintenance
- Isolation/Making system Hydrocarbon free/lock out and other related operation.

During this period plant Officers will follow up the training rigorously to enable the trainee to do the routine jobs independently.

Category (B) - Tech. Apprentices (Mech.)

During this training period, the TA (Mech.) will be trained as per following details :

- Testing and calibration of various electrical meters and protective relays.
- Cable jointing.
- Fault finding and new connection of communication equipments viz Telephone, loudophone etc.
- Rewinding of small motors and transformers.

b) Control Room Operations :

- Meter reading and Energy calculations
- Startup and shutdown of the system
- Preventive maintenance job of H.T. and L.T. panels,
- Transformers, Batteries and other substation auxilaries.
- Power distribution system within the complex.

c) Power generation/receiving : (8 weeks)

- Control room operations
- Meter reading, Breaker and faults.
- Startup shutdown of systems
- Preventive maintenance jobs
- Distribution system and other routine activities.

d) Place of final posting : (12 weeks)

During this last phase of on-the-job training the trainee will be placed in the department/plant where he may be posted after his absorption.

During this period the concerned engineers will follow up the training rigorously to enable the trainee to do [illegible] jobs independently.

CATEGORY (E) - TT (LAB.) - ON-THE-JOB TRAINING (34 WEEKS)

This intensive on-the-job training will be broadly divided as under to gain allround experience in lab. testing and routine working of the laboratories.

a) **Quality Control Lab : (12 weeks)**

- Instruments/equipments used for testing of raw materials, finished products, significance of the tests, test methods/ procedures.
- Routine Q.C. laboratory jobs.

b) **Plant Laboratories : (12 weeks)**

Any two plant laboratories of relatively of different nature.

- Familiarisation with lab. set up.
- Various testing Instruments/equipments/reagents in the laboratory.
- Detailed test procedures.
- Sampling points in the plant and sampling procedures.
- Safety aspects of the Job.

c) **Place of final posting : (10 weeks)**

During this last phase of on-the-job training the trainee will be placed in a laboratory where he will be posted after his absorption.

During this period the concerned lab. Chemist will follow up on the job training rigorously to enable the trainee to do the routine jobs independently.

PERIOD - IV (1 week)

- **Employee Development Programme : This programme will be common for all the trainees. Outside faculty will be called to conduct the programme. Following topics will be covered :**

- Productivity Techniques
- Communication
- Motivation
- Creativity
- Industrial Relations
- Team Working
- Discipline

PROGRAMME COORDINATION

1. TRAINEES

a) Head of the Training Department will be the coordinator for allround training of Technician and will be responsible for arranging the necessary resources.

b) Field Engineers, proficient in delivering lectures in respective discipline to trainees will be nominated to conduct class-room lectures at the training centre.

c) An officer of the Training Centre will be nominated to a category of trainees to coordinate and supervise the process of training in the plants/departments.

d) An engineer in the respective discipline would be nominated as 'Trainer' during on-the-job training period in the respective plant/area. A report from 'Trainer' and Training Coordinator from training centre would be reviewed by the assessment committee.

The training coordinator will follow up training rigorously during on-the-job training period and monitor progress of the trainee.

2. GUIDES

Dy. Manager in respective discipline will be a guide during the period of training in the respective department, the head of the department will nominate a person for this purpose.

3. TRAINING AIDS

Following training aids will be deployed for the purpose of training.

a) Instruction manuals, drawings etc. of manufacturers of machines.

b) Instruction manuals for operation and maintenance.

c) Hand-outs on different technical topics (Chem., Mech., Elect., Inst., etc.)

d) Library books for reference.

e) Computerised process simulator.

f) Films on Technical topics and safety in Petrochemical Industry.

4. REPORTS

Daily dairy will be given to each TA and he is expected to write observations, important operational instructions/ procedures/drawings and relevant technical information about what he learns during the period. This diary will be a very important document of information. The trainee should submit this diary every month to Training Officer duly signed by trainer/guide in the plant/department/Lab.

At the time of periodic assessment, final assessment, the diary will be reviewed by Assessment Committee members.

Assessment Committee will not assess TT. who fails to submit the diary prior to the assessment.

PERFORMANCE REPORTING

The overall performance reporting system is based on the following:

1) Periodic Assessments (Quarterly, Half Yearly, Profinal and Final)

2) Confidential Reports

3) Daily Diary

1) **Periodic Assessments :**

These assessment will be conducted at the Training Centre by the members of approved assessment committee for the purpose :

Assessment Schedule :

Sr. No.	Month from date of joining	Assessment number	Remarks
1.	3rd Month	Ist	Ist Quarterly assessment.
2.	6th Month	2nd	Half yearly assessment.
3.	9th Month	3rd	3rd Quarterly Assessment.
4.	11th-12th Month	4th	Final Assessment

Assessment Committee

a) **Quarterly Assessment (I&III)**

This will comprise of the following :

Deputy Training Manager	(1)	
Deputy Managers	(3)	(From respective disciplines and plants/deptt. depending on the category of apprentices.

Training Officer	(1)	Training Officer Attached to the group of trainees to co-ordinate the training.

b) Half Yearly Assessment

Training Manager	(1)	
Managers	(3)	(From respective discipline and plant/ department depending on the catatory of apprentices.
Safety Manager	(1)	
Training Officer	(1)	

c) Final Assessment

Head of Training Deptt.	(1)	
Senior Managers	(3)	(From Operations/ Engineering/Personnel)
Training Manager	(1)	
Training Officer	(1)	

Head of Training Department will nominate the above mentioned Officers as assessment committee members considering the category of Technical Apprentice and obtain approval of the Director (Personnel).

2) Confidential Report

At the end of every quarter (period 3 months from the date of joining), confidential report form will be seperately filled by Training Co-ordinator (counter-signed by Training Manager) and the head of department/section where the trainee is placed for training). The average of the two above ratings will be considered as the performance of the trainee for the quarter.

Shortcomings if any as reflected in CR form will be conveyed to the apprentices.

5) Daily Diary

This diary is to be submitted by the trainees to their respective training officer every month in the Training Centre. The training Officer will check the diary work on a regular basis and guide the trainee accordingly.

This becomes an important document for the trainee as it has bearing on his performance rating.

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ASSESSMENT FORM

[For I-Quarterly Assessment]

Assessment :

Date :

Time :

DISCIPLINE :

CATEGORY :

Sr. No.	Name S/Shri	Code No	Plant Area	Rating: Knowledge about, the organisation. (50)	Rating: Knowledge about, the discipline (40)	Rating: Expression (10)	Total Marks (100)
1	2	3	4	5	6	7	8

Signature of Assessment Committee Member

Name : ________________

Designation : ________________

INSTRUCTION TO COMMITTEE MEMBERS :

1) During this assessment, the assessment of the trainee should be based on Induction and Orientation training programme.

2. Assessment should be based on the job requirement and relevant knowledge about the job of the trainee, as expected from the cadre.

ASSESSMENT FORM

[For II, III, and Final Assessment]

Assessment : ____________

DISCIPLINE : Date :

CATEGORY : Time :

Sr. No.	Name S/Shri	Code No	Plant/ Area/ Deptt	Ratings: Job knowledge (50)	Expression (20)	Review of report of performance in previous Qtr. (30)
1	2	3	4	5	6	7

Signature of Assessment Committee Member

Name : ____________

Designation : ____________

INSTRUCTION FOR FINAL ASSESSMENT COMMITTEE MEMBERS:-

1. During the assessment job related traits as identified will be taken in account.

2. The committee members will be objective while assessing the trainee keeping in with relavent works area.

3. The suggestion about trainees absorption if any, should be based on trainee's performance in the 34 weeks intensive training period.

4. Committee should be very objective while recommending further course of action.

CONFIDENTIAL

INDIAN PETROCHEMICALS CORPORATION LIMITED

HUMAN RESOURCES DEVELOPMENT SECTION

-: CONFIDENTIAL REPORT FOR TRAINEES :-

IMPORTANT :-

1) Judgement should be based on the performance during the entire period of appraisal and not on isolated incident.

2) Each factor should be appraised independently and uninfluenced by the rating on other factors.

3) Excellent below average Rating to be supported by explanation/evidence.

Name of Trainee : Shri ____________________ Plant __________

Code No. : 04/ ____________________

Category : ____________________

Discipline : ____________________

Period : From ____________________ To __________

Sr. No.	Attributes	Maximum Marks.	Marks obtained.
1.	Job Knowledge	35	
2.	Initiative	15	
3.	Conduct & Behaviour	10	
4.	Co-Operation & Team Spirit	10	
5.	Expression (Oral)/ (Written)	10	
6.	Punctuality & Discipline	10	
7.	Sincerity	10	
	TOTAL	100	

RATING GUIDE

Excellent	: 85 - 100%	Good	: 60 - 69%
Very Good	: 70 - 84%	Average	: 50 - 59%
		Below Average	: 50%

Signature & Stamp of the Assessing Officer.

Signature & Stamp of Sectional/Deptt. Head.

CHAPTER 10

ENVIRONMENT AND ECOLOGY

CHAPTER 10 : ENVIRONMENT AND ECOLOGY

1. GENERAL:

Environmental protection is the subject of a large number of Laws, Regulations, Conventions and Practices prescribed by the National Government coupled with international Conventions and Agreements where in both the government and industry undertake to ensure that all due care is given to conservation of natural environment whilst at the same time providing the industrial development the country needs. "To defend and improve the environment for present and future generations has become an imperative goal of mankind" as qouted by Stockhom conference Proclamation (1972). To this ARPC approach for environment and ecology (E&E) management should be comprehensive on the basis of most realistic environ mental standards to be attained and maintained for the satisfactory quality of life and work.

2.GOAL /OBJECTIVE

Following aspects should be considered to fix up the GOAL and OBJECTIVES.

(i) To treat all wastes, liquid, solids and Gaseous which contribute to the degradation of E&E.

(ii) To comply with all regulations stipulated by government for air and water quality. hazardous waste, land use strictly in design, construction & operations of the units.

(iii) To encourage, support and develop achieving realistic environmental standards and improve environmental management.

(iv) For better enviromental management, share with others new methods and techniques being developed.

(v) To cooperate with government industries and associations in establishment of pollution criteria and standards which relate either to own operations or the use of own products.

(vi) To keep informed the employees, authorities and the public about the environmental activities.

(vii) To anticipate and have long range plan for the future environmental needs.

(viii) To organise environmental audit periodically to ensure proper working of pollution control activities.

3. ENVIRONMENTAL MANAGEMENT.

The measures taken by ARPC to protect and conserve environment are highlighted below:

3.1 CLIMATOLOGY :

Climatic factors like rainfall, ambient temperature evaporation rate, cloud-cover, and radiations have significant effects on the quantity, quality and biological activity of the waste waters and their mode of dispersion and disposal. Winds have profound effect on the dispersion of waste gases in atmosphere. Design basis considered for effluent treatment and waste disposal system by ARPC, are :

Temperature: (Process design) Dry Bulb: Max 40 C, Min: -16 C

(highest recorded: 44 C

lowest recorded : -28 C)

Wet Bulb: Max 21 c (for Air coolers)

Relative humidity: Max 86% (in January)

Rain Fall: Max 80 mm 24 Hrs.

Max 40 mm 1 Hr.

(Rainy season months-November through April)

Barometric pressures: Min-802 Max-818 Milli Bars
average-810 Milli Bars

Wind: Prevailing direction: West- East

Velocity: Max 120 kmph (at 10m above grade)

The weather conditions indicate the presence of FOG and ICE. Dust storms are common at and around site area. Frost line is 1.0 M below grade level. Water table is 15M (approx.) below grade level.

3.2 WATER SUPPLY

WATER holds the key position among the major utilities requirements of ARPC. It is required for process cooling water, D.M.water, drinking Fire fighting washing , horticultural activities, etc.

Fresh water requirement estimated as 1000 to 1400 M3/hr which will be met from tube wells around the complex area.

Water quality in general is :-

PH	7.5
Total Hardness	165 mg/l as caco3
'M' Alkalinity	152 '' '' ''
'P' ''	0 '' '' ''
Chloride	5.4 '' '' CL-
Sulphate	14.3 '' '' SO4-
Nitrate	18 '' '' NO3-
Potassium -K	0.39 '' '' K+
Sodium -Na	14 '' '' NA-
Manganese -Mn	<0.1 '' '' MN++

Iron-FE	<0.1	" "	FE
Silica- SIO2	14	" "	SIO2
Total dissolvo.solids	225	"	
Suspended solids	4	"	
Conductivity	311	Micromhos	

3.3 EFFLUENT TREATMENT AND WASTE DISPOSAL SYSTEM:

This is a package unit . Unit contractor is M/S Snam progetti,Italy , who are the ON. SHORE contractor for the off-sites facilities.

The basic design specifications for this system were finally revised on August.9 1991.

3.3.1 AQUEOUS EFFLUENTS :

(i) CLEAN WATER collected in the sewer system shall be treated for use as make-up for cooling water. By mechanical treatment, coarse solids, sand, sedimental solids.(by gravity) will be removed from this water.

About 10000 m3 of water will be expected to be recovered and the rest will be allowed by a overflow through wear to surface water drainage outside the complex.

(ii) ORGANIC AND OILY WASTE WATER SYSTEM CONSISTS of collection of contaminated storm water from polluted paved area, drainage of condensate from utilities area , oil tank including organic process waste water. In primary treatment coarse solids, free oil,floating and settling solids shall be removed.

Then this effluent will be mixed with sanitary waste water for removal of biodegradable organic pollutants. After chlorination it will be mixed with inorganic waste water for 'tertiary treatment' to remove dissolved solids. Treated water finally will be reused as make-up to the cooling towers.

(iii) SANITARY WASTE WATER collected from process and common buildings is pretreated in underground septic tanks. Then this will be pumped to 'Aeration stage' to mix with organic and oily waste water for biological treatment .

(iv) INORGANIC WASTE WATER COLLECTED from blow down and side stream filters of cooling towers,from raw and pottable water treatment,intermittent boiler - blow- downs, used C,W from PBR unit. This mixed stream will contain suspended and dissolved solids and with PH in acceptable range. After removal of coarse solids by a bar screen, this stream will be mixed with treated organic waste water.

(v) HIGH SALINITY WASTE WATER stream having total dissolved solids(TDS) not exceeding 3000 mg/L and the organic load which can be taken care of in biological process, can be considered as recoverable . This streams are led through separate sewer net work to evaporation pond after neutralization and oxidation.

The streams are :

a) Neutralised spent caustic from olefins unit.

b) Neulratised water from B.F.W treatment, olefins.

c) Neutralised regenerative water from D.M unit.

d) Catalyst preparation from HDPE unit .

e) Waste Acid from 2.Ethyl- Hexanol unit.

3.3.2 LIQUID AND SOLID WASTES:

(i) LIQUID WASTES are hydrocarbons , spent catalysts with high pollutant organic, fuel oil. Solvents and by products like oligomer , crotonaldehyde fraction , heavy high ends heavy glycol residue,heavy amine residue,etc. which is not recoverable from this streams will be incinerated .This streams will be pumped and collected in dedicated tanks.Toxic,hazardous and having high viscosity will be collected in drums.

(ii) SOLID WASTES are of two types.

(a) Organic and hazardous.

(b) Inert organic.

(a) Organic and hazardous solid waste contains hazardous organic compounds or substances having disagreeable smell. These streams are spent catalyst from AA,waste prepolymer from LLDPE, PE wax from HDPE, waste rubber from PBR, organice sludge from waste water treatment,etc. Organic solids from process units will be transported and burnt in the incinerator.

(b) Inert organic solid wastes are waste polymer powder from LLDPE, HDPE, PP while inorganic solid wastes are alumina -sulfur contaminated zinc-oxide and zinc-sulphate from PP, chemical sludge from the waste water recovery sections This wastes will be collected and taken to landfill outside the complex.

3.3.3: AIR POLLUTION:

APPC to achieve Air pollution standards, as per Appendix-4 Engineering standard. Specs. under contract with MC and UC.

Pollutant	standard	Nor to exceed
sulphur dioxide	0.03 ppm annual avg.	2ppm
	0.14 '' daily '' .	
	0.50 '' 3-Hrly '' .	
Hydrogen sulfide	---	0.01ppm
Carbon monoxide	9 ppm 8-Hr avg.	
	35'' Hrly ''	
Particles	75mg/nm3 annual avg.	
	260mg/nm3 daily avg.	
Hydrocarbons	0.24ppm 3-Hrly avg.	
Nitrogen oxide	0.05ppm annual avg.	
	0.01ppm Hrly avg.	
Turbidity	20%	

To achieve this standards it is necessary to calculate pollution concentration from emission source. 'Statistical Gaussian Approach' is useful, although assumption for the concentrations of pollutants from stacks,chimneys follow 'binomial probability distribution' in the vertical and cross word direction,downward from the source.

It gives useful information to decide the height of stacks and chimneys. Ground level concentration (GLC) can be calculated from ' Pasquill ' formula. After commissioning the complex, all figures must be verified by using monitoring system. Experience shows that calculated concentrations are higher than the measured values.

Pollutant concentrations due to fuel burning are controlled by using low sulphur free/natural gas and raising chimney/slack heights above 100 meters to achieve maximum dilution with atmospheric air.

All hydrocarbon emissions from process equipments, vents, safety valves etc, should be connected to flare system. Stack emission maniroring for SO_2, Nox, SPM and hydrocarbons by continuous monitoring system is ADVISABLE .

3.3.3.1 AMBIENT AIR MONITORING:

Ambient Air Monitoring provides unbiased data on pollution levels and trends.

System consists of.

(i) Measurement of specific pollutant- concentration in ambient air.

(ii) Transmission of measured data to a data collection centre.

(iii) Comparision of measured pollution levels with acceptable values. Processing of measured data is useful for prediction of future pollution levels.

For emission measurement, the measuring equipment/arrangement should be provided on stack/chimney which provides exact data on contribution of specific source to the atmospheric pollution. Air monitoring can be carried out for pollutant levels in the area to be protected. Also alongwith the meteriological forecasting this data provides information on probable build - up of pollution which can cause damage to the environment.

Ambient Air monitoring system consists of monitoring stations equipped with microprocessor data based. acquisition and auto - calibration facilities, capable of automatic sampling and analysis of pollutants.

About four to five such monitoring stations within complex area and there should be one meteriological station for measurement of wind velocity, direction,relative humidity, temperature, rainfall, solar rad'..:ion and precipitations. Such five stations form a net.work within the complex area.In this complex main components to be monitored are S02,Nox,Dust-SPM,HC,CO,Data received at the central station is recorded The net work has also an alarm system which gives an alarm at the control station when any pollutant level exceeds beyond standard value.

Location of monitoring stations may be 800 meters away from stacks /chimneys where maximum ground level concen tration is expected.

Also it is recommended to have mobile van equipped with similar analysers for pollution level measurements in and around the complex. The same can be used for checking the permanent stations also.

3.3.3.2 WORK ENVIRONMENT MONITORING:

Under "Appendix U" Engineering standard specification" of on-shore contract with Managing Contractor and

Contractor for off-site facilities, the work area and living - area limitations have been standardised as under:

Pollutants	WORK Area	LIVING Area
Sulfur dioxide	2 ppm 8Hrs Avg.	
Nitrogen Dioxide	3 " "	
	5 " 15 Mts Avg.	
Hydrogen Sulfide	10 " 8Hrs Avg.	
	15 " 15Mts"	
Methyl mercaptan	0.5 " 8Hrs "	$9*10^{-6}$ mg/m3 for20 mts
Ethyl Mercaptan	0.5 " "	
Butyl Mercaptan	0.5 " "	
Propylene --	1.5 ppm for 24 Hrs.	
Ethylene --	0.5 ppm for 1 Hr.	

It should never happen to receive more than Four Times the 15 MTS. Avg. limits during any 8.HR working period and occurance should not be less than 60 minutes.

Above standards are to be met by sound engineering practice followed for design of units and good operational control.The work environment must be monitored by detectors and dragger tube once in 8 Hrs- in each unit Results to be recorded for trend analysis.

During shut-down when pollution levels could be higher,protective appliances should be used.

Detector system could be mobile one with printer.

3.3.3.3. NOISE POLLUTION :

General criteria for annoyance due to noise/disturbance with sleep, work etc. are given in terms of noise levels. The unit of measurement is Decibel measured by Decibel meter Industrial Noise as measured at the boundries of surrounding residential areas is normally in the range of 50-60 decibels.

Noise standards as per contract to be followed for ARPC are:

Working Area:

Noise level :(db)	80	85	90	95	100	105	110	115
Duration	16	8	4	2	1	1/2	1/4	1/8

Comparative figures of noise standard as per Indian Government prescription:

Industrial Area	75 (70)	figures in bracket
Commercial Area	65 (55)	are for night time
Residential Area	75 (45)	others for day time
Silence zone	50 (40)	

ARPC may like to check vendors specifications for noise producing equipments.In case the level is higher,then sound - proof cabins can be provided to the operators with suitable communication. Noise levels measured in similar complexes is normally in the range of 60-65 Decibels which can be considered fairly good. ARPC may arrange survey of noise-levels during complex operation for day and night and record as a base level data.

A further decrease in the noise-level can be achieved by selection of trees to be planted around the complex as a ´green - belt which can be a ´natural filter´ to reduce SPM,Pollution and Noise level.

4. ENVIRONMENTAL IMPACT ASSESSMENT:(EPA)

EPA has recently become generally acceptable study for decision - making and has been made ´obligatory´ in ´ development proposals´.It is a formal study process to be used to predict the Environmental Consequences of proposed projects and operating units.The aim of an EIA is to ensure that the potential problems are foreseen and addressed at an early stage in the project planning design and operation of the units.

(i) SITE SELECTION:

Before taking decision for exact /final location of the complex a comparative study is undertaken for alternative sites- with respect to environmental aspects. Study is undertaken as per the guidelines followed in the country or as per available international, norms' for the new as well as for expansion of the existing projects. Criterian such as distances from ecologically sensitive area , high-tide line,highway,major settlement, non-conversion of forest and agricultural land, townships, enough space for waste water treatment facilities, provision of green - belt, space for storages, etc are taken into consideration for all the alternatives before finally selecting the site .

(ii) RAPID EIA STUDY:

This is to be undertaken at and around site covering 10 KMS radius of area.It relates to the existing air quality, meteriology, water quality, land-use pattern socio economic factors.etc. Study is recommended for a period of 3-4 months preferably winter months to access the impact on the area.

(iii) COMPREHENSIVE - EIA STUDY:

Subsequently, comprehensive EIA study is undertaken for 12-15 months covering 3-4 seasons. Over and above the data under rapid EIA study , following other factors are also covered.

(a) Topography of site.

(b) Number of old or new monuments of national importance existing which may need protection from gaseous emissions.

(c) Number of large and medium scale industries around project site.

(d) Within 10 km of radius population as per latest census and nature of activities of theirs .

(e) Data on fisheries,drinking water and agriculture water supply systems.

(f) Waste water generation and disposal system.

(g) Meteriological data of Iranian Meteriolagical Department of Ministry of Roads-for last 30 years.

(h) For ambi nt air quality measureunent,six stations to be set up within a radius of 10 km from site. At one of the stations , meteriological data station to be provided Data so collected to be computerised to estimate GLC for special pollutants.

(i) Tree plantation in width of 500 meters around the complex area to be provided. Trees are absorbent to the pollutant gases,expected to take care of fugitive emissions.

(j) A computer study may be prepared on available process information with certain assumption to estimate GLC of specific pcilutants . The resultant air quality should be well within pollutions standard issued by Government.

(k) Other factors like hydrology , soil , flora, wild life,agriculture , health may be included in EIA study.

For continuing EIA study ,an experts assistance is advisable for a period of 2 years. Involving ARPC engineers and management during study period will develop the skill for conducting such EIA study for future expansion and new projects by ARPC.

5- ENVIRONMENTAL AWARENESS:

(i) TRAINING - Speiclised training can be planned in the area of enrironmental management for the employees working in the effluent treatment plant, in the units, central waste water treatment plant, those working for air survey / monitoring, handling hazardous and toxic waste. The training can be provided through National Institute and in the similar plants like refinery, fertilizers and petrochemicals.Also short duration seminar and work shops could be arranged for the benefit of middle and senior level concerned managers.

(ii) CAMPAIGN-For creating and enhancing environmental protection and conservation consciousnees and awareness in employees and community , a well planned campaign like celebration of, environment day displays by posters/exhibition publicity by video-films,house magazines, etc should be organised . Awareness can be created in neignbouring public with the help of civil administrative authorities.

(iii)ARPC can strive continuously to achieve base-line environmental conditions by organisational approach. Continuous training is provided to all employees, shop-floor workers for motivating to minimise use of water and segregate effluents.

6- ECOLOGY:

Conservation of natural resources and maintaining ecological balance in and around complex area is of paramount importance for a size of complex implemented by ARPC. For water conservation and reuse, adequate provisions are made in treatment facilities , however experience of operating facilities of such unit shows that alternative mode of utilization of treated effluent should be planned.

Utilisation of treated effluent for agriculture horticulture,tree plantation and afforestation is having many advantage and should be considered as an important activity.

ARPC can have a scheme of 10 hectors of land for use of treated effluent meeting agricultural standards of water for growing various crops,vegetables,ornamental plants and to study the effect on soil,growth of plants yield and toxicological effect of residual pollutants on agricultural produce and soil.

Treated effluent may be also used for tree plantation around complex boundary in a width of 500 meters-called a 'green belt'. Trees selected for the belt will be pollutant absorbing type having large leaf size and canopy of hardy variety available locally. Such green belt would help in control of pollution and noise level.

For afforestation a scheme of developing a waste land in nearby area can be taken up. This development will be associated with the activities of horticulture,forestry, development of wild-life and bird-sanctuary. Such land would provide forest products , grazing land for cattles,rise of water-table in the area and attracting monsoon clouds for better rains.

Horticutural activity includes aesthetic landscape, lawns and garden development .Also for water conservation drip water irrigation, sprinkler system greenhouse etc. can be considered by utilising HDPE, LLDPE polymer in the form of pipes, sheets, nozzsles, etc. A waste water pond with LLDPE sheet lining can be created to study effect of residual pollutants an fish.

7- ORGANISATIONAL SET-UP

Basic set-up has been suggested as per the attachment No.1. Also an estimated man power and broad functions are given the set-up can be modified as per the need of ARPC now and in future.

8-JOB FUNCTIONS:(Ref Attachment 2)

1. SR.MGR/MGR:

Duty post - One.

Qualifications - Graduate or post-graduate in chemical engineering.

Experience:

At least 10 years in the field of operation maintenance of effluent treatment plants air - surveys, management of toxic / hazard wastes, preparing technical reports knowledge of national / international standards of liquid , gas air solids - pollutant levels environmental audit, impact assessment studies .

Duties:

He reports to technical manager. He executes environmental protection measures, policy formulation implementation of schemes. He advises and assists all units /plants , other departments and senior management executives in all matters related to environmental aspects. Maintains records and documents for statutory requirements. organises training programmes on environmental science for engineers, officers of the company .

2. MGR/Asst.MGR.

Duty post :

Two : Environmental protection .

One : Ecology Management.

Qualifications :

Graduate in Chemical Engineering, Environmental Engineering & Public Health Engineering.

Experience:

6 to 7 years in the field of operation and

maintenance of effluent treatment plants, air-monitoring, air- pollution control equipments, ecology system.

Duties:

He shall be responsible for conducting environmental audit of liquid, solid, air pollution and suggest remedial measures oversees implmentation of technical schemes-prepares scope for studies to be carried out by outside experts/agency coordinates EIA studies for operating plants,major expansions etc. Ecology Manager /Asst . Mgr.shall develop horticulture in consultation with units in the areas / spots available in the complex.and township. Develops methods of water mangement by utilising treated effluents for gardening , tree planting and horticultural activities , conducts experiments on soil agriculture -produce, trees on toxicology due to utilization of treated offluent .

3. ENVIRONMENTAL ENGINEER

PROCESS ENGINEER

AGRICULTURAL ENGINEER (Horticulturalist)

Duty posts : one in each area .

Qualifications : Graduate in relevant field.

Experience:

2-3 years in operation of treatment plants in refinery, fertilisers or petrochemicals.

Duties:

He shall be responsible to collect information data of all units and treatment plants daily. Maintains records on liquid, air solid treatment plant - survey reports ambient air and emission monitoring data, prepares water balance, calculates plant efficiency for hydraulic and biological loads.

4. TRAINEE ENGINEER

Posts : Three

Qualifications : Graduate in Engineering.

Experience : NIL

Training period : Minimum one year.

5. SENIOR GARDNER

Post : One

Qualifications : High school .

Experience : 10-15 years in nursery , gardening , ornamental plants in big parks/gardens.

Duties : develops gardens,nursery in complex and township.

6. GARDNER

Posts : fifteen

Qualification : Read and write in Farsi language

Experience : 3-5 years in gardens,parks, nursery .

7. WORKERS

Posts : Twenty

Qualification : Read and write in ' Farsi' language

Experience : Tree plantation and manintenance or forest , agriculture works etc.

9- CONCLUSIONS AND RECOMMENDATION:-

(i) For proper control of effluents at the battery limit ofthe plant/unit, MONITOR ONCE DAILY-FLOW, - PH, COD, BOD, Hydro Carbons, TDS,Oil and Grease. At central treatment facilities , Hydrocarbons, phenols, sulphides pathogenic bacteria , dissolved oxygen,BOD , COD.PH should be measured continuosly. This is only an outline of measuring parameters. A well-developed analytical support and procedure need to be developed to monitor and apply remedial measures for such treatment plant.

(ii) Wherever possible sell the solids and semisolid waste rather than incinerating or disposal by land -filling Incineration is expensive and creates air pollution. Alternative method like microbial degradation should be explored. Landfill area should be away from the complex site- Ground water contamination should be checked around the waste disposal yard.

(iii) For Air pollution, measurements of SO_2 NOx, HC and SPM to determine GLC can be started. Emission factors like gas flow rate , temperature , pressure , molecular weight moisture content and ionisation potential available in UC can be calculated . For solid waste, analysis of Carbon, Oxygen, Nitrogen, Water, Sulphur, Ash, Calofic Value, Toxicity and Corrosiveness should be obtained from UC and MC for similar operating plants.

(iv) On the basis of emission factor start study of ambient air quality - locate the place where maximum concentration will occur to control emission source.

(v) Provide ambient air monitoring net-work in ARPC with Central Control Room - This will provide record and action required to stop abnormal pollutants discharge in the atmosphere.

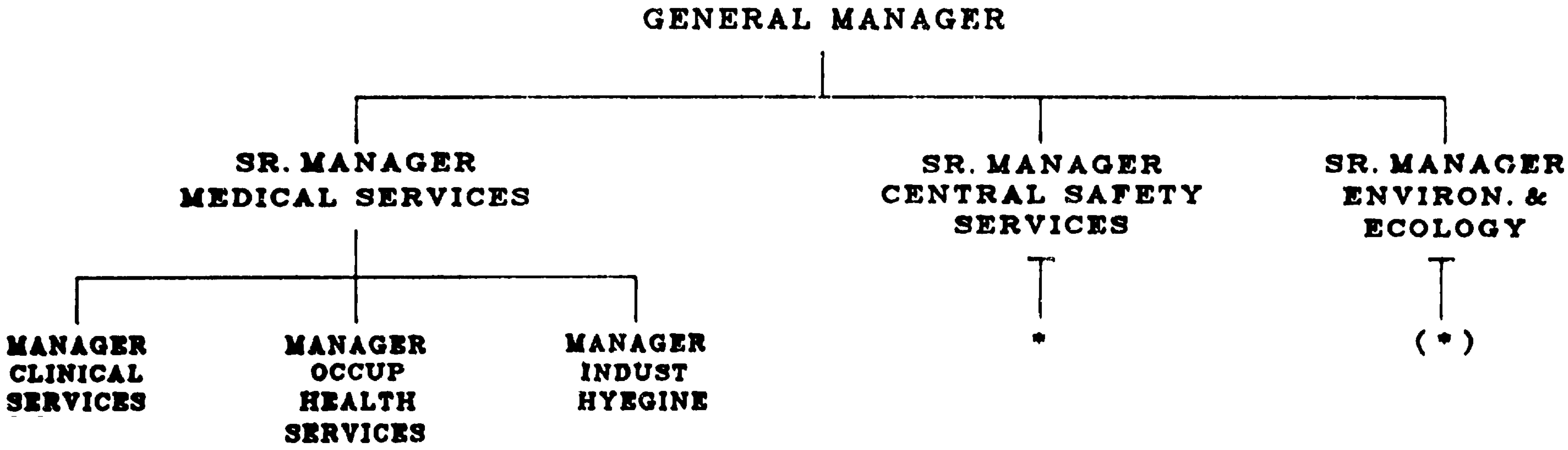
(vi) Plan and develop green belt around the complex with selected trees.

(vii) For incineration of solid wastes prior to design of the incinerator, test - burning should be undertaken for size. Shape weight and batch-frequency otherwise redesign of incinerator cannot be ruled out.

(viii) Expertise technical assistance after the commissioning is advisable. Expert would assess the necessary improvement measures for the existing control system.

HEALTH, SAFETY, ENVIRONMENT & ECOLOGY

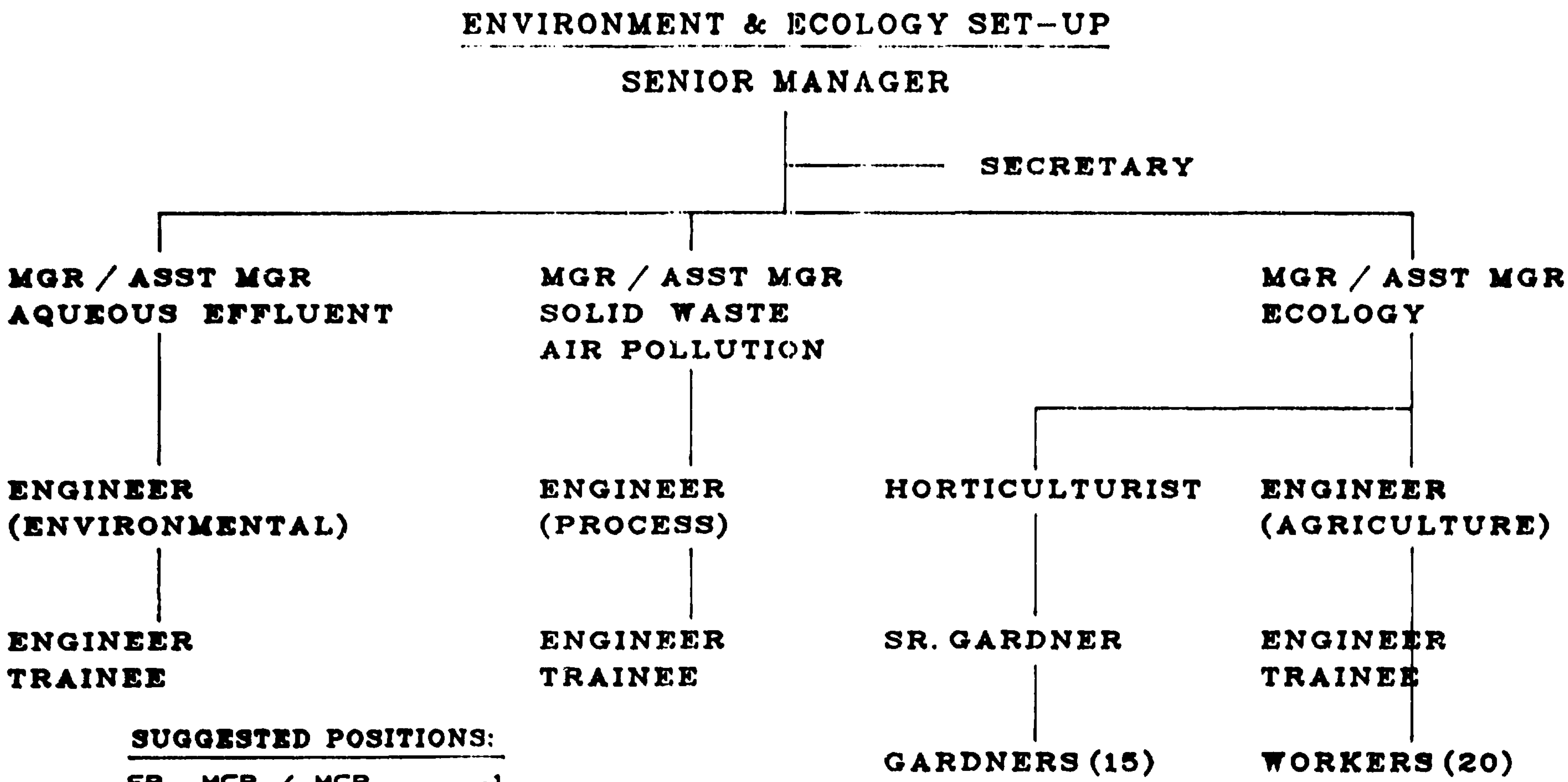
ORGANISATION SET – UP



* SET–UP GIVEN SEPARATELY

(*) REFER PAGE.2 OF THIS ATTACHMENT

ATTACHMENT 1/2



SUGGESTED POSITIONS:

SR. MGR / MGR	-1
MGR / ASST MGR	-3
ENVIRON. ENGR	-1
PROCESS ENGR	-1
HORTICULTURIST	-1
AGRICUL. ENGR	-3
SR. GARDNER	-1

ATTACHMENT 2/2

CHAPTER 11

RISK ASSESSMENT AND DISASTER MANAGEMENT

CHAPTER 11. RISK ASSESSMENT AND DISASTER MANAGEMENT

GENERAL :

Under draft code of practice on major hazard control issued by International Labour Office, Geneva vide SEG HYG August 1989 on page-3 , Chemical and Petrochemical Works is included as major hazard installation.

They are ususally identified by means of list of hazardous substances, each with an associated 'threshold' quantity in such a way that they have the potential for causing a serious incident which is likely to affect people both ' on-site' and 'off-site' .

Major hazard installation possess the potential to cause a major accident as one of the following:

(a) Release of toxic gases in "large" quantities which are lethal or harmful at considerable distances from the point of release.

(b) Release of extremely toxic substances though in "kilograms" quantity which are harmful at a considerable distance from the point of release.

(c) Release of flammable liquid or gases in "tonnage" quantities which may burn or form an explosive vapour cloud.

(d) The presence of unstable or highly reactive materials which may explode.

HAZARD CONTROL:

Apart from routine safety and health provisions, special attention should be paid by competent authorities to major hazard installation by establishing major hazard control system:

(i) Information to include.

- Technical , about design and operation.
- About the hazards identified and documented by safety studies.
- Details on management of safety
- About safety precautions to prevent major accidents and the emergency provisions to reduce effects of such accidents .

Information should be systematically arranged in such a way that parts of the installation,which are critical to the safety are clearly defined.

Major hazard assessment should identify uncontrolled events which could lead to a fire and explosion or a toxic cloud dispersion. This can be achieved by hazop study or check lists and should include commissioning, normal operation, start up and shutdown.

The consequences of potential explosion fire or toxic release should be assessed.This will include estimation of :

(a) Blast waves, over pressure and missile effects in case of explosion.

(b) Thermal radiation.

(c) Concentration profiles and toxic doses in case of toxic release.

Particular attention should be paid to the potential for DOMINO EFFECTS from one installation to another.

Works Management should control major hazard by :

(a) Good plant design and installation including the use of high standard components.

(b) Regular plant maintenance

(c) Good plant operation

(d) Good management of safety on site

(e) Regular inspection of the installation with repair and replacement of components where necessary.

Works Management should consider possible causes of major accidents including :

(a) component failure
(b) Deviation from normal operation
(c) Human and organisational errors
(d) Accidents from neighbouring plant or activities
(e) Natural occurrances and catastrophes.

For SAFE operation, Works Management should ensure:

(a) General operational instructions and sound procedures provided and enforced .

(b) To select carefully workers for operation and trained in their duties.

(c) To investigate accidents and near-misses and report to competent authorities.

RAPID HAZARD ASSESSMENT METHOD:

There are two proven 'Dow Index' and 'Mond Index' methods for Rapid Hazard Asessment of various section of a plant , or between independent plants - out of which Mond Index is widely accepted by statutary authorities, administration and insurance companies for determination of hazard potential.

Mond Index approach is same to that of World Health Organisation (WHO)'s Rapid Environmental Impact Assessment (EPA) technique .

Mond Index have application in design and technology optimisation, layout of plant sections to prevent DOMINO effect, design of safety barriers(baffle walls), design of evacuation avenues, access for hazard-specific emergency services ,protection control and design oi safety system , operating procedures , supervision , intensity and diversity of training , on-site emergency planning etc.

MOND Index assist administration for guidance on new plant-sites, inter-plant layout criteria, priority of safety inspection, basis of safety audit, capacity and reliability planning of intrastructures and offsite emergency services and action planning. For insurance company it provides design of sliding scale premium, rebates for specific protective systems:

Mond Index Range (overall Risk)-R	Qualitative Risk category	Statutory processing code
0 - 20	Mild	A
20 - 100	Low	A
100 - 500	Moderate	B
500 - 1100	High Gr.I	C
1100 - 2500	High Cr.II	C
2500 - 12500	Very High	D
12500 - 65000	Extreme	D
> 65000	Very extreme	D

here R - Overall Risk

A - Interview of industry

C - Examination of off-setting criteria and drawing up of ON/OFF site emergency plans

D - Review of 'C' by'major hazards advisory committee'

Using above Overall Risk Range(R), separate element of plant within complex can be classified and necessary action to mitigate the same can be initiated. In the enclosed Attachment-1....., procedure for determining Mond Index is given for reference.

Numerical toxic load range is under development. However, Toxic Hazard Index Range - T is available and given as follows:-

T.Range	Category	T.Range	Category
0 - 20	Light	300-500	Very High
20 - 50	Low	500-700	Extreme
50 -100	Moderate	>700	Very Extreme
100- 300	High		

To ensure reasonable completeness and comparability the hazard assessment should follow formalised Method:

- As a first step, preliminary hazard analysis to identify toxic release, fire, explosion, release of flammable material,etc. alongwith check of safety system is carried out . This can be then documented for each accident considered. The relevant camponents like storage vessel , safety valves , pressure / tempereture gauges to be considered as events inviting accidents. This will help in identifying which unit or procedure requires more examination.
- Next,Hazop study is carried out to examine every part of design, its intention, deviation and possible hazardous conditions.
- Finally accident consequence analysis is carried out to determine potential major accident having its effect on complex, workers, neighbourhood and on the environment.

Mond Index formula is given in Attachment-2. This can be used with forgoing procedure for risk-rating of the plant.

ACCIDENT CONSEQUENCE ANALYSIS:

DATA: (a) Description of the accident

(b) Estimation of released quantity

(c) Calculation of dispersion of material released

(d) Assessment of harmful effect.

The data can be used for finding requirements of protective measures like Fire-fighting, Alarm systems, or Pressure Relief systems.The technique should include physical Models for dispersion of pollutants in the atmosphere , propagation of blast waves, thermal radiation, etc.

More sophisticated method for individual parts of a plant such as control system or other sensitive components to assess accidents in more detail according to their occurance frequency,method of graphic description of failure sequences and the mathematical calculation of probabilities can be used.Event Tree Analysis and Fault Tree Analysis where necessary can be used. It gives indication of optimization of the releasibility and availability of safety system and should be applied to sensitive components of major hazard plant.

Illustration of FAULT TREE is given in ATTACHMENT 3.

Risk Assessment Study is usually carried out by experienced consultant in the field since study includes in depth analysis of hazardous events. This will need computarised calculations of properties of chemicals , reaction kinetics.process parameters,hazop-hazan studies,fault-tree analysis.probability of accident occurance along with dispersion calculation using meteriological data. Main steps of risk assessment are system description,hazard analysis,modelling and data-analysis , accident probabilities , accident canseqnences . risk deter-mination and decision-making.

DISASTER MANAGEMENT: ON-SITE EMERGENCY PLAN:

After thorough assessment of the risks and hazards associated with petrochemical completex,On-Site EMERGENCY PLAN should be prepared. Main objective of the PLAN is to localise any emergency and eliminate , minimise harmful effects on people,property and environment.

The PLAN is specific only to deal with emergencies which can occur at site and which can be controlled or contained within complex area. The plan pin-points the role of key personnel during an emergency and lays down well-defined procedures to meet such situation. For On.site EMERGENCY PLAN following elements are considered .

(a) An assessment of the nature and dimensions of the event.

(b) The foreseen probabilities of its occurrance .

(c) Formulation of planned liaison with various groups/agencies including emergency services .

(d) Laying down of procedures for

(i) Raising an alarm

(ii) Communication within and outside complex.

(iii) Appointment of key-personnel and fixing their duties and responsibilities.

(e) Role of the incident controller/chief controller.

(f) Setting up of emergency control centre.

The PLAN has been set out in such a way as to enable the designated personnel at the site of incident to initiate actions both within and outside the works at the earliest. All requirements for drawing upon the emergency resources such as personnel and equipment and also assembly points are well defined.

Plan also defines resources exist at works to carry out various operations in conjuction with emergency services keeping in view the time factor.

Regular mock.drills are a part of routine operations. Care should be taken for availability of personnel during silent hours to meet with emergency.Thus ON.SITE.PLAN has an over all approach to manage any situation to prevent loss to human beings , property and environment.

OFF-SITE EMERGENCY PLAN :

The 'off-site emergency plan' deals with those incidents identified in the ON-SITE-PLAN which have potential to harm the persons or affecting the surrounding of complex.PLAN should have flexibility to deal with emergencies other than specifically covered under ON-SITE PLAN.

The OFF-SITE EMERGENCY PLN should include organisation having command structure,warning system,emergency control centre and names of key personnel and their responsibilities.

Communication ,specialised emergency equipments. information about hazardous chemicals , list of voluntary organisations, meteriological data. transport evacuation centres.ambulances,first aid,public information by radio,TV/etc. are the important aspects of the emergency plan.

The off-site emergency plan provides guidelines for the individual/collective role during the emergency .It also serves as a ready reference to all the agencies like fire , medical services , civil defence,district administration , etc. for taking immediate actions.

It is advisable to establish jointly with adjoining refinery,near the complex boundry a central control room : This will be manned round-the-clock with good communication net-work.The control room will activate and mobilise all the resources in case of emergent situation when OFF-SITE emergency plan is required to operate.

Simulation exercises at least once in six month should be conducted to cheek the effectiveness of the plan.

On every situation of emergency , after it normalises.causes of occurrance should be collected and the weaknesses in the OFF-SITE PLAN should be rectified.

ATTACH NO.1
(REF. P-5)

MOND INDEX PROCEDURE

DIVIDE PLANT IN TO UNIT

CONSIDER FIRST / NEXT UNIT

INITIAL ASSESSMENT

IDENTIFY THE DOMINANT MATERIAL & CALCULATE ITS MATERIAL FACTOR

USE THE MOND FORM AND MANUAL TO OBTAIN PENALY FACTORS RELATED TO
I) SPECIAL MATERIAL HAZARDS
II) GENERAL PROCESS HAZARDS
III) SPECIAL PROCESS HAZARDS
IV) QUANTITY HAZARDS
V) LAYOUT HAZARDS
VI) TOXIC HAZARDS

USE MATERIAL & PENALTY FACTORS IN GIVEN FORMULATE TO CALCULATE INDEX VALUES & CONVERT TO DESCRIPTION LIKE LOW, HIGH, MODERATE FOR:

FIRE	(F)
INTERNAL EXPLOSION	(E)
AERIAL EXPLOSION	(A)
OVERALL RISK RATING	(R)
TOXIC RISK RATING	(T)

REVIEW

IF RATINGS ARE HIGH REVIEW INPUT DATA REFINE WHERE POSSIBLE AND TRYING ALTERNATIVE DESIGN DATA

OFFSETTING

PROCEED TO NEXT FROM (OFFSETTING) & USE MANUAL TO EVALUATE CREDIT FACTORS FOR PLANT HARDWARE AND SOFTWARE (ie) FEATURES THAT MAY REDUCE THE FREQUENCY OF INCIDENTS OR THEIR MAGNITUDE

USE CREDIT FACTORS IN GIVEN FORMULATE TO GET REDUCED INDEX VALUES & RATING

LAST UNIT ?

NO

YES

USE RATING TO CONSIDER THE HAZARD POTENTIAL OF OVERALL PROCESS

ATTACH NO.2
(Q4 P.6)

MOND INDEX FORMULAE WHICH CAN BE USED ALONG WITH FOR-GOING PROCEDURE FOR RISK RATING OF PLANT.

OVERALL HAZARD INDEX

$$D = B (1 + M / 100)(1 + P / 100){ 1 + (S + Q + L + T) / 100 }$$

IN PLANT FIRE INDEX

$$F = B * K / N$$

IN PLANT EXPLOSION /DETONATION INDEX

$$E = 1 + (M + P + S) / 100$$

IN PLANT AND OFF-PLANT (COMMUNITY) AERIAL EXPLOSION INDEX

$$A = B (1 + M / 100)(1 + P)(QHE / 100)((T + 273) / 300)$$

OVERALL RISK RATING

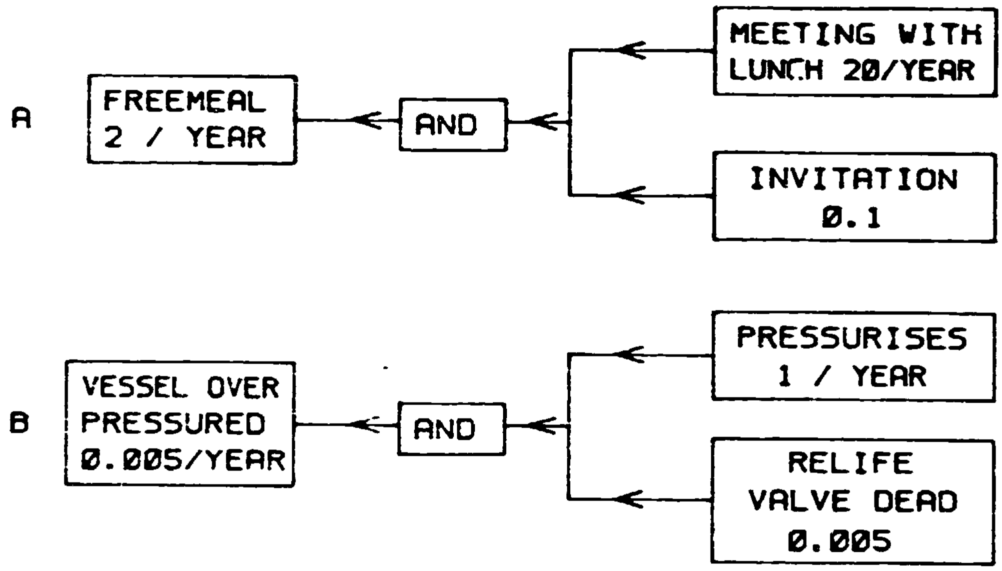
$$R = D \{ 1 + (0.2 E \sqrt{AF}) \}$$

THUS, BY ABOVE CALCULATIONS INDICES AVAILABLE ARE:

OVER ALL NUMERICAL RISK INDEX.
NUMERICAL FIRE INDEX.
NUMERICAL INTERNAL EXPLOSION INDEX.
NUMERICAL AERIAL EXPLOSION INDEX.

ATTACH NO.3 A
(REF. P – 7)

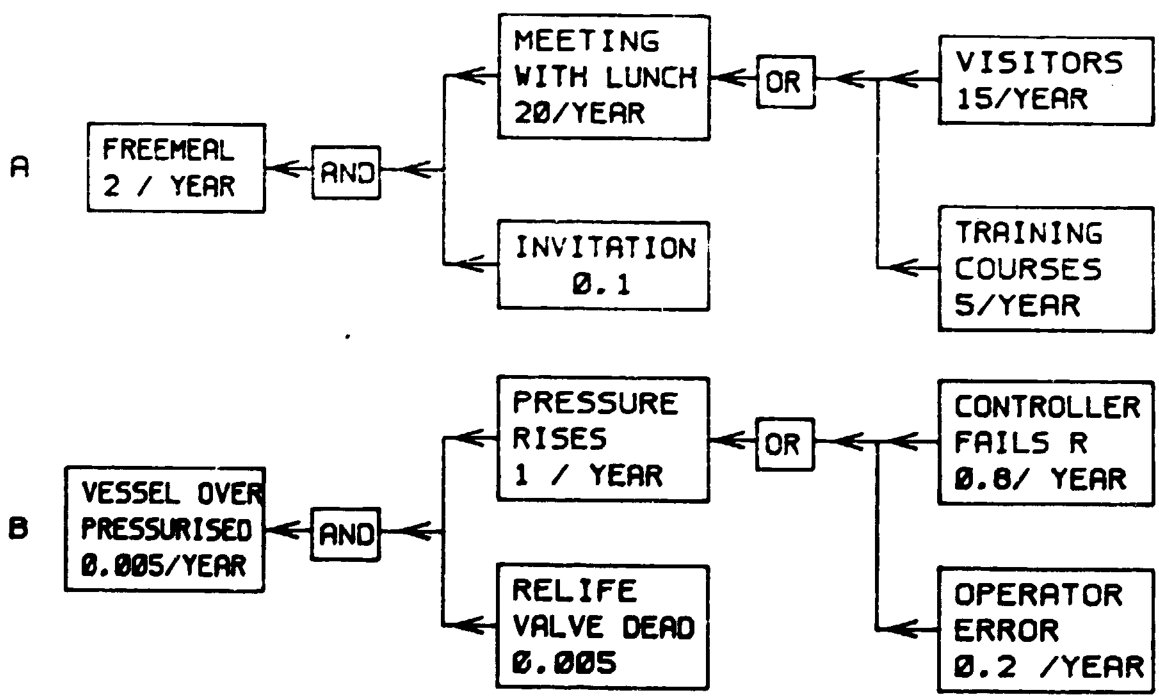
FAULT TREES WITH & GATES TOP EVENT



HERE FREQUENCY 1 IS MULTIPLIED BY PROABILITY
I.e RELIFE VALVE DEAD X PRESSURE RISES
Ø.ØØ5 * 1 = 0.ØØ5 / YEAR

ATTACH NO.3 B

FAULT TREE WITH 'AND' AND 'OR' GATES. TOP EVENT



HERE FREQUENCY ARE ADD AT THE 'OR' GATES.

CHAPTER 12

EFFECTIVE MANAGEMENT OF A CHEMICAL COMPLEX OPERATION (LIKE ARAK PETROCHEMICAL COMPLEX)

CHAPTER 12 : EFFECTIVE MANAGEMENT OF A CHEMICAL COMPLEX OPERATION (LIKE FUTURE ARAK PETROCHEMICAL COMPLEX).

1. INTRODUCTION :

Arak Petrochemical Complex is a large Petrochemical Complex consisting of 13 process units, 6 Utility Package Units, 19 Offsite facilities and 13 common buildings. In future Arak Petrochemical Complex with an objective of operating all process units and Utility package units/offsite facilities at an optimum capacity with a given budget over a specified period of time will have a set of interrelated activities amenable to unified management. Each of the Unit/Department will have to follow a uniform pattern of work flow. Each activity and its large number of sub-activities have logical inter-relationship. This relationship is definite.

To carryout these activities number of agencies are participating Viz., Production, Maintenance, Technical Services, Engineering Services (including workshops), Marketing, Finance, Safety and Fire Services, Materials Services, Personnel and Administration Services, Medical services, Associated Contracted Services, etc. The binding force for all these agencies and their interrelationship can be developed and defined by 'who-will-do-what-work' for ARPC.

A single coordination point for all the participating agencies and its activities may be Director Operation. Director Operation may provide the relative emphasis between activities, agencies and their relationship. A typical organization structure its establishment, staffing and duties/responsibilities of key personnel for a process unit is given as an illustration, which can be modified and made adoptable for future working of ARPC.

2. CENTRAL COMMUNICATION SYSTEM

The aim and objectives of Central Communication System are to develop the principles and techniques related to production, maintenance, and vital support services such as engineering resources, fire and safety, medical, technical, etc. and to foster the planning so as to :

i) Ensure the safe and smooth operation of all units to optimum capacity.

ii) Encourage the good maintenance practices.

iii) Encourage the development of technology base.

iv) Meet the need of marketing.

v) Prevail waste control caused by poor maintenance and operation.

vi) Promote safety in general and specifically in operation and maintenance work.

vii) Promote generally the development of all aspects of Petrochemical Products.

A system for collecting, processing, evaluating and disseminating information is vital for smooth operation of all units/plants. It must be ensured that the adequate quantity and quality of information is received and transmitted to each key personnel at predesignated locations, thus, providing sufficient data to all discipline involved and minimising duplication and gaps in information relayed to the media and public. Information should be both accurate and literally consistent with the situation.

In ARPC for project implementation phase, there is well defined systems and procedures for communication with various local and overseas agencies by distribution of copies of letters exchanged to concerned agency. This is in various modes such as paper, fax, telex, telephone and meeting (face to face). For each type of communication, a formal procedure is already laid out to ensure good communication.

The existing procedure can meet the requirement of future Arak Petrochemical Complex Operation. The centre of communication now can be Director Operations. The existing procedure may continue with super-imposition of the operation organization structure in place of project management structyre. All communication for a production unit, utility or offsites (including common facilities) should be directed to the group head of operations (with appropriate distribution of copies). Similarly all communication to various agencies - local and overseas - must originate from a group head of operation for his sphere of responsibility. All internal communication must also be directed to and originate from the head of operation as he is not only responsible for smooth operation of units but also for financial, contractual, maintenance, technical, personnel and administration aspects. A production head may seek appropriate level of approval where it is needed.

When matters deal at a higher level or by another department the concerned production head may get copies of all communications. Thus, all local, overseas and internal communication will be through operation head for single point effective control.

Regarding effective monitoring and co-ordinating operations of all units in ARPC, a detail write up is provided under Chapter No.5 Viz; Central Control Room in a proposal format outlining its functions, system design, system operation, data reporting authority, linkages and recommendations which can be taken as model. This can be suitably modified for adopting the same in ARPC.

3. ORGANIZATIONAL STRUCTURE, ITS ESTABLISHMENT AND FUNCTIONING:

Effective Management of a Chemical Complex Operation (like future Arak Petrochemical Complex) having appropriate central communication system works through an organization. Both management and organization may be perceived as compliments to each other for effective functioning. Therefore, we have reviewed the organization structure wherein system is to work. An organization acts as the vehicle for the management control system.

This must go beyond the project completion with a simultaneous planning to have smooth change over from construction activities to immediate operation, as economic and efficient operations is the ultimate objective of having a project. Thus, Owner - Management role continues after Managing Contractors, Process Licensors, Local Contractors and Vendors complete their part of the work. So, planning must run concurrently with the project. This report deals with the conceptual proposal for organization structure for smooth changeover from Project implementation to operations (includes maintenance and other services). However, organization structure can be suitably modified depending upon management policies and local requirement at Arak site.

Arak Petrochemical Company will have following plants :-

Sr. No.	Plant		Annual Capacity (MT per annum)
1.	Olefin	(OL)	247,000 (Ethylene)
2.	Pyrolysis Gasoline Hydrogenation	(PGH)	102,000
3.	Acetic Acid	(AA)	30,000
4.	Vinyl Acetate	(VA)	30,000
5.	Linear Low Density Polyethylene	(LLDPE)	60,000
6.	Butene-1	(B-I)	7,000
7.	High Density Polyethylene	(HDPE)	60,000
8.	Polypropylene	(PP)	50,000
9.	Butadiene	(BD)	27,500
10.	PolyButadiene Rubber	(PBR)	25,000
11.	Ethylene Oxide and Ethylene Glycol	(EO/EG)	1,00,000
12.	Ethanol Amines	(EA)	30,000
13.	Oxogas and 2-Ethyl Hexanol	(2-EH)	45,000

These are interrelated and interdependent units. Closing or stopping of one unit effect the other units. Also level of an operation of one may effect the other. An output of one unit is input to the other units. Figure-1 illustrates the relationships.

In addition to above units, there are number of common resources (to be shared by above units) - utilities, offsites and common facilities, which are also very important part of the complex.

These are :-

A. Utility Package Unit/Projects :

i. Demineralization water unit

ii. Cooling Water system

iii. Plant and Instrument air system

iv. Nitrogen and Oxygen unit

v. Steam Generation unit

vi. Electric Power Generation unit

B. Offsites and Common Facilities
(including comon buildings)

Arak Petrochemical Company personnel are already under training and also associated with Project implementation, precommissioning, commissioning and start up activities. This should now result into smooth changeover from project stage to operation phase with the linkage of the same personnel.

An organization structure suggested in this report for effectiveness of management should have reduced levels of hierarchy for quick decision making and avoidance of role overlap. It is also essential that the employees at any level will not remain confined to their own area of working but would adopt to MULTIFUNCTIONAL SKILLS.

Supervisory Manpower

The supervisory requirements have been suggested on the level concept as follows :

Level 1 (L1) Group Head

Level 2 (L2) Manager

Level 3 (L3) Senior Engineer/Engineer

The emphasis being on the team performance as demanded by the automated technology. (Where more than one officer of the same level happen to be posted in the same group/plant/ Department/Section, the senior most person amongst them in the respective level, should coordinate the activities of that area).

For the requirement of manpower in chemical, mechanical, electrical, instrumentation and systems for all the three levels distributed in various plants/group has to be worked out in consideration of age, educational qualifications, years of experience, etc. ARPC have already started working out these requirements. Therefore, in this report for effective management of a Chemical Complex, an organizational structure which should be established for operation of plants is given. Organizational structure under Managing Director is as per Annexure-I, which indicates the organizational structure having functional directors. Under Director Operation, General Managers of respective disciplines are shown.

For organizational structure under General Manager (Operation) as per Annexure-2 along with duty/responsibility of key personnel is given.

The process plants are grouped as under :-

A.	Olefin Group	-	OL, PGH & BD Plants
B.	Polymer Group	-	LLDPE, HDPE, PP, PBR and B-1 Plants inclusive of warehouses.
C.	Chemical Group	-	VA/AA, EO/EG, EA and 2 EH Plants
D.	Offsites Group	-	Utilities and common facilities . (buildings)

(i) <u>OLEFIN GROUP</u> :

This group should be headed by Level-1 Officer (L-1). He will be assisted by three discipline heads of systems chemical and maintenance group of mechanical, electrical and instrumentation discipline. Each discipline will be headed/coordinated by the officer of Level-2 in the group. At Level-3, the required number of officers working in general shifts and rotating shifts, depending upon work allocation may be decided by ARPC.

Organizational structure and duties/responsibility is given in Annexure-3.

(ii) POLYMERS GROUP :

All plants under Polymers Viz. LLDPE, HDPE, PP and PBR and B-1 plants should be headed by Officer at Level-1 (L1). It can be divided into for sub-groups each headed by an officer of L2 level as under :

a) LLDPE/HDPE/B-1

b) PP/Ware Houses

c) PBR

d) Maintenance Group

Maintenance Group should consists of 2 officers of Mechanical and one each from Instrumentation & Electrical disciplines where the officer at Level-2 will be incharge of this group. There will be suitable number of officers at L3 level.

The organizational structure and duties/responsibility of various officers of these plants is given in Annexure-4.

(iii) CHEMICAL GROUP :

This group shall consists of VA/AA, EO/EG, EA and 2EH plants and should be headed by Level-1 officer. It can be further divided into 4 sub-groups each needed by an officer of L2 level as under :-

a) VA/AA

b) EO/EG

c) EA 2-EH

d) Maintenance Group

Maintenance group shall consist of of officers of Mechanical, Electrical and Instrumentation disciplines and shall be headed/coordinated by Senior most officer at level 2 (L2) of this group. There will be suitable number of officers at L3 level.

An organizational structure along with duties/responsibility of officers who would be working in these plants is given in Annexure-5.

(iv) OFFSITES, UTILITIES AND COMMON FACILITIES GROUP :

This group of plants should be headed by an L1 Officer. It can be further divided into sub-groups each headed by an officer at Level-2 as under :-

i) DM Water/Cooling Water/Raw Water/Fire Water/WWTP/ N_2O_2 Plant and Instrument Air system.

ii) Steam Generation and Power Generation Units.

iii) Maintenance group.

Maintenance group shall consist of officers of Mechanical, Electrical and Instrumentation discipline shall be headed by officer at Level-2. There will be suitable number of officers at Level-3.

An organizational structure and duties/responsibility of various officers is as per Annexure-6.

(v) <u>CENTRAL MAINTENANCE SERVICES GROUP - (MECH./CIVIL/C&I/PLANNING)</u> :

This group can be headed by Level-1 Officer. It can consist of following sub-groups :

a) Corrosion & Inspection
b) Civil Engineering
c) Design and Modification
d) Planning (includes Rotating machines, documentation cell and contracts).
e) Central workshop including Construction Equipments.

Each of the above sub-group should be headed by an officer at Level-2. Suitable number of officers of Level-3 shall also be providing necessary support in these groups.

During the commissioning stage, some of the officers in Planning, D&M, Workshop, etc shall be placed in plants for commissioning purpose as per requirement. After stabilized operation is established, distribution of officers within central and plant groups may be reappropriated keeping all departments functioning fully.

Organizational structure and illustrative duties/responsibilities as per Annexure-7.

(vi) CENTRAL MAINTENANCE SERVICES GROUP (ELECTRICAL) :

Officer at Level-1 will be incharge of this group and he will be assisted by three sub-group heads at level-2 officers as under :

i) Trouble shooting and Contracts.
ii) Planning.
iii) Electrical Repair shop and Services to non-plant areas.

An organizational structure and duty/responsibility is as per Annexure-8.

(vii) CENTRAL MAINTENANCE SERVICES GROUP (INSTRUMENTATION) :

This group shall also be headed by L1 Officer. Following sub-groups shall be headed by L2 Officers. Required number of L3 officers can be posted in this group :

i) Digital Control System/Programmable Logic Controller/ Software.
ii) Analyzers/Instruments/Workshop.
iii) Field Instrumentation.

An organizational structure, duties/responsibilities is as per Annexure-9.

(viii) <u>TECHNICAL SERVICES GROUP</u> :

The Level-1 officer incharge of this Group will be assisted by officers at Level-2 and the sub-groups are as under :

a) Chemical & Utilities
b) Polymers
c) Environment

These sub-group can be further divided and headed by L3 officer.

Organizational structure, duties/responsibility is mentioned in Annexure-10.

(ix) <u>QUALITY ASSURANCE GROUP</u> :

This group incharge at level-1 officer should be assisted by two officer at level-2 (qualification - Master of Science in Chemistry or Applied Chemistry). Level-2 Officers will head sub-groups as under :-

a) Polymers and Chemical
b) Raw materials, finished products, trouble shooting and updating analytical technology.

Sub-groups (a) and (b) shall consist of following laboratories :

(a) 1. OLEFINS, PGH & BD

2. PP/LLDPE/BUTENE-1/HDPE/PBR

3. EO/EG, VA/AA, EA & 2EH

4. OFFSITES AND UTILITIES & WASTE WATER TREATMENT PLANT

As per requirement suitable number of officers at Level-3 to look after above sub-groups should be Chemical Engineers and are transferable in operation groups. This will help in developing multi-functional skill in officers at level-3.

(b) 1. Raw materials & investigation

2. Finished products & customer complaints.

3. Trouble shooting and updating analytical technique.

Officer at level-3 in such group should be M.Sc. (Chemistry/Applied Chemistry) having relevant experience of 4 to 5 years.

An organizational structure, duty/responsibility is mentioned in Annexure-11.

x) <u>MATERIALS GROUP</u> :

This group should be headed by an officer of Level-1 and will be assisted by two officers at level-2. The activities can be sub-divided into following sub-groups :-

a) Raw Materials

b) Chemicals and Catalysts

c) Engineering items

d) Packaging

e) General (including administrative items)

An organizational structure, duties and responsibility of Materials Department is given in Annexure-12.

(xi) FINANCE SUPPORT :

In an operation/production oriented organization, Officer as Group Head at Level-1 will be responsible for cost monitoring and control. For this, he should be assisted by Finance Officer at Level-2. Procedure may be formulated to have financial matter referred and routed through an operation/production Group head at Level-1.

4. RECOMMENDATIONS :

The following recommendation may be considered by ARPC for future operation oriented organization of ARPC.

i) ARPC may consider the organization based on single point responsibility for each unit/plant for effective management viz. one head for operation and maintenance.

ii) Operation/production head may be considered as an effective coordinator among inter-disciplinary work.

iii) Within Petrochemical Complex for day to day working and meeting the requirement of production, maintenance and product dispatches, creation of Central Control Room as outlined in Chapter-5 of this report should be taken up on priority.

iv) For Duty/Responsibility of key personnel in non-technical area, ARPC may continue present system and procedure with necessary modification to suit production oriented functions.

5. <u>CONCLUSION</u> :

In this chapter, we have given production/operation oriented organizational structure defining technical officers at Level-1, Level-2 and Level-3, with their illustrative Duty/Responsibility and functions. Thus key level personnel either single or as team can work effectively. Present ARPC system/procedure can be strengthened by adoptation and if necessary after modification for effective management of ARPC. For more in depth study and to formulate detail organizational structure along with duty/responsibility of officers, technicians, operators, etc. it is suggested that ARPC may engage services of full time consultant for a period of 14 man months. Scope of study should aim at formulating line function role clarity, performance appraisal of employees, placement, recruitment, training etc. This type of study and its documentation will prove to be very useful for ARPC management to take corrective action for control to have optimum/maximum production from the complex.

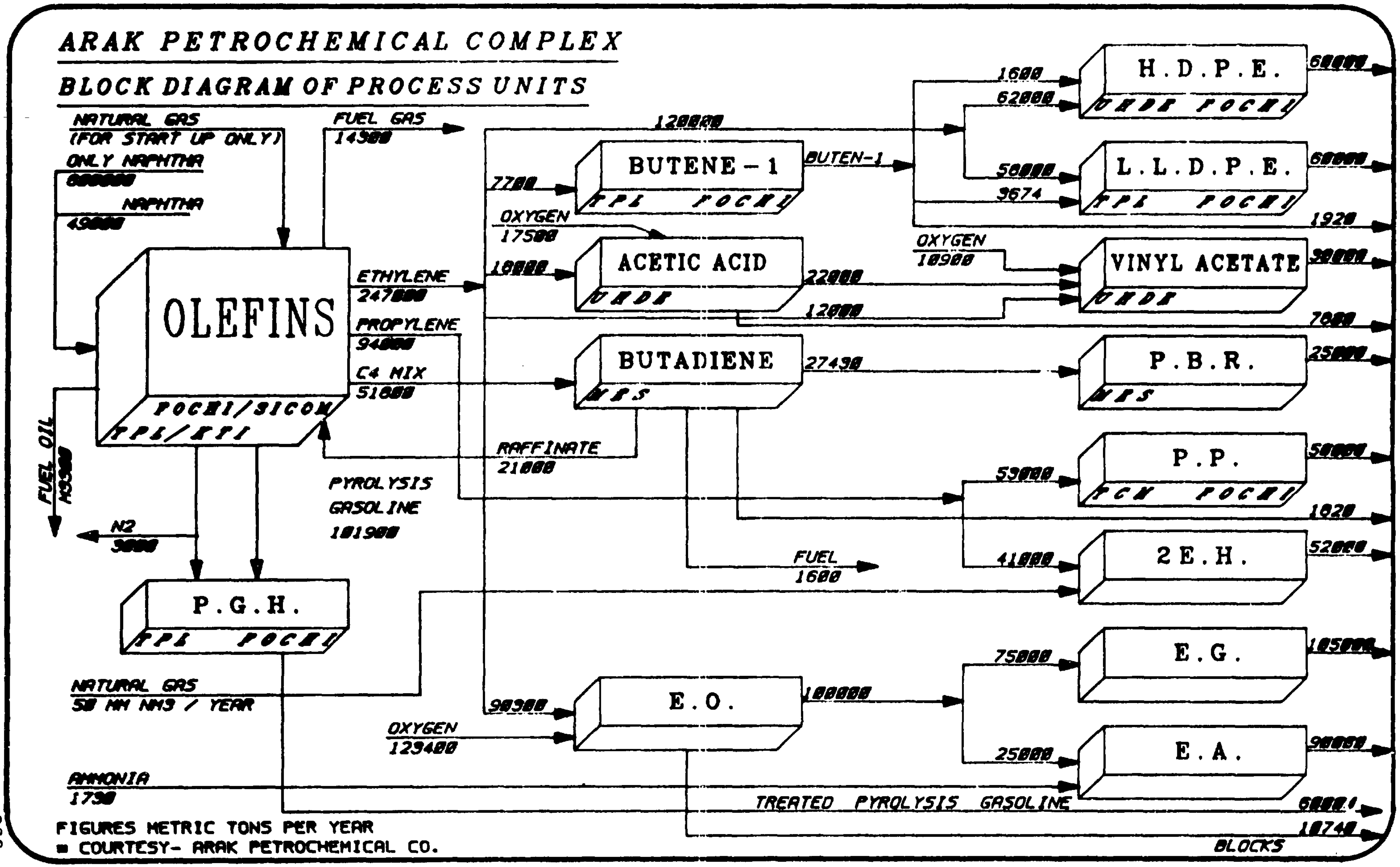
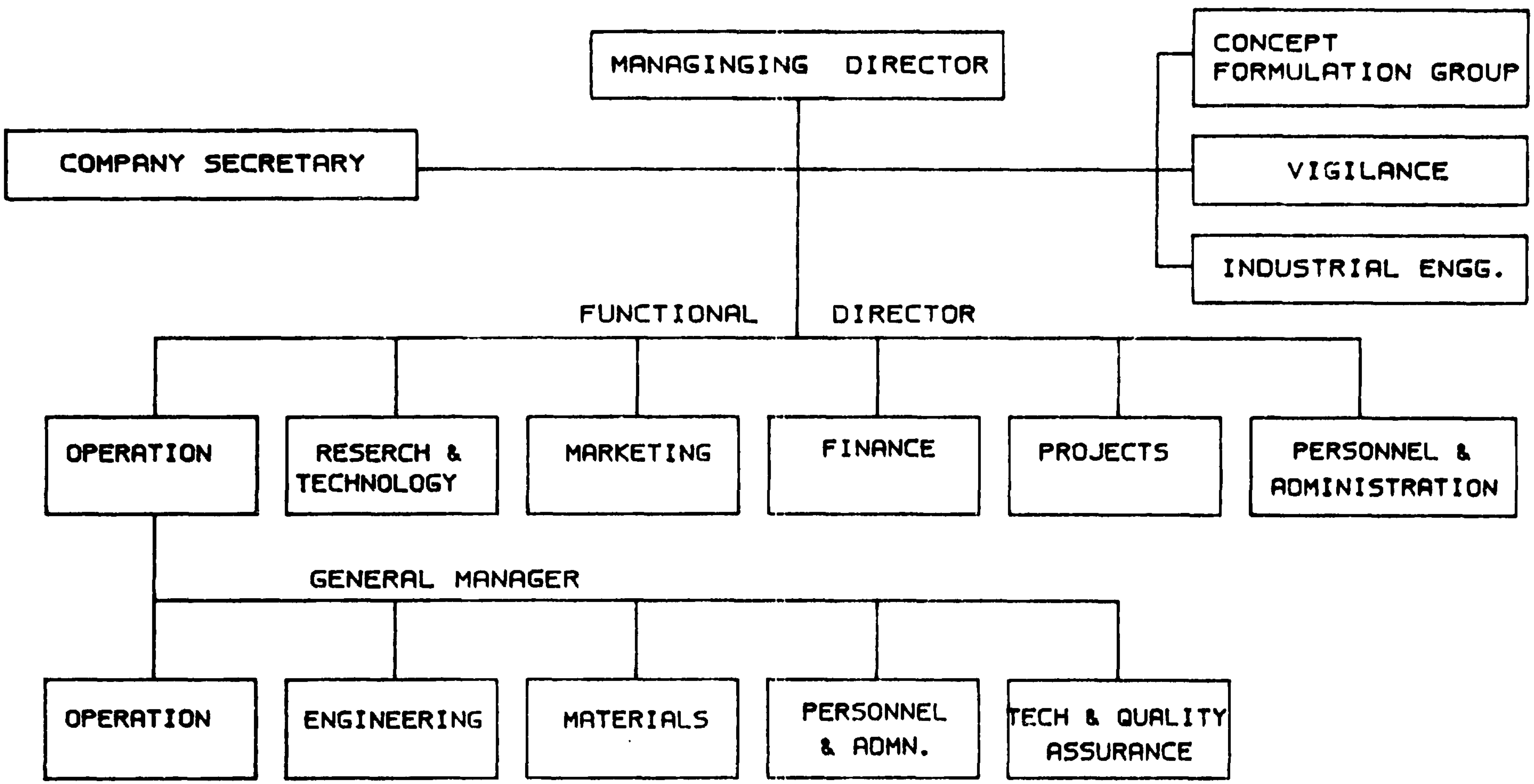

ARAK PETROCHEMICAL COMPLEX
BLOCK DIAGRAM OF PROCESS UNITS
NATURAL GAS
(FOR START UP ONLY)
ONLY NAPHTHA
600000
NAPHTHA
49000
FUEL GAS
14300
OLEFINS
POCHI/SICOM
TPL/KTI
ETHYLENE
247000
PROPYLENE
94000
C4 MIX
51000
FUEL OIL
M3500
N2
3000
P.G.H.
TPL POCHI
PYROLYSIS
GASOLINE
101900
RAFFINATE
21000
120000
7700
BUTENE-1
TPL POCHI
BUTEN-1
OXYGEN
17500
10000
ACETIC ACID
UHDE
22000
12000
BUTADIENE
HRS
27490
FUEL
1600
NATURAL GAS
50 MM NM3 / YEAR
90300
OXYGEN
129400
E.O.
100000
AMMONIA
1730
1600
62000
H.D.P.E.
UHDE POCHI
60000
58000
3674
L.L.D.P.E.
TPL POCHI
60000
1920
OXYGEN
10900
VINYL ACETATE
UHDE
30000
7000
P.B.R.
HRS
25000
59000
P.P.
TCM POCHI
50000
1020
41000
2 E.H.
52000
75000
E.G.
105000
25000
E.A.
90000
TREATED PYROLYSIS GASOLINE
60001
10740
BLOCKS
FIGURES METRIC TONS PER YEAR
COURTESY- ARAK PETROCHEMICAL CO.

FIGURE-1

ANNEXURE-1.

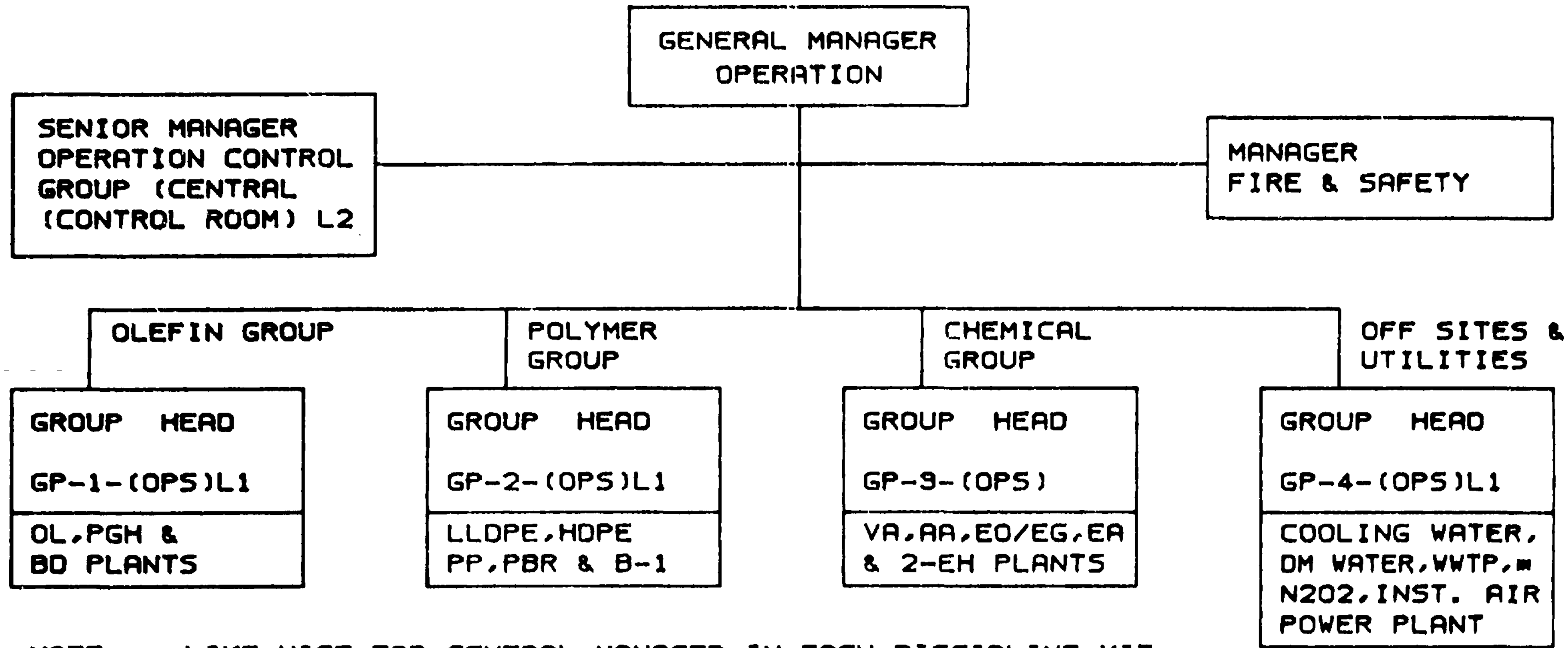
ORGANISATIONAL STRUCTURE:

ARAK PETROCHEMICAL COMPLEX, UNDER MANAGING DIRECTOR



ORGANISATIONAL STRUCTURE:

OPERATION ARAK PETROCHEMICAL COMPLEX UNDER GENERAL MANAGER (OPERATION)



NOTE :- LIKE WISE FOR GENERAL MANAGER IN EACH DISCIPLINE VIZ ENGINEERING SERVICES, MATERIAL SERVICES, TECHNICAL SERVICES PERSONNEL & ADMINISTRATION SERVICES ORGANISATIONAL STRUCTURE CAN BE FORMULATED BASED ON ITS FUNCTIONS.

WWTP : * WASTE WATER TREATMENT PLANT.

ANNEXURE-2.

DUTIES/RESPONSIBILITY OF KEY PERSONNEL :

The following is the typical description (and not exhaustive list) of the jobs, to be carried out by key personnel in operations during the operation of plants in ARPC. On similar line job description for other departments depending upon the functions to be performed in respective department can be prepared by ARPC for trouble free operation of all plants.

General Manager - Operation

1. Planning production in conformity with approved budget and monitoring the same on monthly and annual basis.

2. Aim at optimum capacity utilization (keeping in view of all the constraints including coordination with marketing).

3. Rationalise manpower.

4. Direct efforts to debottlenecking process constraints.

5. Ensure compliance with provisions of Government regulations.

6. To ensure that the effluents from ARPC meets the environmental standards and requirement of safety.

7. Directing plant personnel for commissioning the new scheme plants.

Group Head (Plants/Units)

1. Ensure implementation of approved production programme of plants.

2. Review the constraints in production and maintenance with respective plants and other departments with a view to resolving them/get assistance from Superiors/Other agencies.

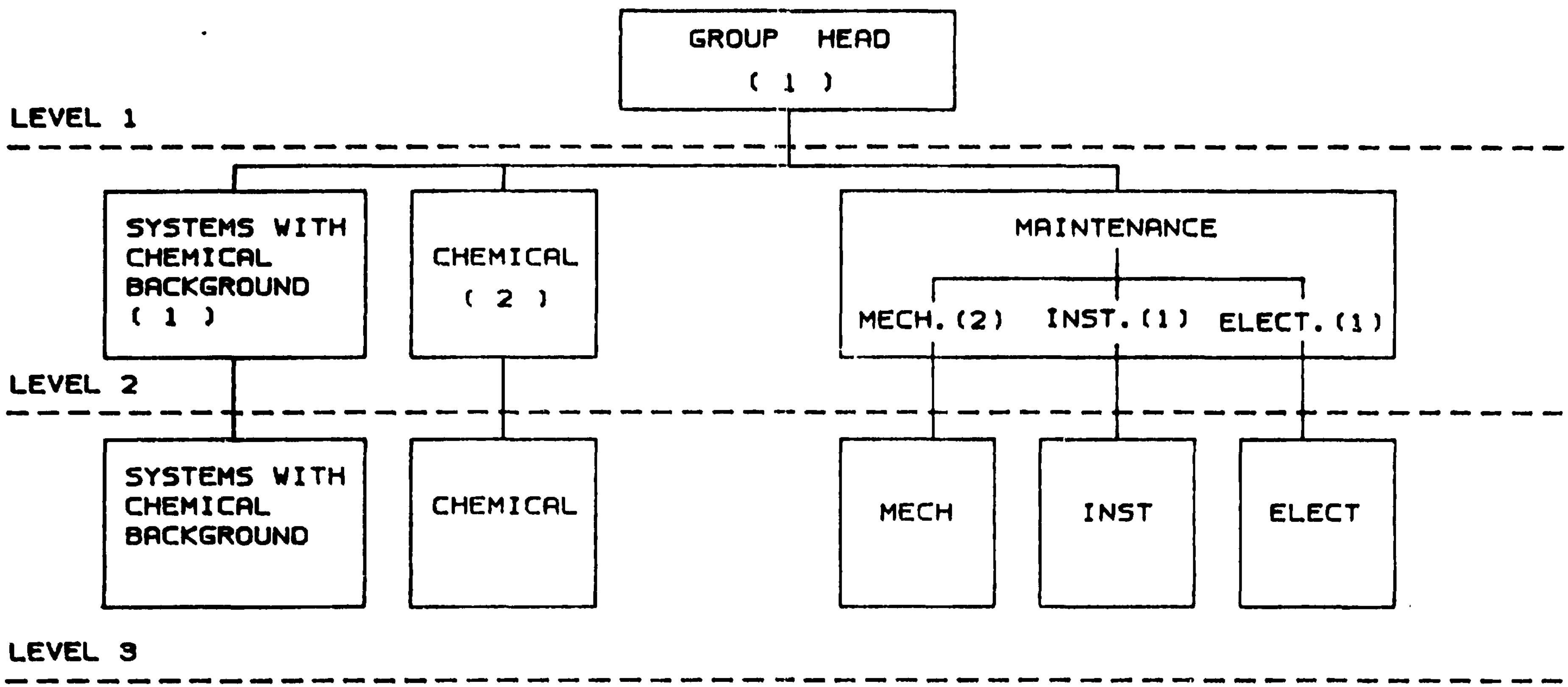
3. After the policy and action has been firmed up, ensure clear understanding of Personnel and Administrative policies procedures for overall day to day handling of problems/ implementation in these areas.

4. Fulfill long term energy conservation in plants and push through debottlenecking plants in association with Project, Technical Services & Engineering Departments.

5. Plan long - term replacement necessities of plant and equipment found vulnerable and critical during operation.

ANNEXURE-8.

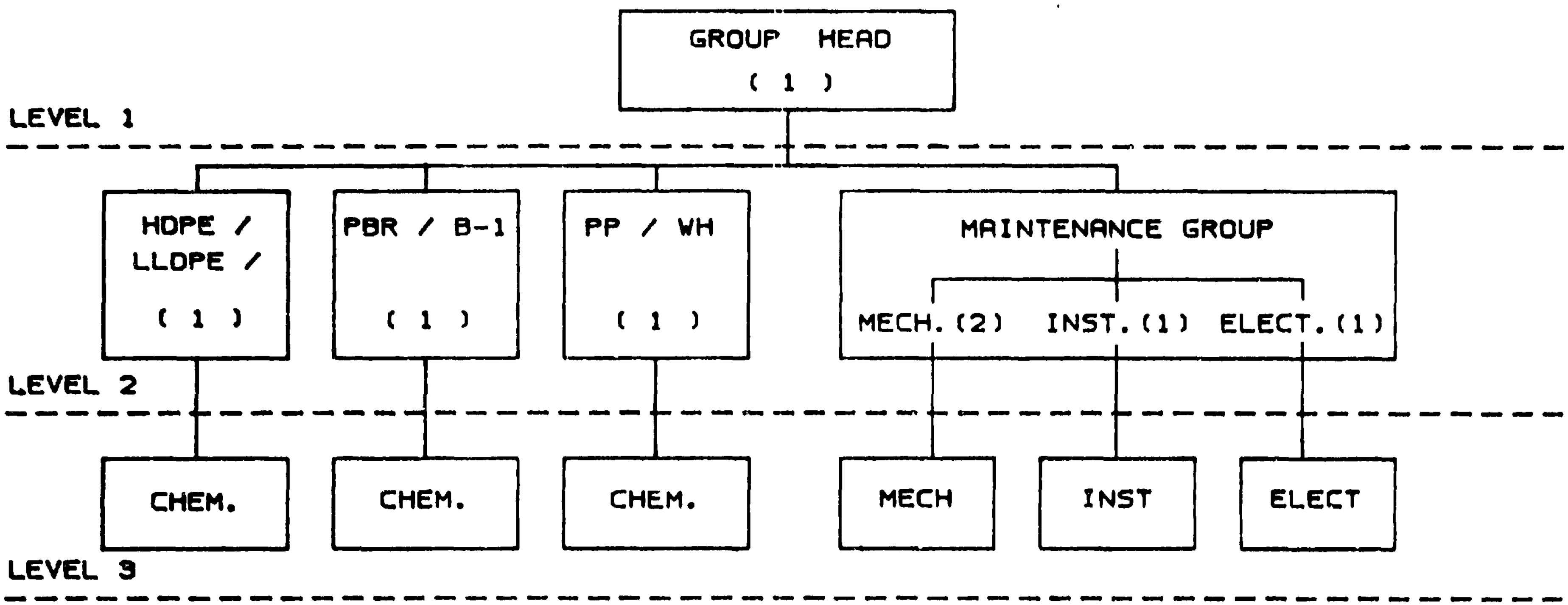
ORGANISATIONAL STRUCTURE – GROUP OF PLANTS
(OLEFINS)



NOTE : BRACKET FIGURE INDICATE NUMBER OF PERSONNEL.

** ** SENIOR MOST L2 WILL COORDINATE THE SECTIONAL ACTIVITIES.

ORGANISATIONAL STRUCTURE – GROUP OF PLANT
(POLYMER)

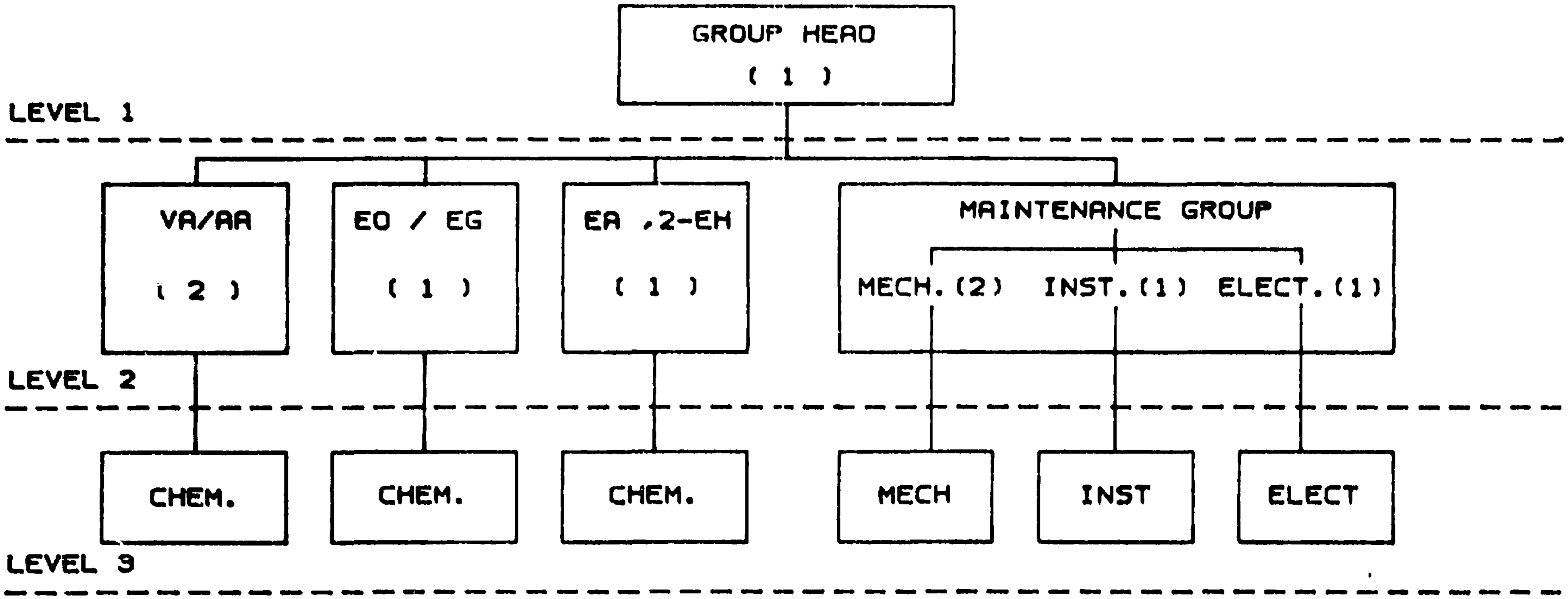


NOTE:
HDPE - HIGH DENSITY POLY ETHYLENE
LLDPE- LINER LOW DENSITY POLYETHYLENE
PP - POLYPROPYLENE
WH - WARE HOUSES
SENIOR MOST OFFICER AT L2 WILL COORDINATE THE SECTIONAL ACTIVITIES.

ANNEXURE-4.

ORGANISATIONAL STRUCTURE – GROUP OF PLANT

(CHEMICAL)

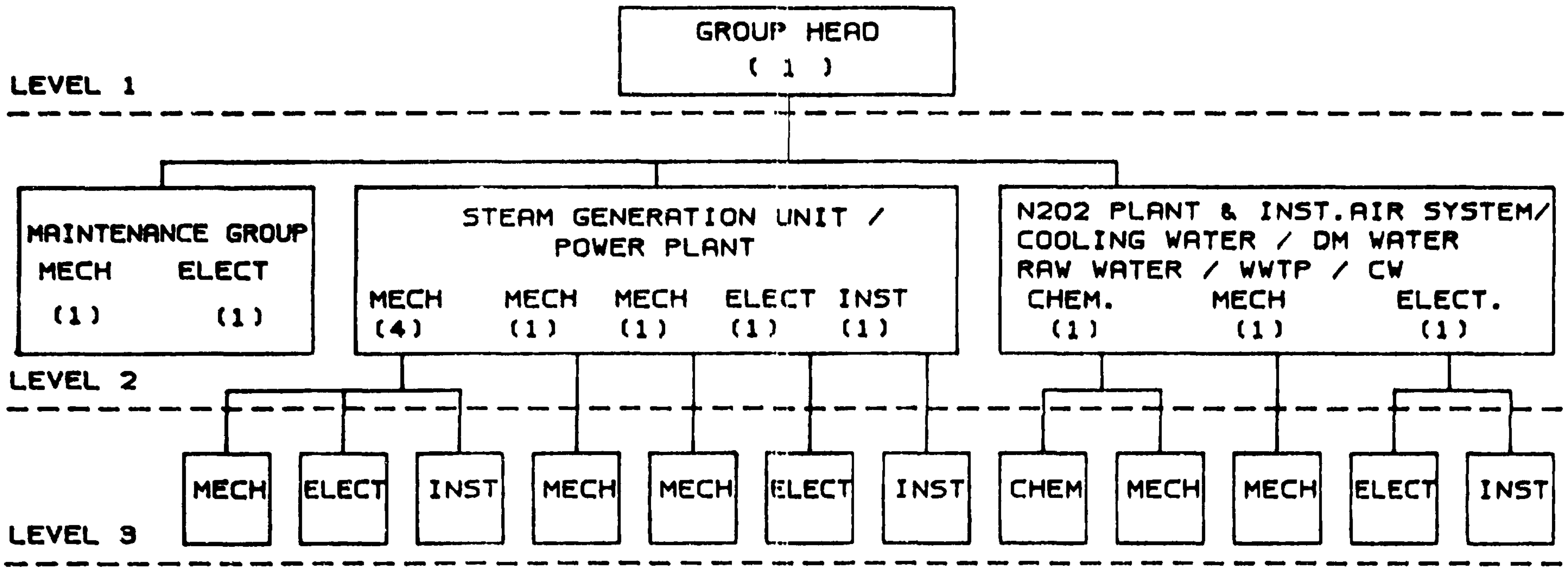


NOTE: SENIOR MOST OFFICER AT L2 WILL COORDINATE THE SECTIONAL ACTIVITIES.

ANNEXURE-6.

ORGANISATIONAL STRUCTURE – GROUP OF PLANT

(OFFSITES UTILITIES, COMMON FACILITIES)



NOTE: N2Ø2 : NITROGEN / OXYGEN PLANT
DM WATER : DEMINERALISED WATER TREATMENT PLANT
WWTP : WASTE WATER TREATMENT PLANT
FW : FIRE WATER

WHEREVER NECESSARY, SENIOR MOST OFFICER AT LEVEL 2 WILL COORDINATE THE ACTIVITIES.

ANNEXURE-6.

Plant Incharge :

Level-1

He will be Level-1 officer incharge of plants.

- will provide necessary guidance to sub-groups working under him, i.e. Production Maintenance & Systems, etc. - will ensure achievement of production targets qualitatively and quantitatively.
- shall interact with various departments for the smooth functioning of their plants.
- shall ensure process improvement, provision and optimum utilization of various resources, to achieve capacity maximisation.
- will ensure plant health and safety.
- will devise effective work procedures.
- will be responsible for development of employees working under them.

Level-2 :

- be responsible for meeting the targets on production and waste reduction.
- be responsible for raw materials, power and utilities consumption.

- coordinate with maintenance and central services group.
- take care of house-keeping.
- provide technical and managerial guidance and support to their subordinate in day to day activities.
- undertake manpower planning for shifts, long and short term shut down of plant.

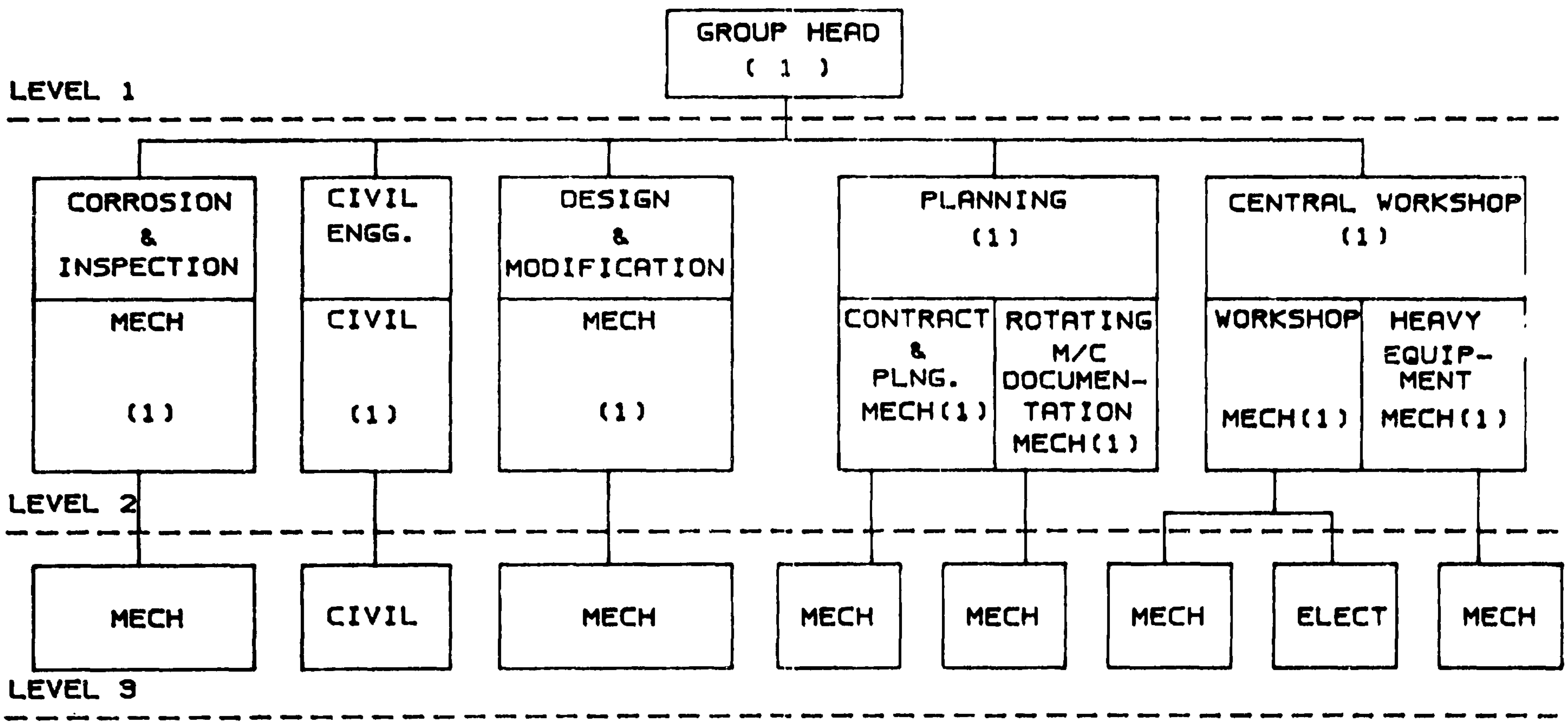
Level-3 :

- be responsible for daily production target.
- be responsible for productivity of resources at their disposal.
- prepare daily/shift reports.
- act as a channel of upward and downward communication.
- act on safety precautions and house keeping.
- suggest improvements in work/technological parameters for efficiency increase.
- be responsible for building up team and maintaining discipline in the work force.

Note: Duty/Responsibility of the key personnel at Group Head, Plant Incharge and other levels are applicable for all the groups viz; Olefins, Polymers, Chemical and Offsites/ Utilities. (Annexure-4,5 & 6).

ORGANISATIONAL STRUCTURE – CENTRAL MAINTENANCE SERVICES GROUP

(MECHANICAL / CIVIL / C & I / PLANNING)



NOTE : SENIOR MOST L2 WILL COORDINATE THE SECTIONAL ACTIVITIES.

ANNEXURE-7.

DUTIES/RESPNSIBILITY OF KEY PERSONNEL - CENTRAL MAINTENANCE SERVICES (MECH/CIVIL/C&I/PLANNING)

Level-1 :

The role will be to coordinate and supervise the activities of Central Maint. Services group to integrate them with the overall objectives of process coordination, optimisation, efficiency improvement and technical support to operating plants. Development of adequate policies and procedures would form the key activity of this level.

Level-2 :

The separate officers for the groups of Corrosion & Inspection, Civil, Design & Modification, Planning & Central Workshop will be responsible for :-

- coordination between the activities of individual plant areas allocated to Level-3 and supervise them.
- implement policies evolved at Level-1. Designing systems for periodic feed-back to the plants and vice-versa.
- co-ordinating for history/data-bank and support from various other functionaries in the organisation.
- monitoring the performance of each group under their control.
- plan activities of next one or two years time span.

- provide support : technical and administrative to officers/staff under their control at Level-3 and below.

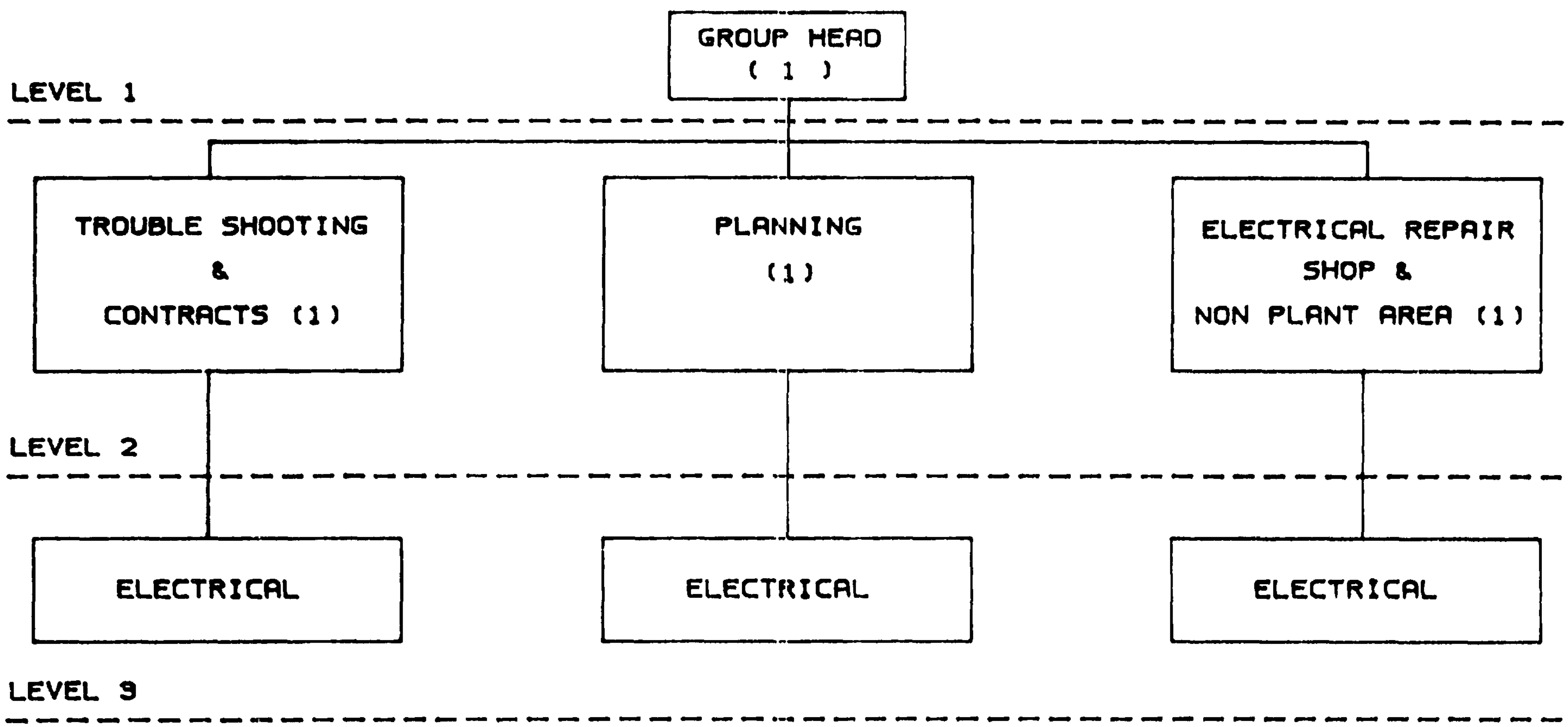
Level-3 :

Their primary function would be to have integrated interaction with plants and other support services with a view to obtaining and analysing data on plant maintenance/operations on day-to-day basis, initiate studies based on intimate knowledge of day-to-day problems, diagnose and suggest remedies for solving long term problems and trouble shooting of difficulties. Building a team and maintenance of discipline in the work force will be their responsibility.

SCOPE OF THE CENTRAL MAINTENANCE SERVICES GROUP - (MECH/C&I/CIVIL/PLANNING)

This department shall be in the form of central group and shall provide specialised as well as vital support services in the field of maintenance planning, engineering back up documentation, civil and general maintenance, workshop and heavy equipment section, rotating machines, design and modification, corrosion & inspection etc.

ORGANISATIONAL STRUCTURE – CENTRAL MAINTENANCE SERVICES GROUP
ELECTRICAL



ANNEXURE-8.

DUTIES/RESPNSIBILITY OF KEY PERSONNEL - CENTRAL MAINTENANCE SERVICES (ELECTRICAL)

Level-1 :

The role will be to coordinate and supervise the activities of Central Engg. Services group (Elect.) to integrate tnem with the overall objectives of process coordination, optimisation, efficiency improvement and technical support to operating plants. Development of adequate policies and procedures would form the key activity of this level.

Level-2 :

The separate officers for the groups of Trouble shooting & Contracts, Planning and ERS & Non-plant area will be responsible for :-

- coordination between the activities of individual plant areas allocated to Level-3 officer and supervise them.
- implement policies evolved at Level-1.
- designing systems for periodic feed-back to the plants and vice-versa.
- co-ordinating for history/data-bank and support from various other functionaries in the organisation.

- monitoring the performance of each group under their control.

- plan activities of next one or two years time span.

- provide support : technical and administrative to officers/staff under their control at Level-3 and below.

Level-3 :

Their primary function would be to have integrated interaction with plants and other support services with a view to obtaining and analysing data on plant maintenance/operations on day-to-day basis, initiate studies based on intimate knowledge of day-to-day problems, diagnose and suggest remedies for solving long term problems and trouble shooting of difficulties. Building-up a team and maintenance of discipline in the work force will be their responsibility.

SCOPE OF THE CENTRAL SERVICES GROUP - ELECTRICAL

To provide electrical engineering services for following areas/groups for plants as well as non-plants :-

I) TROUBLE SHOOTING :

Trouble shooting of various electrical equipments, systems and circuitries.

II) Number of modifications are required in process as well as in engineering section of various plant for improving production as well as downtime. This section will develop schemes for such modifications.

III) CONTRACTS :

No. of jobs are envisaged to be given on contracts on short term as well as long term basis. The group will arrange to formulate such contracts.

IV) PLANNING :

Planning of short time shut down jobs, annual shut down jobs is essential in terms of man and material. Standardization of inventory spares and maintenance practice is also required. The group will provide planning for such activity.

V) ELECTRICAL REPAIR SHOP :

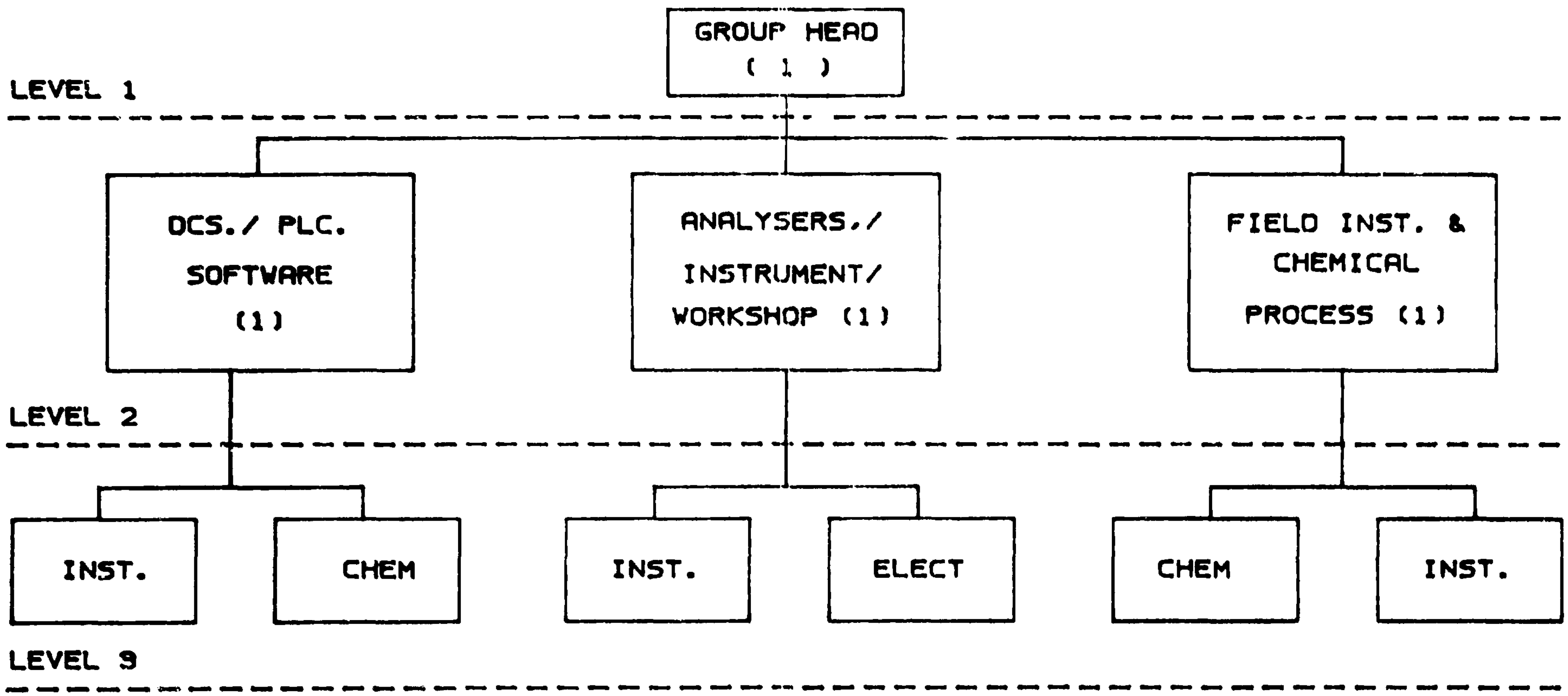
Various electrical equipments of the plants are required to be overhauled and repaired in order to make them reusable in the plant. The group will organise and mobilize for the same.

VI) NON-PLANT AREA :

Various non-plant buildings, towns[illegible], etc. require electrical services, the group [illegible] cater to this requirement.

ORGANISATIONAL STRUCTURE – CENTRAL MAINTANENCE SERVICE GROUP

(INSTRUMENTATION)



DCS – DIGITAL CONTROL SYSTEM
PLC – PROGRAMMABLE LOGIC CONTROLLER

ANNEXURE-9

Annex-9 (Contd..)

DUTIES/RESPNSIBILITY OF KEY PERSONNEL - CENTRAL MAINTENANCE SERVGICES (INSTRUMENTATION)

Level-1 :

The role will be to coordinate and supervise the activities of Central Services group to integrate them with the overall objectives of process coordination, optimisation, efficiency improvement and technical support to operating plants. Development of adequate policies and procedures would form the key activity of this level.

Level-2 :

The separate officers for the groups of DCS/PLC & Software Analyzers/Instrument Workshop/Field Inst. & Chemical Process will be responsible for :

- coordination between the activities of individual plant areas allocated to Level-3 officer and supervise them.
- implement policies evolved at Level-1.
- designing systems for periodic feed-back to the plants and vice-versa.
- co-ordinating for history/data-bank and support from various other functionaries in the organisation.
- monitoring the performance of each group under their control.

- plan activities of next one or two years time span.

- provide support : technical and administrative to officers/staff under their control at Level-3 and below.

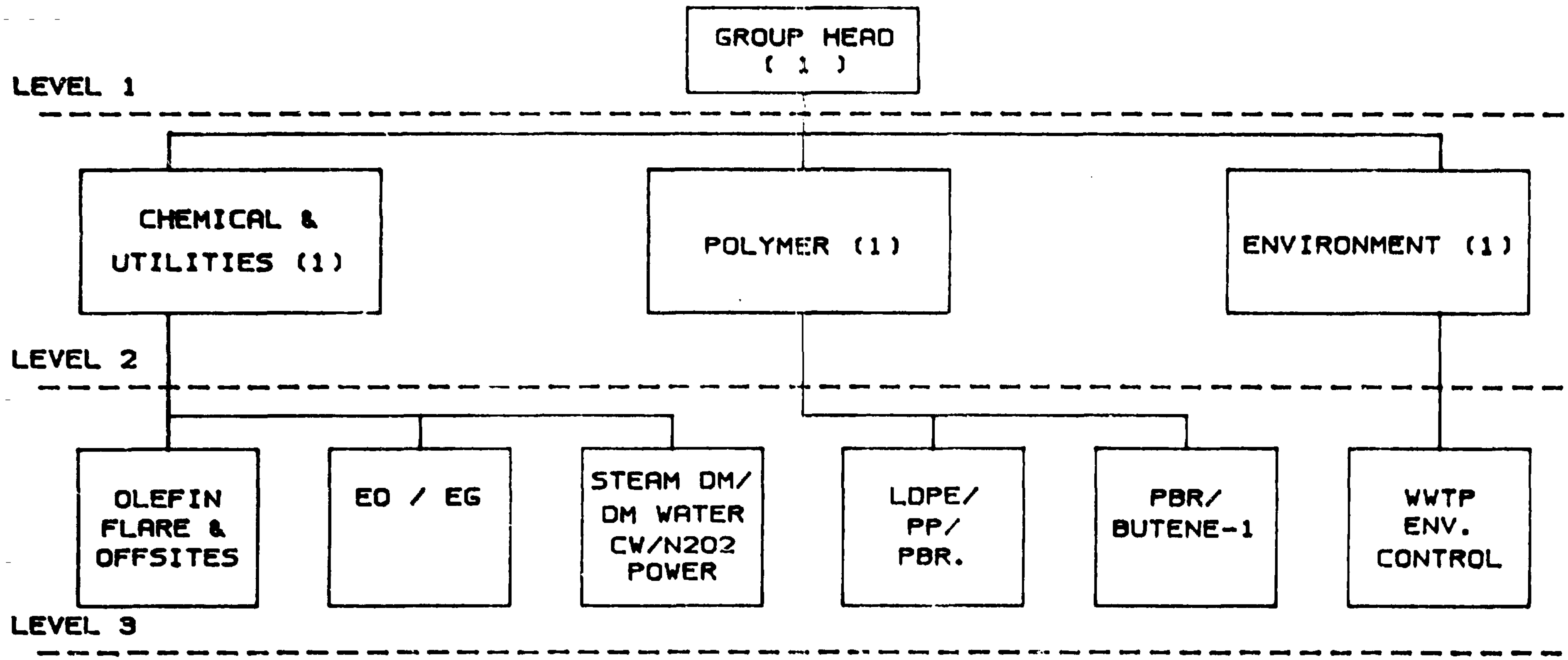
Level-3 :

Their primary function would be to have integrated interaction with plants and other support services with a view to obtaining and analysing data on plant maintenance/operations on day-to-day basis. initiate studies based on intimate knowledge of day-to-day problems, diagnose and suggest remedies for solving long term problems and trouble shooting of difficulties. Building-up a team and maintenance of discipline in the work force will be their responsibility.

SCOPE OF THE CENTRAL INSTRUMENTATION SERVICES GROUP

This department is a centralised one and gives specialised support services in the field of instrumentation in hardware maintenance, application software, maintenance and spare parts planning, major back up services through workshop, standardisation of spares, indigenous developments, Central Laboratory hardware maintenance, design and modifications, etc.

ORGANISATIONAL STRUCTURE – TECHNICAL SERVICES GROUP



EG/EO – ETHYLENE GLYCOL / ETHYLENE OXIDE
LLDPE – LINEAR LOW DENSITY POLYETHYLENE
WWTP – WASTE WATER TREATMENT PLANT
CW – COOLING WATER
ENV – ENVIRONMENT
N2O2 – NITROGEN /OXYGEN PLANT

ANNEXURE-10.

DUTY/RESPONSIBILITY OF KEY PERSONNEL - TECHNICAL SERVICES

Level-1 :

The role will be to coordinate and supervise the activities of Process Services Group to integrate them with the overall objectives of process coordination, optimisation, efficiency improvement and technical support to operating plants. Development of adequate policies and procedures would form the key activity of this level.

Level-2 :

The separate officers for the groups of Chemicals and Utilities and Polymer and Environment will be responsible for :

- coordination between the activities of individual plant areas allocated to Level-3 officer and supervise them.
- implement policies evolved at Level-1.
- designing systems for periodic feed-back to the plants and vice-versa.
- co-ordinating for data and support from various other functionaries in the organisation.
- monitoring the performance of each group under their control.
- plan activities of next one or two years time span.

- provide support : technical and administrative to officers/staff under their control at Level-3 and below.

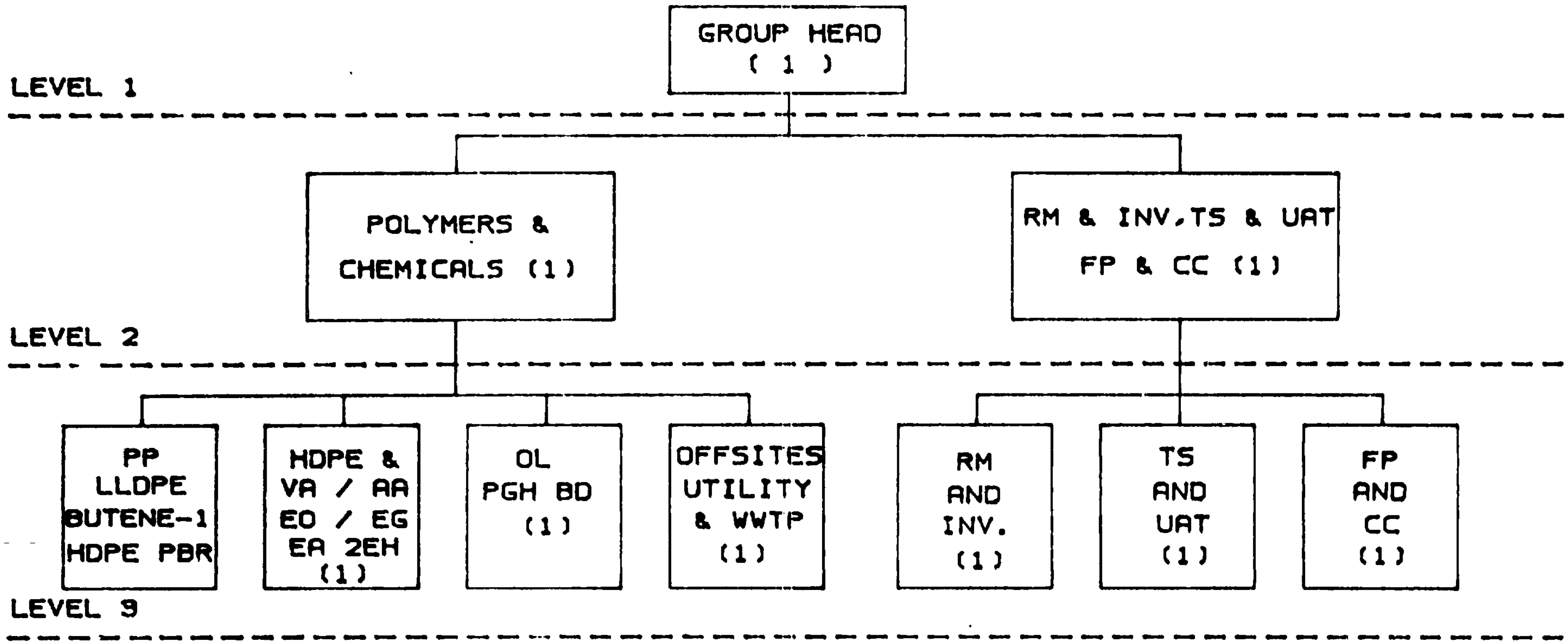
Level-3 :

Their primary function would be to have integrated interaction with plants and other support services with a view to obtaining and analysing data on plant operations on day-to-day basis, initiate studies based on intimate knowledge of day-to-day problems, diagnose and suggest remedies for solving long term problems and trouble shooting. Building-up a team and maintenance of discipline in the work force will be their responsibility.

SCOPE OF THE TECHNICAL SERVICES GROUP

The scope of this department has to be defined in conjunction with the scope of operating groups because many of the activities could be undertaken by either of these groups. Here it is proposed that operating groups should be independently equipped to tackle day to day operation of plants. The technical services group should provide back up for problems which would need in-depth study or design calculations. Thus, operating plants would be responsible for generating data on plant operation, efficiency calculations, trend projections, etc. The technical services group would be responsible for evolving/calculating methods for efficiency, trend parameters, etc and analyze/correlate the data generated on operations and advise corrective/improvement steps. Technical Services Group will also be responsible for development/acquisition of calculation or design procedures required in support of operating groups.

ORGANISATIONAL STRUCTURE – QUALITY ASSURANCE GROUP



RM & INV – RAW MATERIALS & INVESTIGATION

TS & UAT – TROUBLE SHOOTING AND UPDATING ANALYTICAL TECHNIQUES

FP & CC – FINISHED PRODUCT & CUSTOMER COMPLAINTS.

ANNEXURE-11.

DUTY/RESPONSIBILITY OF KEY PERSONNEL - (QUALITY ASSURANCE)

Level-1 :

The role will be to coordinate and supervise the activities of Quality Assurance Group to integrate them with the overall objectives of Laboratories coordination, efficiency improvement and analytical support to operating plants. - will keep constant touch with latest trends in analytical techniques -development of adequate policies and procedures would form the key activity of this level.

Level-2 :

The separate officers for the groups of Polymers & Chemicals, raw materials and finished products will be responsible for :

- coordination between the activities of individual plant areas allocated to Level-3 officer and supervise them.
- implement policies evolved at Level-1.
- designing systems for periodic information and feed-back to the plants and vice-versa.
- co-ordinating for data and support from various other functionaries in the organisation.

- monitoring the performance of each group under their control.

- plan activities of next one or two years time span.

- provide support : technical and administrative to officers/staff under their control at Level-3 and below.

Level-3 :

- have integrated interaction with plants and other support services with a view to obtaining and analysing samples from various stages/sections of respective plants and report the results to the plants on day-to-day basis - prepare daily/shift reports - act as channel of upward and downward communication.

- act on safety precaution and house-keeping.

- initiate studies based on intimate knowledge of day-to-day problems.

- diagnose and suggest remedies for solving long term problems and trouble shooting of difficulties.

- build up a team and maintenance of discipline in the work force will be their responsibility.

SCOPE OF QUALITY ASSURANCE GROUP

Quality Assurance Group will have the following scope of work :-

Quality assurance for all the inputs : This would include - the quality control of various feed stocks required for the complex - quality control of all the chemicals, catalysts, lubricants additives required - quality control of all the packaging materials required for packing of finished goods produced by the company.

Stage-wise Process Control : This involves a very heavy work load of the process control samples and their detailed analysis.

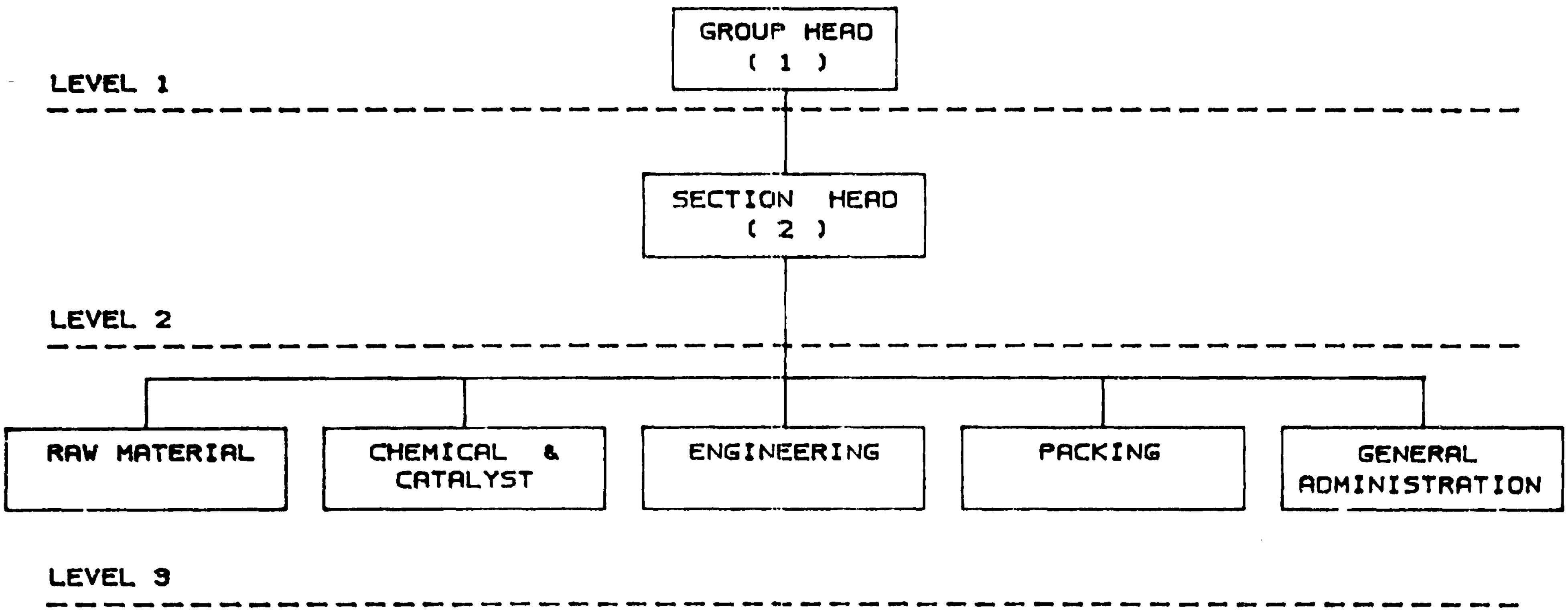
Quality Control of all the Finished Products : Classification of the products based on different analytical parameters and certification of the products for marketing purpose.

Trouble shooting & Investigations : Above three activities involves not only the routine analytical work-load but many investigational problems for Process Trouble Shooting and resolving customer complaints.

Updating the analytical procedures : Keep in constant touch with latest trends in analytical techniques and revise the old analytical procedures/instruments with the latest development.

ANNEXURE-12.

OPERATIONAL STRUCTURE – MATERIALS GROUP



DUTY/RESPONSIBILITY OF KEY PERSONNEL - MATERIALS DEPARTMENT

Level-1

- Preparing manuals for purchase, stores and inventory control to act as guideline for L2 and L3 officers.
- Arranging disposal of surplus/non-moving items with a view to reduce idle inventory.
- Planning of adequate storage of material handling facilities in order to facilitate service to user plant/department.
- Development of import substitution for conservation of foreign exchange and indigenization of material.
- Laying down policy guidelines for inventory control, stocking levels and working capital to optimise return on inventory.
- To ensure zero loss of production on account of non availability of material keeping the overall inventory within the decided levels.
- Development of human resources under his control.

Level-2

Within the policy framework and guidelines laid down in operating manuals, the Section Heads will be responsible for all the functions stipulated at level-1 in respect of the items under their control.

Level-3

Each Officer shall be responsible for both stocking and procurement and would conform to meet the requirements/contracts laid down by level-2 and level-1 in this regard. In addition, they would also be responsible for Safety/Good House-Keeping.

SCOPE OF THE DEPARTMENT

The Materials Department will arrange for all the materials/services required by Petrochemical Complex. The Department will be responsible for procurement, warehouse planning, transport, inspection, warehousing, receipts and issues, inventory control, disposal of surplus/scrap items, ancillary industries development, import substitution, value engineering and all other related materials management functions.

CHAPTER 13

TERMINAL SECTION

CHAPTER 13 : TERMINAL SECTION

1- PREAMBLE;

Project titled as " Management Consultancy Services" under code no. J 13420 and contract no.89/114 between the United Nations Industrial Development Organisation and the Indian Petrochemicals Corporation Limited (IPCL), Baroda, India for Arak Petrochemical (Company) Complex, Arak, Islamic republic of Iran for the Management Consultancy Services of 20 man - months was undertaken from June 1990 and completed in December 1991. The project work was carried out by the team of consultants in phase-out manner.

Phase-1 of the project work was executed by the consultants-team posted at Tehran from June 1990 to September 1990 on development and implementation of Management Control System to be used during the project stage, i,e during design, engineering procurement, construction and commissioning of the Arak petrochemical complex.

Consultants-team examined and analysed the information gathered through documentation, discussions and reports. The team also visited site to have appreciation of the overall status of the various project activities and the management thereof. Based on the inputs and the analysis, the consultants-team prepared the study report and made recommendations which have been presented through First Interim Report dated September 1990.

The report provides concept, review and recommendations for the project control system for the effective monitoring of the progress and control the project activities with respect to cost and time.

Initial part of the phase.2 of the project work was executed by the consultants-team posted at Tehran from November 1990 till February 1991. The team attempted to develop the second phase of the contract which covered conceptual work regarding central control room, fire and safety, spare-parts management, local vendor development etc. The team also had a review of contractual documents, progress report and a visit to site. The suggestions / recommendations have been presented in Second Interim Report February 1991.

Both the above reports were submitted to the Project Planning, Control and Co-ordination department of Arak Petrochemicals Company , Tehran and UNDP office, Tehran.

For the balance part of the phase.2 and the concluding part of the Management Consultancy Services the consultants- team arrived in Tehran on 20-9-1991.

All the above teams were attached to Planning, Control and Co-ordination department of Arak Petrochemical Co.Tehran.

2- SCOPE OF WORK

As ARPC is expected to be an ever- growing Centre of Petrochemical Industries and the complex is considered one of the biggest of its kind in Islamic Republic of Iran, the precommissioning, commissioning and start-up operations of such an integrated complex of process units, utilities and off- sites together with vital support services at a time for sustained operations is a challenge of major importance.Also the objective is to develop in-house capabilities and confidence without any continued assistance from outside. To achieve the goal, Consultants-team from IPCL was requested to provide such technical assistance.

The areas to be considered were

- To assist the ARPC site Management to analyse, review and make recommendations on the precommissioning, commissioning and start-up activities proposed by Unit Contractors and Managing Contractor.

- To enable ARPC site Management in formulating key support services like maintenance, technical, safety right from the stage of precommissioning, commissioning and start- up.

- To draw up proper operational safety set-up and safety procedures.

- To outline functions of operational central control room.

- To review manpower requirement of expatriates from Unit Contractors, Managing contractors, Vendors and the Owner during the precommissioning, commissioning and start-up.

- To introduce concept and formulation of Environment and Ecology, Risk Assessment and Disaster Management as developing Area of critical and important activity for the management of Petrochemical complex.

- To consider suggestions, if any in the area of training ARPC personnel for operation and maintenance of the complex .

- To review drawings and documents concerning the central laboratory, technical building, effluent treatment plant, complex master schedules, monthly construction progress reports, etc. as required and provide comments/suggestions.

3- METHODOLOGY

Based on the reports and documents furnished by ARPC, consultants-team carried out review, analysis, held series of discussions/meeting with concerned and visited process, utilities and off-sites areas of the complex. Due to secrecy agreement with the Unit Contractors (Licensors) access to process information, operation manuals, mechanical catalogues was limited.

However with the support of home - office assistance, systems and procedures for vital support services like operational safety, maintenance, engineering, technical services environment and ecology, risk assessment and disaster management were taken up to provide basic concept and system development during the precommissioning, commissioning and start-up operations. It will be also useful for the post-commissioning need of the complex to ensure smooth operations, good maintenance practices and strong safety base for sustained production of the petrochemicals.

4- REPORT STRUCTURE:

This report presents,the working of consultants-team during the consultancy-service period at Tehran and Arak (Complex site). The consultants work was oriented towards scope of work outlined as above. A chapter on each subject was prepared to provide concept and system development. The systems suggested not only concerns to the period of commissioning and start-up but also a set-up for the post operational needs of the complex. This is with a view to assist ARPC towards the goal of self - sustenance in operating the integrated petrochemical complex.

4.1 Precommissioning, commissioning and start-up operations:

In this chapter the latest construction progress was critically reviewed in relation to the delays in precommissiong activities and recommendations made towards prioritising and sequencing. Start-up schedules submitted by UCs and MC were examined for their effectiveness and deployment of man-power. Other aspects of storage and preservation, testing and inspection, checking for completeness, planning of spares, etc. were touched upon. Planning of operation and maintenance personnel has been given due weightage.

Concept of Area Management having unit of command, responsibility and authority with the Area Manager has been stressed upon. Area Manager with his team of multi-discipline will co-ordinate all activities for successful commissioning and smooth take over of the operations of the unit under his command. For the preparedness, safety/technical audit of plants, hazop studies have been also suggested.

4.2 Central (Operation) control Room:

Its named as central control room. Apart from individual control room of the units, need for the central central room was examined and proposal formulated outlining the objectives, functions, system design, system operation with needy linkages and data-base requirement. It will lead to the establishment of mechanism for follow-up of agreed actions /decision and monitor to the extent possible. This will be the key-centre for the management over the complex operations.

4.3 Operational safety:

Prerequisite to the successful commissioning of the petrochemical complex is an appropriate safety structure. The chapter provides details of the organisation structure as it relates to the precomm.commissioning and start-up need of the complex in the midst of construction activities. For effectiveness of the safety system, 'Central Safety' concept is considered. The proposed structure, procedures, functions will lead itself for smooth changeover from construction to operational need. It will also ensure management for monitoring and timely control for safe working.

4.4 Maintenance Engineering Services:

The need for this services was carefully examined and keeping in view the set-up as planned by ARPC, a sound system to cover various maintenance engineering aspects has been presented in this chapter. Development needs of the services were also recommended in view of the remote location of the complex. The chapter deals with aim, approach, system advantages, organisation set-up, role and responsibility at centre and at plant-level, expatriate need, functions, interaction/communication with other departments, etc. Such a partly decentralised set-up has been found quite useful in petrochemical complexes of the developing nations.

4.5 Technical Services :

For trouble shooting, debottlenecking, modifications, modernisation, development of alternatives; establishing services of such nature is a must. Not only the technical services would provide continuous support to the operations, but it will ensure quality and quantity of the products designed from the Complex. Conceptual framework is developed and presented in the Chapter.

4.6 Training :

Based on the available information through discussions only the training plan and scheme of ARPC has been reviewed. Present scheme is to form composite groups of engineers and operators/

technicians of respective discipline and subject them to 6-8 weeks of class room training and thereafter 8-16 weeks training at the licensors' plant or similar plants in the country or abroad. This could be formalised in a system. So the system approach for training of supervisory and non supervisory category of employees has been suggested. Along with plant training other areas of training needs-like specialised training. supervisory development, training facilities etc. were considered in the chapter.

Also annexed the complete "one year training programme" for the non-supervisory employees to the chapter.

4.7 Environment and Ecology:

For the effluent treatment facilities, basic design package for liquid and solid waste treatment was reviewed. An integral approach having multi-disciplinary functions for management of pollution and its effect on ecology along with the remedial actions required have been dealt with in this chapter. It gives clearly defined objectives, need of ambient air monitoring, work environment monitoring and environmental impact assessment.

4.8 Risk Assessment and Disaster Management:

This chapter is introduced with a view to provide system approach towards the risk assessment and disaster management, a newly developed concept, since petrochemicals complex are classified as Major Hazard Installation. It is recommended that ARPC can start organising in this area, fulfilling their obligations to the safety of the human beings in and around the complex.

4.9 Effective Management of a Petrochemical Complex Operation :

This chapter is devoted on typical organizational structure, functions of key personnel and Central Communication System, which can be adopted by ARPC management for the petrochemical complex operation in future.

5.0 RECOMMENDATIONS:

A chapter has been separately drawn out summarising all the recomendations and conclusions of the study work. The same can be considered for useful implementation by ARPC on short-term or long-term basis.

6. REVIEW AND COMMENTS :

During the period of the consultants stay, from time-to-time, some of the issues were referred for technical opinion. This were examined and comments and suggestions were given for ARPC to take up with concerned agencies. The documents/drawings, referred were enlisted/analysed under communication no.1-5 (Tehran Office) and no.1-5 (Arak site office) which have been incorporated in this report. (Ref. APPENDIX)

7. CONCLUSION :

While the Consultancy services work by the consultants-team was in progress, there had been reviews with ARPC and UNDP.

The topics and issues covered in the project report were discussed and the impression gathered was that the recommendations made therein were found acceptable. Also the short-term and long-term consultancy need were described and reported in the report.

RECOMMENDATIONS AND CONCLUSIONS

RECOMMENDATIONS AND CONCLUSIONS

During the stay of the Consultants-team, the following conclusions and recommendations were drawn :

1. In order to achieve the latest, revised targetted date for commissioning of the Phase-I units in the complex (say, during Nov. Dec.1992), it is essential that all out efforts should be made for follow-up and monitoring for completion of the units as prioritised in the utilities/offsites and process areas. Similar priorities should be exercised to prepare and made available the area management team for the operations and services in the respective units.

2. Once the guarantee/performance tests are over and the plants accepted, ARPC may need post-commissioning assistance to overcome teething problems and debottlenecking of known constraints and absorption of technology and know-how for sustained production. After concluding the present contracts with UCS/MC, ARPC should under separate arrangement to retain consultancy services from the operating companies for definite issues and for definite period. In this situation assistance/consultancy through UNIDO/UNDP can be also thought of. This will have an advantage of

gaining self-confidence, self-reliance while absorbing the various technologies of the integrated complex.

3. Adhearing to the due importance to the Central Control Room, ARPC should arrange manning of the same with experienced personnel. On rotation, plant managers can have opportunity to be in this position.

4. Right from the precommissioning stage, Area Management concept is recommended. This is with a view to have a strong team under the unit responsibility for smooth and safe commissioning and take over of the units once performance tests are successfully established.

5. It is the immediate need of the complex to establish 'Central Safety Services' having multidisciplinary team of relevant specialists and professionally qualified personnel looking after all matters of safety from design stage till safe operations. Safety procedures should be framed, introduced and monitored with 'no relaxations'.

6. By the time, the units are nearing mechanical completion, ARPC should establish services like technical, maintenance engineering, and involve with

the plant-operations to have advantage of the knowledge of equipment/plant behaviour and collect information/data as a basis for future reference.

7. Qualified engineers who have been associated during design and basic engineering stage can be transferred to the technical and engineering services to strengthen the support to the operations.

8. Establish Laboratory services and start sampling and analysing during commissioning to have better knowledge about on-spec/off-spec utilities. Raw materials, chemicals and products. Laboratory personnel must be trained and tuned with plant operations.

9. ARPC may consider having a small 'cell' under the technical services for the energy conservation and energy-efficient operations.

10. ARPC have planned to organise the Maintenance Engineering Services with the right approach, the same can be established with inter-relations and responsibilities as suggested in the report. However, during start-up stage, this services will not be fully geared up and available. ARPC may retain some of the skilled personnel from the contractors to overcome the situation.

11. ARPC due to its remote location have to overcome the problem of trained and experienced/expert manpower availability There will be need to attract or develop service anciliaries/agencies who can provide expertise for the diagnostic maintenance needs. In future, then, ARPC can retain such services on regular contract basis.

12. With the coming up of adjoining refinery, there is a possibility of sharing the services, expertise in the field of maintenance. It may be also possible to jointly promote service anciliaries.

13. ARPC can have computerised maintenance management system for data and control of critical spares, inventory and planning of preventive maintenance, shut-down maintenance, etc. Also the system can record and provide information on engineering standards, personal data of the engineering personnel, and on the vendors and services.

14. It is suggested that shift-manning for the maintenance is centralised with minimum number. The requirement of the shift maintenance personnel will be higher during the start-up stage, which can be reinforced by hiring contractors personnel.

15. On regular basis engineers and technicians working in the plants and central engineering could be interchanged/rotated for better appreciation of the services on either side..

16. ARPC may like to modify their training programme/plan on the basis of inputs furnished in the chapter on 'training'. On completion of the training, the engineers and operators/training should be attached to commissioning team, i.e. under the Area Manager, to take up precommissioning/commissioning activities-simultaneously a short of on-the-job training.

17. It is very essential that plant operation and maintenance personnel undergo fire-fighting and safety training/mock drills during this period.

18. For continuing education and training, an establishment of regular training centre with due facilities is the priority for ARPC.

19. For proper control of plant effluents, at the battery limit all important parameters should be measured. A well developed analytical support and procedure should be established to monitor, control and treat the effluents.

20. It is recommended to sell, if possible, the semi-solid wastes rather than incinerating or disposal by land-fill. Incineration of waste is expensive and adds to pollution. Alternative methods of landfill, microbial degradation should be explored. In case of land-fills, ground water contamination should be monitored.

21. ARPC should consider installation of Air Monitoring net-work connected to Central Control Room. This will provide record and information in time for any preventive action to control/stop abnormal discharge of pollutants in air.

22. Prior to design or during the basic engineering of the incinerator, it is recommended to ensure by test-burning of samples for the size, shape, weight and batch-frequency. If this is not done, the redesign of the incinerator cannot be ruled out.

23. The future Consultancy Services in the areas, ARPC may have to look into are;

    (i) Post operational assistance for sustained operation and performance of the units.

    (ii) Diagnostic Maintenance Services.

(iii) Process Engineering and Technology for debottlenecking, modernisation, new schemes and projects.

(iv) Occupational Health Services.

(v) Operational Safety Services.

(vi) Risk and Disaster Management and for On-site/Off-site emergency plan.

(vii) Ambient Air and Stack emission monitoring systems.

(viii) Training Facilities.

24. For effective management and its establishment in ARPC review of present management system could be considered. For this, ARPC management may like to engage Consultancy Services. Scope of Consultancy Services should include formulation of line function, role clarity, performance appraisal of employees and their placement, recruitment and training. Detail documentation of such study having organizational structure along with Duty/Responsibility of all officers, technicians, operators will prove to be very useful for formulation of future policies and initiate corrective action in time. It is therefore, suggested that ARPC may like to engage Consultancy Services for setting up future operation oriented management based on Level Concept outlined in this Final Terminal Report.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Technical Specifications for Central Laboratory Equipment.

2. Basic Design Specification for Central Laboratory Equipment.

3. Project Execution Manual Volume 1 to 5 prepared by Managing Contractor.

4. Conditions & Scope of Work of contract for management, coordination and supervision services to construction, commissioning and start-up between Arak Petrochemical Complex and Managing Contractor and Contractor for offsite facilities - Onshore.

5. Monthly progress reports for July, August - September and October 1991 for overall complex issued by managing contractor.

6. Monthly progress report issued by MC, Milan and site office to ARPC.

7. Complex master schedule Rev.5 and Rev.6 issued by managing contractor.

8. Offsite facilities monthly progress report August 1991.

9. Pre-commissioning, commissioning chapters of operation manual for Olefin, Polypropylene, Detail

Precommissioning/commissioning schedule in case of BD/PBR from unit contractors.

10. Basic design specification for effluent treatment and waste disposal system (Package)

11. Engineering services manual - Indian Petrochemicals Corporation Limited.

12. Safety system and procedure - Indian Petrochemicals Corporation Limited.

13. Environmental Quality Control documents

14. Critical path method monthly precommissioning/ commissioning charts by Managing Contractor.

15. Spareparts Manuals.

APPENDIX

1. Communication no.1-5
   (Tehran office)
2. Communication no.1
   (Arak site office)
3. Communication no.2-5
   (Arak site office)
   (Annexed to Chapter 4)

From: UNDP CONSULTANTS (IPCL)

COMMUNICATION-1
ARAK SITE OFFICE
12.10.91

SUB: TECHNICAL OFFICES AT ARPC SITE : PLAN ARRANGEMENT

Following drawings were reviewed :

1. Drg.No. Ar-P-C-C-68-56 dt.19.12.89 Basement and parking plan -
2. " " " " -57 " " " First Floor
3. " " " " -58 " " " Second Floor
4. " " " " -59 " " "

Following Technical Offices are located in H. Shape building at present.

1. Engineering and Process Engineering
2. Research Centre
3. Training Centre and Trg. shops
4. Drawing, Documentation, Microfilming, Library, etc
5. Model Room
6. Engg. Planning Offices

SUGGESTION/RECOMMENDATION

For smooth coordination and keeping in mind the co-related activities of the respective disciplines, following changes have been suggested. This will also satisfy the functional need of the services.

1. Documentation with Drawing, Drafting, Microfilming and other Engg. offices.

2. Process Engineering & Research Centre.

3. Training Centre with Trg.shops and classes at the basement and Ist floor.

4. Model room in separate wing 'C' on I floor having larger area and independent location.

Following sections of Engineering which are not shown in the plan can be accommodated in this building.

1. Rotating Machines cell including vibration monitoring instruments.

2. Refractory and insulation - Central Services.

3. Design and Modification Cell.

4. CADD (Comp. Added Design and Drafting) in the Drafting) in the Drafing Room.

Other Services which can be Centralised

It is recommended that following services should be centralised and accommodated in the vacant space available in this building (-B2 and C wings on Second Floor).

1. **Safety**

2. **Environment & Ecology**

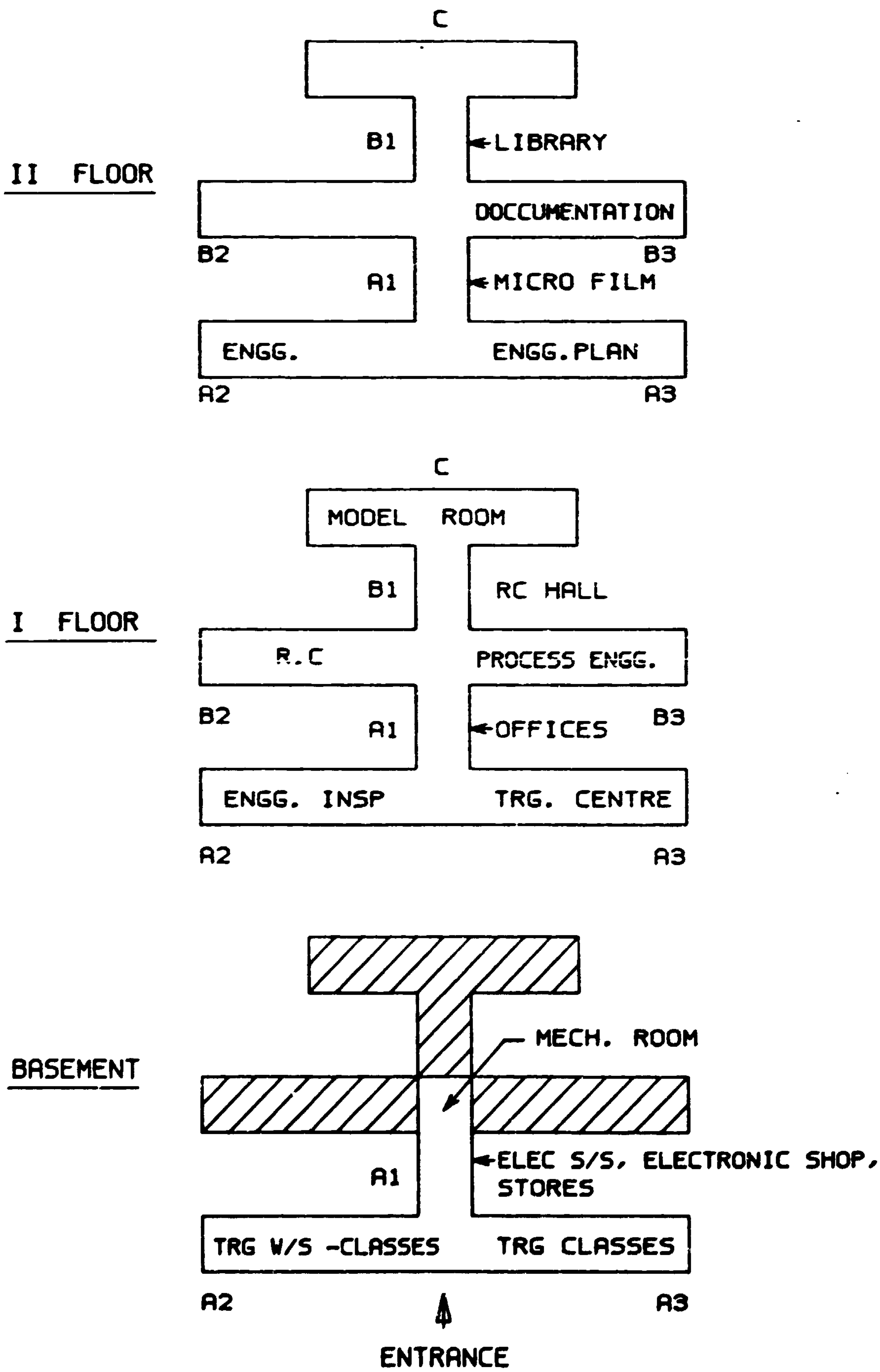
3. **Occupational Health**

Encl. Annex.I, II.

M.V.Naik/D.C.Bhatt

ANNEXURE-I

SERVICE BUILDING PLAN



NOT TO SCALE

ANNEX: II

Proposed Allocation in Service Building.

Basement

A1 No change

A2 No Change

A3 No change but R.C. Hall shifts to B1 (I Floor)

B1 -

B2 -

B3 -

C -

I Floor

A1 No change

A2 No change

A3 Training Centre shifted here from B3 (II Floor)

B1 R.C. Hall shifted here. Model Room to C (I Floor)

B2 R.C. Research Centre from B2 (II Floor)

B3 Documentation shifts to B3 (II Floor), process Engg. from A3 (I Floor)

C Model Room from B1 (I Floor)

II Floor

A1 No Change

A2 No Change

A3 No Change

B1 No Change

B2 Research Centre shifted to B2 (I Floor). This space is for future.

B3 Training Centre shifted to A3 (I Floor). Documentation here from B3 (I Floor).

C Space for future

From: UNDP CONSULTANTS(IPCL)

COMMUNICATION-1
TEHRAN OFFICE
DT. 24.9.91

SUB: COMPLEX MASTER SCHEDULE REV.6

Our finding and recommendations are presented for consideration.

Documents referred are :

1)	Complex Master Schedule	Rev.6 (31.7.91)
2)	" " "	Rev.5 (28.2.91)
3)	Monthly Detail Progress Report from MC at site	(June'91)
4)	Monthly Report from MC at Milian	(July'91)
5)	Monthly Report from MC at site	(Aug.91)

By reviewing complex master schedules revisions 5 and 6. it is clear that there is a delay of about 12 - 13 months for project completion. This appears to have been accepted by ARPC.

From the monthly report from MC at site (Aug. 1991) overall summary indicates following date of Project Completion, as agreed to by ARPC.

UNIT	COMPLETED BY
ARAK1 - Olefins	30 Nov 1991
ARAK2 - Polyolefins	31 Dec 1991

ARAK3 - Utilities	30 Oct 1992	(Overall Completion)
ARAK3 - Offsites	30 Oct 1992	(Overall Completion)
ARAK4 - ED & PBR AA/VA	23 Sep 1992 22 Dec 1992	"

MC should clarify that for meeting commissioning dates of ARAK 1 and ARAK 2 Utilities (ARAK - 3) and offsites (ARAK 3) are completed and available beforehand.

In case for Phase-I Commissioning, priorities are planned for part of utilities and offsites by MC, this should be accordingly reported for review by ARPC.

Rev.6 shows scheduled completion of ARAK 1 and ARAK 2 by Oct/Nov.1992 and utilities and offsites (ARAK 3) by July/Aug 1992 which is sequentially correct and in order. However when it is compared to monthly report issued by MC at site, it does not match. M/s.ARPC may like to clarify such mismatch with respect to Rev.6 from MC.

Responsibilities of MC regarding scheduling the Project Completion with a delay of 12 - 13 months should be discussed in detail and fix up remedial measures and actions to minimise the delay. Otherwise such trend in revising the schedules to accommodate the delays without taking timely actions on constraints will continue. It need not be emphasised that any day gained in early completion of the Project could save the avoidable revenue loss to the organisation (ARPC) . It is also recommended that before accepting Rev.6 schedule, MC may be invited to spell out the measures taken to follow at least this revised schedule and attain completion of the Project even earlier.

The overall summary report should refer only one (Master) schedule showing the scheduled v/s actual progress on S-curves or a bar-chart so that instead of referring in detail, management can take the view for identifying the responsibility and take remedial actions in time. Also there should be only one and only one schedule referred in all the progress reports without any mismatch.

OTHER POINTS:

Manpower deployment seems to be a major constraints from the construction contractors. Before we attempt to increase suddenly the manpower at site it should be examined whether such number working at one site at a time is feasible. This will need critical review.

It is also stated that during construction contractors are even not agreeable to the revised schedule 6. If that is so, then schedule may have to be revised again and further delay? This is to be seriously discussed.

In the documentation, we do not find any 'CPM'. Network for monitoring and control, particularly the critical activities. This could be discussed and considered.

From the discussion, we understand that the task force concept as recommended in our first interim report is not yet considered. It may be still worthwhile (Advisable) to organise unit-wise and overall task-force who can closely follow up the progress, advise MC and UC time-to-time and be responsible for completion of Project and commission thereafter.

M.V.Naik / D.C.Bhatt

From: UNDP Consultants (IPCL)

COMMUNICATION-2
TEHRAN OFFICE
DT. 24.9.91

COMMENTS ON CENTRAL LAB. LAY OUT 24/9/91

1. Central Laboratory should have one common sub-station rather than two.

2. For safety reason sub-station should have approach from roadside.

3. For feed to burners in laboratory a natural gas line be adequately designed and provided. A storage of few LPG cylinders could be considered as a back-up.

4. Suggest to have one gas cylinder bunker instead of two as shown in drawing.

5. Slope waste room (22) should be shifted from the present location to one of the corner of the building for safety reason.

6. For room No.16 i.e. simulation bunker polymerisation test. Window should be provided.

7. Wherever necessary, Acid/alkali proof flooring should be considered.

8. A vide door in machine room of knock testing (13) be deleted for safety reason.

M.V.Naik/D.C.Bhatt

From: UNDP CONSULTANT (IPCL)

COMMUNICATION-3
TEHRAN OFFICE
28.9.1991

COMMENTS ON COST CONTROL REPORTS (APR - JUNE 1991)
DATA REF. OLEFINS UNIT

	APR	MAY	JUNE	
P.B.	57	59.5	64	Planned Base-Line %
C.B.	92	96	97	Contractual Base-line %
ACWP	50	54	55	Actual Cost Work Performed %
AWP	50	55	58	Actual Work Performed %

	ACTUAL PERFORMED (Paid)			PLANNED	
	June 90	Jan.91	June 91	June 91-Dec.91	
P.B.	25	44	64	64 - 100	Possible-No
C.B.	32	78	97	97 - 100	" -Yes
ACWP	24	43	55	55 - 98	" -No
AWP	14	40	58	58 - 100	" -No

Note:

1. The rate of planned base line looks abnormal since from June 1990 - June 1991 it is 25 to 64 whereas assumed for June 1991-December 1991 as 100% which is not feasible.

2. Also actual work performed and actual work progress is slow from June 1990-June 1991 i.e. 24 to 55% and 14 to 58% which cannot reach 100% by December 1991 in six months.

3. Hence (PB) and (CB) needs reworking of the schedule.

4. This example for Olefins can be studied and reviewed for cost control case of Arak 2,3,4.

M.V.Naik

Mr.Sharifdini

From: UNDP CONSULTANTS (IPCL)

COMMUNICATION-4
TEHRAN OFFICE
SEPT/OCT 1991

SUB: PROJECT MONITORING AND CONTROL
FINDINGS AND RECOMMENDATIONS.

REF: PRESENT PROGRESS STATUS.

PRESENT STATUS

On referring certain documents of the progress reports of the complex and discussions with planning and coordination, the status of the complex as in August-September 1991 has been presented in form of observations. While understanding and interpreting the report, the analysis and comments are given. Also as suggestive attempt, recommendations are put forward for consideration of ARPC.

DOCUMENTS REFERRED

Complex master schedule Rev.5 (Feb. 1991)

Complex Master schedule Rev.6 (July 1991)

Monthly Progress Report from MC Milan (July 1991)

Monthly Progress Report from MC site (August 1991)

Overall Complex Progress Report MC (August 1991)

Monthly Material Status Report MC (August 1991)

OBSERVATIONS

1. Comparisons of master schedules Rev.5 and Rev.6 indicates project delay of further 12-13 months (the schedule revision from February 1991-to-July 1991).

2. Monthly report from MC at site.

   Overall summary indicates following dates of completion of projects.

Arak 1	Olefins	30 Nov. 1991	
Arak 2	Polyolefins	31 Dec. 1991	
Arak 3	Utilities	30 Oct. 1992	(Overall Completion)
Arak 3	Offsites	30 Oct. 1992	"
Arak 4	BD and PBR	23 Sept.1992	
	AA and VA	22 Dec. 1992	

3. When the above information is compared with that in Sch.Rev.6, the completion dates of Arak 1 and Arak 2 are different.

   Rev.6 indicates

   Oct./Nov.1992 for Arak 1/Arak 2 and July/Aug. 1992 for Arak 3 i.e. offsites and utilities.

4. Overall complex progress as on 31.08.91 shows in per cent:

		Schedule	Actual
(A)	Phase I	71.03 (72.53)	61.38 (66.05)
	Phase II	25.29	NIL
	Overall	64.49	52.61

(--) Figures in bracket are for process Units. Details of above are in annexure I, II, III.

(B) Utilities - Cumulative

	Schedule	Actual	Main Delaying Activities
61. D.M.Water Unit	67.5	46.1	Const/commiss-ioning
62. C.W.System	53.0	37.05	Mat.FOB to Site,Const/ Comm.
64. Plant & Inst. Air	46.25	27.71	FOB Mat, Mat to site, Const/ Comm.
65. N2/02 Plant	50.63	49.46	Mat. to site
68. Steam Gen.	51.21	44.67	Mat. to Site, Const/Comm.
69. Elec Power Gen.	70.47	61.00	Mat. to Site, Const/Comm.
Overall Utilities	60.5	49.86	Mat. to Site, Const/Comm.
(C) Offsite gen. facilities	82.07	63.19	Const/Comm. and common services

Offsite facil-ities	64.55	58.73	Mat. to Site, Const/Comm.
Overall off - -sites	75.52	61.52	Mat. to Site, Const/Comm.

Thus the main contribution towards delay are the FOB material delivery (particularly in case of inst. & plant air), material transportation to site and activities of construction and commissioning.

5. Another data comparing the progress as on 31.8.1991 and as on 14.09.91 (information to ARPC from MC by letter dtd.14.9.91) Overall-Cumulative.

		SCH	ACT	DIFFERENCE	
Arak 1	31.8.91	75.71	66.31	-9.4	
	14.4.91	81.19	67.68	-13.51	A
Arak 2	31.8.91	46.82	32.60	-14.22	
	14.9.91	55.29	34.58	-20.71	A
Arak 3	31.8.91	34.95	17.36	-17.59	
	14.9.91	41.81	18.14	-23.67	A
Arak 3	31.8.91	26.69	17.76	-8.83	
	14.9.91	32.40	19.71	-12.69	A
Arak 4	31.8.91	13.52	6.40	-7.12	
	14.9.91	15.32	6.78	-8.54	A

A. There is a further delay in the month of September, 1991. The trend of the progress is further negative (deteriorating) for all Units in just a period of two weeks.

6. The enclosed annexures I, II and III projects following (Ref.: overall complex progress report No. 30.8.91) delays in most of the areas :

Engineering and Procurement services	17.9%
Material Commitment	15.0%
FOB - material delivery	4.9 %
Transportation from FOB to site	16.4%
Construction and pre-commissioning	14.2%
Commissioning and start-up	6.7 %

The main delays are on account of late completion of engineering activities mainly for the Utilities Package Units, late FOB material delivery, delay in transportation to site, delay in construction due to inadequate site management/planning, manpower mobilisation, lack of civil construction material supplies, delay in receipt of construction drawings etc.

7. Contracts for Phase II Units namely, EO/EG-EA, OXO/2-EH awarded respectively to M/s.Tecnimont (Oct. 1990) and to M/s.SPEICHIM/DAVY MCKEE (Jan.1991) are not yet

effective. This results in overall progress of the complex very poor as compared to progress of phase I units alone.

8. The Sch. Rev.6 also indicates the BD and PBR units on CRITICAL PATH. Even at site there is no sign of completing civil foundation of these projects.

9. The manpower deployment at site is now about 50 (fifty percent) % less than scheduled in the deployment chart. More reduction particularly in the month of June-July-August 1991.

ANALYSIS/COMMENTS

1. Plant units Arak1 and Arak2 will be complete before the Utilities and offsites (Arak3, Arak4) are ready which is contrary to as shown in schedule Rev.6.

2. It seems Utilities and Offsites (Arak3, Arak4) will be getting ready progressively from Mar./Apr. 1992 till Sept/Oct.1992 and fulfilling the needs of pre commissioning/commissioning of process Units Arak1 and Arak2. If that is so, then detail schedule (could be a NETWORK) showing interrelated activities of precommissioning the Arak3 and Arak1/Arak2 must be produced/published.

(xxxx)

3. The rest of the Units in phase I i.e. Arak4 : BD and PBR will be the last to be ready in Sept./Dec. 1992.

4. There is a trend in revising the master schedules of the complex, since within six months (from Feb. 1991 till July 1991) the schedule had been revised shifting project completion by about 12-13 months. This revision could have been avoided if timely necessary actions to remove constraints had been taken. Otherwise such trend will lead to indefinite situation.

5. Commissioning and start-up schedules started showing negative trends right from now. It can mean that scheduling of commissioning is over optimistic and not realistic in relation to sequential completion of Utilities and Process units.

6. There is no point in reporting progress on Phase II Units in overall progress of the complex, when the effective dates of these Units are not clear. Scheduling at this stage of these projects together could be a misnomer.

7. The inordinate delay on Units under Arak4 i.e. Butadiene, PBR, AA and VA which are on critical path need lot of inputs to bring them up on schedule. The manpower and equipment mobilisation of the local contractor is very poor.

RECOMMENDATIONS/SUGGESTIVE ACTIONS

1. A serious assistance and coordination is required from MC for :

   a) Making available construction drawings/documents.

   b) Getting completion of the detail design of all the process and Utility packages.

   c) Despatch of FOB-delivery of the remaining equipment/items and transportaion within the country to site.

   d) Site construction activities for management and planning of manpower by the respective agencies-also the mobilization of the construction equipments.

   e) Monitoring and control of the revised schedules Rev.6 and identifying the constraints well-in-time and recommend solutions to the Owner.

2. Owner on their part to identify and hold reponsible the respective UCS and UPCS and take necessary actions in consultation with MC.

3. Also Owner on their part to take immediate necessary actions to supply materials of construction activities of civil and for transportation from port to site.

4. Owner to call frequent review meetings with MC and the contractors for identifying the Hold-UPS, constraints and actions to catch up for the delays atleast now in relation to Sch. Rev.6.

5. ARPC to closely monitor the construction activities by deploying unit wise responsible coordinators of their own (ARPC Personnel) for following up with unit wise schedules and identifying responsible defaulters.

These coordinators should take also the responsibility for the Owner's obligations in completing the respective units.

These coordinators will be fully involved with their team (task force) in precommissioning, commissioning and start-up activities and ultimately take over the unit operations.

6. Completion of the Utilities and Offsites will have to be advanced than scheduled. Basic requirement is expediting FOB delivery of the material (Particularly in case of Inst. and Plant-Air), the shifting of the material at site and enhancing site activities of construction. MC and ARPC to jointly review and take necessary action . Atleast this may help in commissioning Utilities/offsites between Mar.Sept.1992.

7. Also it is suggested to phase out the Utilities and Offsites and to complete the part which can be used for the pre-commissioning and commissioning activities of Phase I process units. That is to establish the availability of steam, power, air, N2/O2 and cooling water, and fuel from March/April 1992 ONWARDS and not in July-Aug. 1992 (Ref. Rev.6 schedule). Necessary PRIORITIES will have to be attended in this direction.

MV NAIK/DC BHATT

From: UNDP CONSULTANTS (IPCL)

COMMUNICATION-5
TEHRAN OFFICE
5.10.91

VISIT TO SITE ON 29.9.199 (SUNDAY)

Met	Mr.Pakaravan	Incharge Personnel & Adm.
	Mr.Sayeedi	Incharge Training
	Mr.Nazarian	Incharge Operations-Tech.Deputy
	Mr.Salihi	Operation Olefins
	Mr.Majumdar	Adviser Operations

Visited Naphtha Cracker - About 65% completion - Still lot of works going on. Civil works flooring, equipment/piping erection, instrumentation, insulation, painting , storage tankages to come up, cryogenic storage erected - C/G compressor erection alignment on, other compressors erection in progress.

PGH - Still pipe racks not ready.

Other Units (General Round)

Utilities to plants pipe/cable trenches construction going on, boilers - about 50% erection, power generation unit - about 30%, still under transportation -

BD/PBR civil work yet not visible

PP erection - about 50 to 70%

LLDPE/B-1 - Erection on - utilities in general far behind.

Overall impression: Rev.6, scheduling commissioning towards 1992 end looks difficult - lot of efforts on all front after critical review every month necessary.

Feedstock from NPC's seventh refinery in neighbourhood, but except some tankages no sign of erection - feed stock towards 1992 end not feasible.

Laboratory workshop still to come up.
Clinic/Admn. bldg., Mini township ready.

Discussed with Mr.NAZARIAN - Opn.-in-Charge - Preparing personnel for commissioning and start up. About 80% recruitment is over. Training already on hand. Likely that few trainees will join Batch of trainees going to IPCL from NPC.

Also deputing Engineers to other units (like refineries/ petrochemicals) where they are involved in operations by taking direct responsibility.

ARPC also thinking to take help from operating units like IPCL for a specialist group who can take start up responsibility of LLDPE/HDPE units. IPCL suggested that it is possible to send such a team.
Visited Arak Town to see the accommodation facilities available for our stay at Arak.

D.C.Bhatt / M.V.Naik