Government of India & Government of The Netherlands

Technical Assistance
HYDROLOGY PROJECT

DHV CONSULTANTS & DELFT HYDRAULICS with HALCROW, TAHAL, CES, ORG & JPS

MAINTENANCE NORMS AND LOGBOOKS FOR WATER QUALITY LABORATORIES

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1 General

The maintenance norms and logbooks presented in this document refer only to Water Quality Laboratories established under the Hydrology Project, both in Surface Water and Groundwater Departments.

The Hydrology Project has made considerable investment in the procurement of equipment and the creation of infrastructure and facilities to create the Hydrological Information System (HIS) in Peninsular India. These facilities need to be operated and maintained to perform satisfactorily and to live their full expected life span. The HIS is a dynamic operating system. It necessitates checks on system health and spotting impediments, often-embedded in Operation & Maintenance (O&M) practices. There is, therefore, a need for laying emphasis on improving the O & M practices and keeping provisions in the annual budget, so that the HIS is sustained. A regular updateable database of station/ office health, equipment health and staff training adequacy is envisaged for inclusion in the system. The Management Information System (MIS), containing facets indicated above, needs to be used by HIS managers at all levels.

For a successful operation of the HIS, earmarking of sufficient budgetary provisions for yearly sustenance of all components established under the Hydrology Project is a must. This document provides norms for this purpose. Recommended spares to be stocked for un-interrupted operation of the facility are prescribed.

2 Upkeep of water quality laboratories

Development/strengthening of a water quality laboratory in the government sector is usually project-specific. Hence, upgrading of laboratory instruments and equipment is not only infrequent but also uncertain. Under the circumstances, it is important to keep the instruments, what-so-ever purchased, in good working condition through proper operation and timely maintenance. This increases not only the life of the instruments but also the reliability of the observations.

It is, therefore, important to maintain a logbook for proper record of the laboratory items procured including instruments, equipment, chemicals, glasswares and other consumables to facilitate annual maintenance of the sophisticated instruments, maintain history of the type of attendance they require for keeping them healthy through repairs, timely replacement of the exhausted instrument spares, glasswares, chemicals and other consumables, and departmental audit.

2.1 Sophisticated laboratory instruments (level II / II+)

Instruments, like UV-Visible Spectrophotometer, Atomic Absorption Spectrophotometer (AAS) and Gas Chromatograph (GC), are quite delicate to operate and maintain. The instrument supplier provides training to the chemists at the time of installation and commissioning of the instrument regarding its operation, general maintenance and operational fault finding. However, special care is needed for preventive maintenance and repairing of fault, which can only be attended to through Annual Maintenance Contract (AMC), preferably by the instrument supplier or its approved agent. For this purpose, a complete inventory of these instruments along with accessories and spares must be prepared and maintained separately for each instrument. The format for such an inventory/logbook is shown in Annexure I.

2.2 Other requirements of laboratories (level I, II and II+)

Besides the sophisticated instruments, there are many other instruments and equipment in the laboratory which should also be inventorised not only for maintenance of stock but also for regular maintenance and repair, as and when required. The format designed for this purpose is shown in Annexure II.

The formats for maintenance of stock for chemicals, glasswares and other often-required consumables are also shown in Annexure II, to facilitate replenishment of stock sufficiently in advance before it is exhausted.

3 Maintenance norms for Water Quality Analysis Laboratories

3.1 Introduction

The Hydrology Project provides for establishment of a network of water quality analysis laboratories in the participating agencies to improve the water quality monitoring programmes. Lists of parameters to be tested under the project have also been enlarged to detect toxic substances and heavy metals. The water quality testing facilities envisaged under the project are indicated below:

Water Quality Analysis Laboratories (SW)

S. No.	Participating agencies	Level I	Level II	Level II+
1	Andhra Pradesh	15	2	-
2	Gujarat	24	1	1
3	Karnataka	10	2	-
4	Kerala	10	1	-
5	Madhya Pradesh	15	-	-
6	Maharashtra	21	4	-
7	Orissa	11	-	-
8	Tamil Nadu	15	-	-
9	CWC	96	10	2
	Whole Project	217	20	3

Water Quality Analysis Laboratories: (GW)

S. No.	Participating agencies	Level II	Level II+
1	Andhra Pradesh	5	1
2	Gujarat	3	1
3	Karnataka	4	1
4	Kerala	2	1
5	Madhya Pradesh	7	2
6	Maharashtra	5	1
7	Orissa	4	1
8	Tamil Nadu	3	1
9	CGWB	-	9
	Whole Project	33	18

The details of operation and maintenance cost for each type of laboratory are elaborated separately. Staffing costs are not included.

The operation and maintenance costs of level I and level II/II+ laboratories are divided into the following categories:

1. Cost of chemicals and glassware
2. Maintenance of laboratory building; as the laboratory buildings need some additional maintenance, as compared to normal buildings, these are included under O & M cost.

3.2 Details of Operation and Maintenance Costs of Laboratories under HP

Annual O&M costs are based on:

- Costs as listed in Annex III, IV and V, are based on listed prices of main national suppliers of laboratory equipment **and valid for 1999** (10% annual increase may be added).
- Requirement of laboratory chemicals are based on one year's consumption.
- Laboratories initially have a complete set of glasswares. Annual replacement costs are estimated at 25% of the complete set.

- Equipment repairs are for analysis equipment, such as flame photometer, spectrophotometer, pH and other meters (not including AAS/GC). Annual repair cost is estimated at 10% of total equipment cost, assumed to be Rs.10,000 for Level I and Rs. 500,000 for level II and II+ laboratories.
- Laboratory consumables include item like gases, laboratory wipes, sampling accessories, and other contingent expenditures, not covered under glasswares, chemicals and repairs.
- Annual Maintenance Contract is recommended for AAS and GC equipment, and estimated at 10% of the original cost, assumed to be Rs. 10,00,000 each.
- Costs of transport for collecting samples is NOT included. Separate budget provision must be made for this important item. Rapid and proper transport of sample in icebox is crucial.

3.3 Electrical charges

The electrical charges have been computed @ Rs. 4/- per Kwh for an average consumption as detailed below:

Continuously running equipment

1	Oven for 15 days/month * 2 Kwh * 24h	=	720 kwh
2	BOD Incubator for 15 days/month * 0.5 kwh * 24h	=	180 kwh
3	Bacteriological Incubator for 15 days/month 0.5 kwh * 24 h	=	180 kwh
4	Refrigerator for 30 days/month * 0.5 kwh * 24 h	=	360 kwh
	Total	=	1440 kwh

Intermittently running equipment

1	Autoclave for 2 hours/day for 5 days/month @ 3 kwh	=	30 kwh
2	Air conditioners 2 * 8 hour/day for 25 days/month @ 1 kwh	=	400 kwh
3	Other Instruments 6 hours/day for 25 days/month @ 3 kwh	=	450 kwh
	Total	=	880 kwh
	Grand total	=	2320 kwh

- Total electrical charges per month = Rs. 4 * 2320 = 9280/-
- Total charges for 12 months = Rs. 1,11,360/-

3.4 Maintenance norms for Level I Laboratory

Item No.	Item	Qtty	Rate (Rs.)	Unit	Amount (Rs.)
	Part A: Cost of Chemicals and Glassware				
1.	Cost of chemicals				2,800*
2	Cost of glassware				2,200*
3	Cost of other lab consumables	Job/year	1,000	Job/year	1,000
4	Cost of registers	5	100	No.	500
	Total for Chemicals and Glassware				**6,500**
	Part B: Maintenance of Equipment				
5.	Equipment repairs	Job/year	1,000	Job/year	1,000
	Total for Equipment maintenance				**1,000**
	Part C: Maintenance of building				
6..	Provision for cleaning powder, brushes, brooms,	Job/year	1,000	Job/year	1,000
7.	Sampling accessories, ice, etc.	Job/year	1,000	Job/year	1,000
8.	Repairs to sanitary/electrical fittings	Job/year	1,000	Job/year	1,000
9.	General maintenance of building	Job/year	1,000	Job/year	1,000
10.	Electrical charges @ Rs. 1000.00/month				12,000
	Total for Lab maintenance				**16,000**
	GRAND TOTAL				**23,500**

*****Please refer to details enclosed in Annex III (**1999 prices;** 10% annual increase may be added).

3.5 Maintenance norms for Level II Laboratory

Item No.	Item	Qtty	Rate (Rs.)	Unit	Amount (Rs.)
	Part A: Cost of Chemicals and Glassware				
1.	Cost of chemicals				35,000*
2	Cost of glassware				25,000*
3	Cost of other lab consumables	Job/year	5,000	Job/year	5,000
4	Cost of registers	5	100	No.	500
	Total for Chemicals and Glassware				**65,500**
	Part B: Maintenance of Equipment				
5.	Equipment repairs	Job/year	50,000	Job/year	50,000
	Total for Equipment maintenance				**50,000**
	Part C: Maintenance of building				
6..	Provision for cleaning powder, brushes, brooms,	Job/year	10,000	Job/year	10,000
7.	Repairs to sanitary/electrical fittings	Job/year	20,000	Job/year	20,000
8.	General maintenance of building	Job/year	10,000	Job/year	10,000
9.	Electrical charges	Job/year	1,40,000	Job/year	1,40,000
10.	**Total for Lab maintenance**				**1,80,000**
	GRAND TOTAL				**2,95,000**

*****Please refer to details enclosed in Annex IV (**1999 prices;** 10% annual increase may be added).

3.6 Maintenance norms for Level II+ Laboratory

Item No.	Item	Qtty	Rate (Rs.)	Unit	Amount (in Rs.)
	Part A: Cost of Chemicals and Glassware				
1.	Cost of chemicals				47,000*
2	Cost of glassware				85,000*
3	Cost of other lab consumables	Job/year	10,000	Job/year	10,000
4	Cost of registers	5	100	No.	500
	Total for Chemicals and Glassware				**1,42,500**
	Part B: Maintenance of Equipment				
5.	Equipment repairs	Job/year	50,000	Job/year	50,000
	Total for Equipment maintenance				**50,000**
	Part C: Maintenance of building				
6..	Provision for cleaning powder, brushes, brooms, napkins, etc.	Job/year	10,000	Job/year	10,000
7.	Repairs to sanitary/electrical fittings	Job/year	20,000	Job/year	20,000
8.	General maintenance of building	Job/year	15,000	Job/year	15,000
9.	Electrical charges	Job/year	1,40,000	Job/year	1,40,000
10.	**Total for Lab maintenance**				**1,85,000**
	Part D: Annual maintenance contract for AAS & GC				
11.	AMC for AAS/GC	Job/year	2,00,000	Job/year	2,00,000
	Total for AMC for AAS/GC				**2,00,000**
	GRAND TOTAL				**5,77,000**

*Please refer to details enclosed in Annex IV and V (**1999 prices;** 10% annual increase may be added).

ANNEX I

LOGBOOK FOR WATER QUALITY LABORATORIES

Location of Laboratory: …….. Year of Establishment:……

SOPHISTICATED INSTRUMENTS (LEVEL II/ II+)

1. Name of the Instrument:
2. Date of purchase:
3. Cost:
4. Make/brand:
5. Warranty period:
6. Name and address of supplier:

7. Details of Annual Maintenance Contract (AMC)

    a. Name of the agency with whom AMC is signed:
    b. Date of signing AMC and duration:
    c. Address and telephone no:

8. Specifications of the instrument:

LIST OF SPARES

S. No.	Name of the spare and supplier alongwith address and bill no.	Quantity	Amount (Rs.)	Date of purchase	Shelf-life	warranty

RECORD OF MAINTENANCE

S. No.	Date	Problem/fault	Date of complaint	Complaint Receipt No.	Date of attending complaint	Status/ test report	Cost involved 9rs.)
1	2	3	4	5	6	7	8

ANNEX II

OTHER REQUIREMENTS OF WQ LABORATORY (LEVEL I, II & II+)

GENERAL LABORATORY EQUIPMENT

Location of Laboratory: …….. Year of Establishment:……

S. No.	Name of Equipment, address of supplier and bill no.	Qty	Amount (Rs.)	Date of purchase	Detail of Maintenance/Repairing			Remark
					Nature of Repair	Date of Repair	Approx Cost (Rs.)	
1	2	3	4	5	6	7	8	9

CHEMICALS

Location of Laboratory: …….. Year of Establishment:……

S. No.	Name of Chemical/ reagent	Qty.	Amount (Rs.)	Date of purchase	Detail of stock			Remark
					Name of the person to whom issued	Number/ amount issued	Balance of the stock left	
1	2	3	4	5	6	7	8	9

GLASSWARES

Location of Laboratory: …….. Year of Establishment:……

S. No.	Name of glassware	Qty.	Amount (Rs)	Date of purchase	Detail of stock			Remark
					Name of the person to whom issued	Number/ amount issued	Balance of the stock left	
1	2	3	4	5	6	7	8	9

OTHER CONSUMABLES (POLYTHENE SAMPLE CONTAINERS, ETC.)

Location of Laboratory: …….. Year of Establishment:……

S. No.	Name of Consumable	Qty	Amount (Rs)	Date of purchase	Detail of stock			Remark
					Name of the person to whom issued	Number/ amount issued	Balance of the stock left	
1	2	3	4	5	6	7	8	9

ANNEX III

CHEMICALS AND GLASSWARE FOR LEVEL I LABORATORIES

Table A Chemicals needed on annual basis

Chemical	Quantity Required	Unit Price (Rs)	Amount (Rs)
Buffer Tablet Bottle, pH 4	1 pkt (10 tablets)	55/ pkt	55
Buffer Tablet Bottle, pH 7	1 pkt (10 tablets)	55/ pkt	55
Buffer Tablet Bottle, pH 9.2	1 pkt (10 tablets)	55/ pkt	55
Manganous Sulphate	1 kg	95/500 g	190
Potassium Chloride (GR)*	500 g	130/500 g	130
Potassium iodate (GR)*	100 g	350/ 100 g	350
Potassium iodide	250 g	670/250 g	670
Salicylic Acid	500 g	185/500 g	185
Sodium Azide	100 g	320/100 g	320
Sodium Hydroxide, flakes	1 kg	55/500 g	110
Sodium Thiosulphate (GR)*	500 g	200/500 g	200
Starch indicator	500 g	330/500 g	330
Sulphuric Acid (GR)*	500 ml	100/500 ml	100
Total (excluding taxes)			**2,750**

Table B Glassware (initial requirement)

Glassware	Number Required	Unit Price (Rs.)	Amount (Rs.)
Beaker, 500 ml	2	68	136
Beaker, 100 ml	6	35	210
Conical Flask, 250 ml	10	66	660
Conical Flask, 100 ml	4	42	168
Pipette, graduated,10 ml	5	62	310
Pipette, graduated, 5 ml	2	58	116
Burette,50 ml	2	272	544
Burette Stand, clamps and tile	2	148	296
Measuring cylinders,1000 ml	1	646	646
Measuring cylinders, 500 ml	2	439	878
Measuring cylinders, 250 ml	2	332	664
Measuring cylinders, 100 ml	2	182	364
Reagent bottles, 1000 ml	4	304	1,216
Reagent bottles, 500 ml	4	215	860
Reagent bottles, 250 ml	8	187	1,496
Total (excluding taxes)			**8,564**
Annual costs (25% of total, rounded)			**2,200**

*****Note: GR (also AR) = Guaranteed Reagent or Analytical grade reagent
Note: Based on **1999 prices;** 10% annual increase may be added

ANNEX IV

CHEMICALS AND GLASSWARE FOR LEVEL II LABORATORIES

Table A Chemicals needed on annual basis

Name of Chemicals	Quantity Required	Unit Price (Rs.)	Amount (Rs.)
1,2 Cyclohexylenediamine Tetra Acetic Acid	25 g	1,800	1,800
Acetic Acid	500 ml	83	83
Acetone	500 ml	80	80
Aluminium Potassium Sulphate	500 g	65	65
Aluminium Sulphate ($Al_2(SO_4).18\ H_2O$)	500 g	75	75
Ammonia Purpurate (murexide)	5 g	130	130
Ammonium Acetate	500 g	115	115
Ammonium Chloride (GR)*e	500 g	130	130
Ammonium Molybdate (GR)*	100 g	280	280
Ammonium Solution 0.91 Sp. Gr.	500 ml	55	55
Bile salt	100 g	450	450
Boric Acid (GR)*	500 g	320	320
Brilliant Green indicator	25 g	80	80
Bromocresol Green	125 ml	44	44
Buffer Tablets, pH 4.0	10 Tabs x 2	55	110
Buffer Tablets, pH 7.0	10 Tabs x 2	55	110
Buffer Tablets, pH 9.2	10 Tabs x 2	55	110
Cadmium granules	500 g	850	850
Calcium Carbonate	500 g	60	60
Calcium Chloride	500 g	95	95
Chloroform	500 ml	120	120
Copper powder	500 g	510	510
Cupric (Copper) Sulphate	500 g	125	125
Curcumine, crystalline	5 g	500	500
Dipotassium Hydrogen O.Phosphate	500 g	185	185
Eriochrome Black – T (GR)*	25 g	150	150
Ethyl alcohol (95%)	500 m x 3	290	870
Ethylene Diamine Tetra Acetic Acid (EDTA) (GR)*	100 g	140	140
Ferric Chloride (GR)*	500 g	390	390
Ferroin indicator (GR)*	100 ml	550	550
Ferrous ammonium Sulphate	500 g	75	75
Glucose	500 g	75	75
Hydrochloric Acid	2500 ml	240	240
Hydroxyl Amine hydrochloride (GR)*	100 g	290	290
Isopropyl Alcohol (GR)*	500 ml	110	110
Lactose	500 g	140	140
L-Glutamic Acid	100 g	120	120
Magnesium Sulphate (GR)*	500 g	110	110
Manganous Sulphate	500 g x 4	95	380
Mercuric Sulphate	250 g	410	410
Methyl Orange powder	25 g	60	60
Methyl Red	25 g	80	80
Methylene Blue (GR)*	25 g	200	200
N-(1-naphthyl)-Ethylene Diamine Dihydrochloride	5 g	325	325
Oxgall, powder	100 g	900	900

Name of Chemicals	Quantity Required	Unit Price (Rs.)	Amount (Rs.)
Peptone	500 g	360	360
Phenanthroline (GR)*	5 g	225	225
Phenol (GR)*	500 g	200	200
Phenolphthalein Indicator	50 g	75	75
Phosphoric Acid	500 ml	175	175
Potassium Antimony Tartrate (GR)*	100 g	160	160
Potassium Bi-iodate	100 g	320	320
Potassium chloride (GR)*	500 g	130	130
Potassium Chloroplatinate	1 g	1,200	1,200
Potassium Chromate	500 g	240	240
Potassium Dichromate (GR)*	500 g	225	225
Potassium Di-Hydrogen O.Phosphate (GR)*	500 g	230	230
Potassium Hydrogen Phthalate (GR)*	500 g	325	325
Potassium Iodide	250 ml x 4	670	2,680
Potassium Iodide (GR)*	100 g	300	300
Potassium Nitrate	500 g	85	85
Potassium Permanganate (GR)*	500 g	310	310
Silver Nitrate (GR)*	25 g	500	500
Silver Sulphate	25 g	600	600
Sodium Acetate (GR)*	250 g	170	170
Sodium Arsenite (GR)*	250 g	6,000	6,000
Sodium Azide	100 g	320	320
Sodium Carbonate (GR)*	500 g	90	90
Sodium Chloride (GR)*	500 g	48	48
Sodium Fluoride (GR)*	500 g	425	425
Sodium Hydroxide Pellets (GR)*	500 g x 4	105	420
Sodium Hypochloride solution	500 ml	45	45
Sodium Lauryl Sulphate, powder	500 g	270	270
Sodium Nitrate (GR)*	500 g	90	90
Sodium Nitropruside	100 g	190	190
Sodium Oxalate	500 g	120	120
Sodium Tetraborate ($Na_2B_4O_7.10\ H_2O$) (borax) (GR)*	500 g	160	160
Sodium Thiosulphate (GR)*	500 g	200	200
SPADNS (GR)*	1 g	340	340
Starch indicator, soluble	500 g	330	330
Sulphamic Acid	500 g	65	65
Sulphanilamide (GR)*	100 g	300	300
Sulphuric Acid 98%	2500 ml	240	240
Trisodium Citrate	500 g	150	150
Tryptose	500 g	1,500	1,500
Zirconyl Chloride	100 g	3,000	3,000
Total (excluding taxes)			**34,910**

*****Note: GR (also AR) = Guaranteed Reagent or Analytical grade Reagent
Note: Based on **1999 prices;** 10% annual increase may be added

Table B Glasswares (initial requirement)

Glassware and Apparatus	Number Required	Unit Price (Rs)	Amount (Rs)
Volumetric flasks, 1000 ml	5	323	1,615
- do - 500 ml	5	215	1,075
- do - 100 ml	10	139	1,390
- do - 50 ml	10	120	1,200
- do - 25 ml	10	107	1,070
Conical flasks NM, 100 ml	10	42	420
- do - 250 ml	25	66	1,650
Burettes single bore with pipe PTFE screwcock, 50 ml	5	791	3,955
Volumetric pipettes, 10 ml	5	58	290
Volumetric pipettes, 5 ml	5	47	235
Volumetric pipettes, 2 ml	5	43	215
Volumetric pipettes, 1 ml	5	43	215
Measuring cylinders with spout, 500 ml	5	439	2,195
- do - 100 ml	10	182	1,820
- do - 50 ml	6	156	936
Graduated pipettes, 10 ml	60	62	3,720
- do - 5 ml	10	58	580
- do - 1 ml	5	45	225
Glass beakers with spout, 1000 ml	5	162	810
- do - 500 ml	5	68	340
- do - 250 ml	10	40	400
- do - 100 ml	25	35	875
Reagent bottles, narrow mouth, Amber coloured, 500 ml	10	310	3,100
Reagent bottles Narrow flat level stopper, 1 lit	10	304	3,040
- do - 500 ml	10	215	2,150
- do - 250 ml	25	187	4,675
- do - 125 ml	10	175	1,750
COD flask, 250 ml , joint 24/29	10	99	990
Reflux condenser, joint 24/29	10	437	4,370
Nessler tubes	10	32	320
Centrifuge tubes, 50 ml	5	110	550
Reagent bottles wide mouth with flat lead dust proof stopper, 250 ml	5	150	750
Burette stand (iron) with fisher type clamps – single	6	175	1,050
Pipette stand, polythene for 12 pipettes	6	105	630
Porcelain tiles glazed, 150x150mm	6	12	72
Porcelain dish, 200 ml	6	120	720
Glass Rod, Assorted	6	8	48
Dessicator, small, with cover knob top, 160 mm	2	1500	3,000
Morter and pestles, porcelain, 15 cm	2	95	190
Watch glasses 125 mm	2	105	210
- do - 100 mm	2	83	166
- do - 75 mm	2	75	150
Weighing bottles 50mm x 35mm	10	299	2,990
Polythene dropping bottles, 100/120 ml	10	28	280
Polythene wash bottles, 1000 ml	10	59	590
Spatulas, S.S. with one side spoon, 150mm	6	10	60
Dishes, evaporating, 150 mm x 80 mm	10	150	1,500
Culture tubes, 25mm x 100 mm	100	10	1,000
Culture tubes, 12 mm x 100 mm	50	5	250

Glassware and Apparatus	Number Required	Unit Price (Rs)	Amount (Rs)
Dilution bottle, 160 ml	20	176	3,520
B.O.D. bottles with interchangeable stopper spout, 300 ml	30	304	9,120
Distillation Assembly with round bottom flask 1000 ml , still head double surface condenser, 2000mm, Thermometer 0-250^{o}C, with PTFE cone and receiver adopter.	1	1,920	1,920
Separating funnels with PTFE plug, conical shape 500 ml	5	658	3,290
Acid and alcohol-proof rubber gloves 300, 350 or 400 mm (any)	4	70	280
Petri dishes glass 100 mm x17 mm	10	99	990
Polythene reagent bottles 125 ml	10	28	280
- do - 500 ml	10	35	350
Wire gauge with asbestos centre 150x150mm	6	8	48
Polythene bottles N.M 2 lit	50	85	4,250
- do - 1 lit	50	48	2,400
Crucible Tongs, S.S. 200mm	2	68	136
Silica crucible 25 ml	1	145	145
Rubber suckers for pipettes of different sizes	12	12	144
Eye and face wash, shower operated	1	5,950	5,950
First aid box	2	295	590
Filter paper, Whatman No.41, 146 x 57mm	1 ream	4,500	4,500
Total, (excluding taxes)			**97,745**
Annual glassware costs (= 25% of total cost, rounded)			**25,000**

Note: Based on **1999 prices;** 10% annual increase may be added

ANNEX V

ADDITIONAL CHEMICALS AND GLASSWARE FOR LEVEL II+ LAB.

All Level II+ laboratories need the complete set of chemicals and glassware as listed in Annex IV. In addition, Level II+ laboratories need certain items for operation of the AAS and GC instruments

Table A Chemicals required annually for AAS and GC

Chemical	Quantity required	Unit price (Rs)	Amount (Rs)
N-Hexane (GR)*	1 L x 3	1,375	4,125
Nitric Acid (GR)*	2.5 L x 1	330	330
Perchloric Acid (GR)*	500 ml x 2	485	970
Standard solutions for organic pollutants (imported)	5	1,250	6,250
Total (excluding taxes)			**11,675**

Table B Glassware and apparatus required for AAS and GC

Glasswares	Quantity required	Unit price (Rs)	Amount (Rs)
Soxhlet extractor plus thimble	1	2,000	2,000
AAS lamps	11	20,000	2,20,000
Volumetric flask, 100 ml	10	326	3,260
Volumetric flask, 50 ml	10	303	3,030
Volumetric flask, 25 ml	10	303	3,030
Volumetric flask, 10 ml	5	324	1,620
Separating funnels, pear shaped, 1 lit	5	818	4,090
Separating funnels, pear shaped, 500 ml	5	658	3,290
Total (excluding taxes)			**2,40,320**
Annual glassware and apparatus costs (= 25% of total cost, rounded)			**60,000**

*Note: GR (also AR) = Guaranteed Reagent or Analytical grade Reagent
Note: Based on **1999 prices;** 10% annual increase may be added