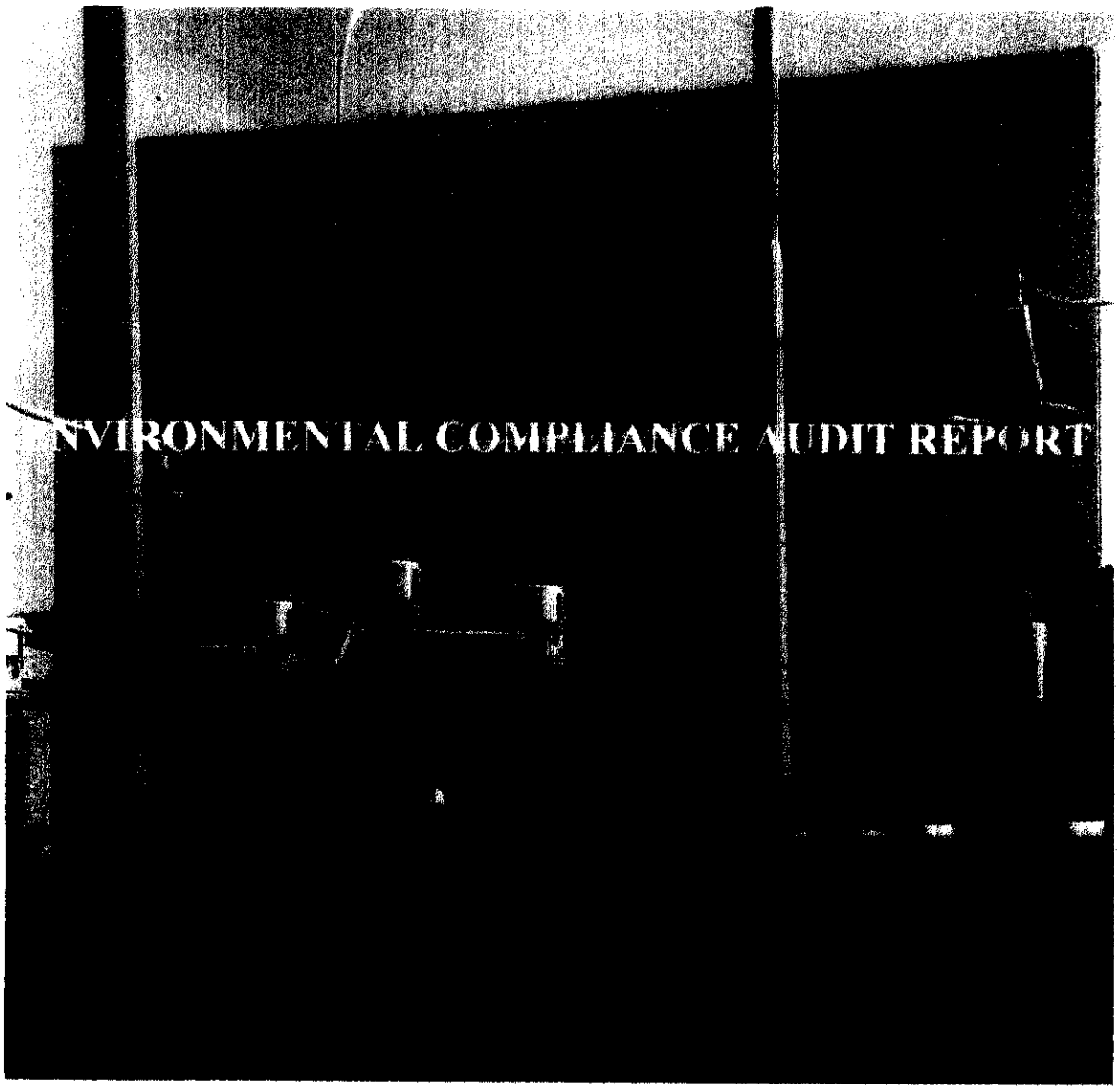
ANNEX E: 2008 ENVIRONMENTAL COMPLIANCE AUDIT REPORT

D.H.A. COGEN LTD,
POWER & DESALINATION UNIT
KARACHI



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September-2008

D.H.A COGEN LTD,
POWER & DESALINATION UNIT
KARACHI

ENVIRONMENTAL COMPLIANCE AUDIT REPORT

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September - 2008.

CONTENTS

Page Number

EXECUTIVE SUMMARY i

SECTION-A
CARBON MONOXIDE (CO), SULPHUR DIOXIDE (SO_2)
AND NITROGEN OXIDES (NO_x)

1.0 General 1
2.0 Instrument 1
3.0 Monitoring 1
4.0 Results and Discussion 1

ANNEXURES:
ANNEXURE-I 3
Gaseous Monitoring Instrument Details
ANNEXURE-II 5
Gaseous Monitoring Instrument Calibration Certificates
ANNEXURE-III 6
Stacks Gaseous Monitored Data
ANNEXURE-IV 7
National Environment Quality Standards (NEQS)-Pakistan

SECTION-B
STACK MONITORING FOR PARTICULATE MATTER (PM)

1.0 General 13
2.0 General Monitoring Instrument and Measurement Methodology 13
3.0 Monitoring 13
4.0 Results and Discussion 13

ANNEXURES
ANNEXURE-I 15
Details of the Iso- Kinetic Stack Sampling System
ANNEXURE-II 18
Stack Particulate Matter Monitored Data

SECTION-C
GASEOUS MONITORING -- AMBIENT
1.0 General 19
2.0 Monitoring 19
3.0 Results and Discussion 19

ANNEXURES:

ANNEXURE -I.....20
Ambient Gaseous Monitoring Instrument
ANNEXURE -II.....24
Ambient Gaseous Monitored Data
ANNEXURE -III.....25
WHO guidelines for Air Quality
ANNEXURE -IV.....28
OSHA Standards

SECTION-D
PARTICULATE MATTER MONITORING –AMBIENT

1.0 General.....41
2.0 Monitoring Instrument and Measurement methodology.....41
3.0 Results and Discussion.....41.

ANNEXURES:

ANNEXURE-I.....42
Monitored Data for Ambient Particulate Matter

SECTION-E
WATER CHARACTERIZATION

1.0 General.....43
2.0 Sampling.....43
3.0 Methods of Analysis.....43
4.0 Results and Discussion.....43

ANNEXURES:

ANNEXURE-I.....44
Waste Water Characterization
ANNEXURE-II.....45
Drinking Water Analysis
ANNEXURE-III.....46
Standards Methods for the Analysis of Water and Waste
ANNEXURE-IV.....54
WHO Guidelines for Drinking Water

SECTION-F
NOISE LEVELS MONITORING

1.0 General.....57
2.0 Noise Level Measurements (Measuring Instrument Details).....57
3.0 Noise Level Measurements.....58
4.0 Limiting Criteria for Noise.....61

5.0 Results and Discussion 62

ANNEXURES:
ANNEXURE-I.....63
Monitored and Processed Noise Levels Data
Regarding Four Walls of the Factory
ANNEXURE-II 64
Monitored and Processed Noise Levels Data
With in the Plant .

SECTION-G
THERMAL DISCHARGES
General 67

SPECIAL ANNEXURES:

1. Map Showing the monitoring points
2. Laboratory accreditation certificate

EXECUTIVE SUMMARY

In accordance with the Pakistan Environmental Protection Act- 1997 **(PEPA), D.H.A. Cogen Ltd, Power and Desalination Unit, Karachi,** is under legal obligation to go for full scale Environmental Compliance Audit **(EA)** during regular operation. Accordingly, to ascertain whether the plant is operating in compliance with the required standards of the National Environmental Quality Standards (NEQS) Pakistan, M/S **APEX Environment Laboratory** carried out detailed Environmental Compliance Audit **(EA)** of the said unit on August 25 to 27, 2008 when it was operating on its maximum capacity. This first EA report deals with the Environmental status of the plant.

The report comprises of the following sections:

SECTION-A	Stack Monitoring for Carbon Monoxide (CO), Sulphur dioxides (SO_2) and Nitrogen Oxides (NO_x) and from one turbine stack of the power house.
SECTION-B	Monitoring of Particulate Matter (PM) from turbine stack of the power house.
SECTION-C	Gaseous Monitoring – Ambient from eleven locations.
SECTION-D	Particulate Matter Monitoring-Ambient from eleven locations.
SECTION-E	Drinking and Waste Water Characterization.
SECTION-F	Noise Level monitoring.
SECTION-G	Thermal Discharges

Stack gaseous emissions for Carbon Monoxide (CO), Sulphur dioxides (SO_2), Nitrogen Oxides (NO_x) from one turbine stack of the power house are in compliance with National Environment Quality Standards (NEQS)-Pakistan.

Also, emissions of particulate matter (PM) measured from stack of turbine stack is in compliance with the NEQS-Pakistan.

As described earlier, ambient gaseous monitoring was carried out at eleven points in total within the premises of the plant. The NEQS-Pakistan do not specify any limiting value regarding the concentration of different gases in ambient air.

Particulate matter in ambient air was monitored at a total of eleven points within the worksite. The NEQS-Pakistan do not specify any limiting value for ambient particulate matter.

Noise levels monitoring was carried out at total of twenty locations within workplace and four boundary walls. At two monitored locations within the plant, the noise levels exceeded the maximum limiting value set by the National Environment Quality Standards (NEQS). The practical solution for this is to provide earplugs to the workers working in these areas. However,

noise levels at all the four boundary walls of the plant remain within prescribed limits of the NEQS.

Data obtained after water and wastewater characterization reveals that all the parameters are in compliance of the NEQS limiting values set for the waste water.

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SECTION – A
STACK MONITORING FOR CARBON MONOXIDE (CO), SULPHUR OXIDES (SOx) AND NITROGEN OXIDES (NOx)

1.0 GENERAL

This section deals with the monitoring of gaseous emissions from stack of turbine of the plant. The turbine of the power house operates on natural gas.

2.0 INSTRUMENT

Technical specifications of the instrument used for gaseous monitoring along with other necessary information and details are appended in the ANNEXURE-I. The calibration certificate of the monitoring instrument is attached as ANNEXURE -II.

3.0 MONITORING

3.1 Stacks Monitoring- CO, SO_2 and NOx (NO+ NO_2)

3.1.1 Stacks

Stack of one turbine of the power house was monitored for gaseous monitoring.

3.1.2 Monitoring

The monitoring was carried out from monitoring hole already provided on stack. All measurements were taken when the plant was operating at its full capacity. Total of three monitorings were carried out at interval of time to ascertain the emission behavior.

4.0 RESULTS AND DISCUSSION

The monitored and processed data regarding gaseous emissions are presented in ANNEXURE-III.

Turbine Stack:

It is evident from the monitored and processed data that the measured value of Carbon Monoxide (CO) from the stack ranges between 285.0mg/Nm^3 to 310.0 mg/Nm^3 as against the maximum limiting value of 800.0 mg/Nm^3 set by National Environment Quality Standards (NEQS)-Pakistan ANNEXURE –IV for this gas. So, these values are in compliance with the NEQS limits.

Similarly, the value of Nitrogen Oxides (NO_x) remains at a minimum of 210.0 mg/Nm^3 from the stack and at a maximum of 229.0 mg/Nm^3 as against the maximum limiting value of 400.0 mg/Nm^3 set by the NEQS for this gas being emitted from the units operating on diesel. As a result, emissions are in compliance with the NEQS-Pakistan.

The value of Sulphur Oxides (SO_x) emissions from the stack remain nill from the stack of turbine. The respective NEQS limiting value for SO_2emissions from is 1700.0 mg/Nm^3.

It is concluded from the above discussion that emissions of CO, NO_x and SO_2in the turbine stack are in compliance with the NEQS respective limiting values of 800.0 mg/Nm^3, 400.0 mg/Nm^3 and 1700.0 mg/Nm^3 set for these gases.

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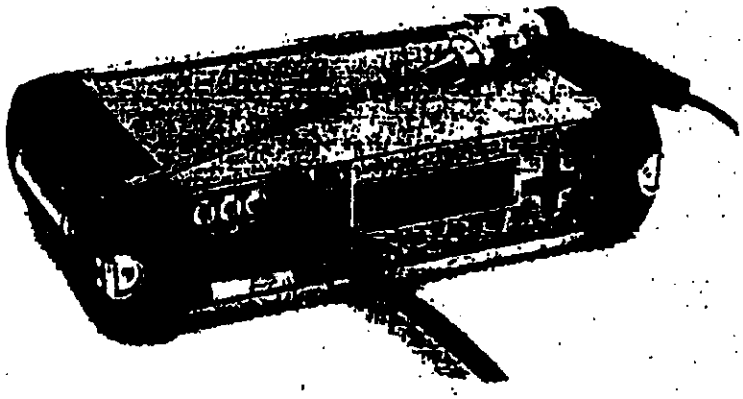
ANNEXURE-I

User Guide

LANCOM III

Portable Flue Gas Analyzer
Publication No. 770.083
Language English



LAND
instruments international

Combustion & Environmental Monitoring

Design and Manufacturing Standards

The Quality Management System of Land Instruments International is approved to BS EN ISO 9001 for the design, manufacture and on-site servicing of combustion, environmental monitoring and non-contact temperature measuring instrumentation. Associated software is designed and developed in accordance with TickIT.

The Quality Management System of Land Instruments International Inc., USA is approved to ISO 9001.

This instrument complies with current European directives relating to Electromagnetic Compatibility 89/336/EEC and Low Voltage Directive 73/23/EEC.

Operation of radio transmitters, telephones or other electrical/electronic devices in close proximity to the equipment while the enclosure doors of the instrument or its peripherals are open, may cause interference and possible failure where the radiated emissions exceed the EMC directive.

The protection provided by both CE and IP classifications to this product may be invalidated if alterations or additions are made to the structural, electrical, mechanical or pneumatic parts of this system. Such changes may also invalidate the standard terms of warranty.

ECOTECH Environment Consultants
Suite # 4,
2nd Floor,
Link Arcade,
Link Model
Town Road,
Lahore

ANNEXURE-II

Performance Verification Certificate

Reference Number: 01-786 /FK /06/ 028

Instrument Serial Number: 11138651

M/s Ectech-Environment Consultants
Lahore

Test Description	Criteria	Target	Actual
Gas Sensors	**Standard Calibration Gases**	**Range**	**Gain**
CO_L	Scientific & Technical Gases Ltd., UK.	0-2,000 ppm	***
CO_H		0-4% Vol.	53510
SO_2		0-2,000 ppm	1735
NO.		0-1,000 ppm	-2760
NO_2		0-100 ppm	-707
C_xH_y		0-5% Vol.	***
H_2S		0-200 ppm	***
CO_2		0-25% Vol.	***

* Need to be replace ** Not Calibrated ***Not exist

We hereby certify that this instrument complies with LAND factory specifications tested by ORION INTERNATIONAL.

Tested by

FARHAN KHAN
SERVICE ENGINEER

Date: May 28, 2007

ORION INTERNATIONAL
319 & 320, HOTEL METROPOLE, CLUB ROAD, KARACHI (PAKISTAN)
PH# 5674468-69, 5660236, FAX# 5660238 Email: orion.intl@cyber.net.pk

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ANNEXURE-III

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(Laboratory certified as "Environmental Laboratory" by the Environmental Protection Agency, Government of the Punjab vide its Memo No: 551/DD(Labs.)/ EPA, dated May 09, 2008, certificate No: 551/DD(Labs.)/EPD/08)

Data Regarding Gaseous Monitoring-Stack

Reference point	CO (mg/Nm^3)	SO_2 (mg/Nm^3)	NO_x (mg/Nm^3)
Turbine Stack	285.0	0.0	210.0
	310.0	0.0	229.0
	296.0	0.0	218.0

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ISLAMABAD, THURSDAY AUGUST 10, 2000

Part II

Statutory Notifications (S.R.O.)

Government of Pakistan

MINISTRY OF ENVIRONMENT, LOCAL GOVERNMENT AND RURAL DEVELOPMENT

NOTIFICATION

Islamabad, the 8th August, 2000

S.R.O. 549 (1)/2000-In exercise of the powers conferred under came (c) of sub-section (1) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997). The Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to direct that the following further amendments shall be made in its Notification No S. R. O. 742 (1)/93. Dated the 24 th August, 1993, namely :-

In the aforesaid notification, in paragraph 2,....

(1289)

Price : Rs. 5.00

[4138 (2000)/Ex. Gaz.]

(1) for Annex 1. The following shall be substituted, namely.....

NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MUNICIPAL AND LIQUID INDUSTRIAL EFFLUENTS (mg/l, UNLESS OTHERWISE DEFINED)

S.NO.	Parameter	Revised Standards			
		Existing Standards	Into inland waters	Into Sewage Treatment(b)	Into Sea(b)
1	2	3	4	5	6
1.	Temperature or temperature Increase	40°C	=<3°C	=<3°C	=<3°C
2.	pH value	6-10	6-9	6-9	6-9
3.	Biochemical Oxygen Demand $(BOD)_5$ at 20°C(1)	80	80	250	80*
4.	Chemical Oxygen Demand (COD)(1)	150	150	400	400
5.	Total suspended solids(TSS)	150	200	400	200
6.	Total dissolved solids (TDS)	3500	3500	3500	3500
7.	Grease and oil	10	10	10	10
8.	phenolic compounds (as Phenol)	0.1	0.1	0.3	0.3
9.	Chloride (as Cl^-)	1000	1000	1000	SC***
10.	Fluoride (as F^-)	20	10	10	10
11.	Cyanide (as CN^-) total	2.0 1.0	1.0	1.0	1.0
12.	An-ionic detergents (as MB As) (')	20	20	20	20
13.	Sulphate $(SO)^{-4}$	600	600	1000	SC***
14.	Sulphide $(S)^{-2}$	1.0	1.0	1.0	1.0
15.	Ammonia (NH_3)	40	40	40	40

1	2	3	4	5	6
16.	Pesticide (3)	0.15	0.15	0.15	0.15
17.	Cadmium (1)	0.1	0.1	0.1	0.1
18.	Chromium trivalent and hexavalent (1)	1.0	1.0	1.0	1.0
19.	Copper (1)	1.0	1.0	1.0	1.0
20.	Lead (1)	0.5	0.5	0.5	0.5
21.	Mercury (4)	0.01	0.01	0.01	0.01
22.	Selenium (1)	0.5	0.5	0.5	0.5
23.	Nickle (1)	1.0	1.0	1.0	1.0
24.	Silver (4)	1.0	1.0	1.0	1.0
25.	Total Toxic metals	2.0	2.0	2.0	2.0
26.	Zinc	5.0	5.0	5.0	5.0
27.	Arsenic (1)	1.0	1.0	1.0	1.0
28.	Barium (1)	1.5	1.5	1.5	1.5
29.	Iron	2.0	8.0	8.0	8.0
30.	Manganese	1.5	1.5	1.5	1.5
31	Boron (1)	6.0	6.0	6.0	6.0
32	Chlorine	1.0	1.0	1.0	1.0

Explanations :

1. Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 Dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for the dilution of this effluent.
2. Modified Benzene Alkyl Sulphate: Assuming surfactants as biodegradable.
3. Pesticides include herbicides, fungicides and insecticides.
4. Subject to total toxic metal discharge would not exceed level given at S.No.25.
5. Applicable only when and where sewage treatment is operational and BOD,=80mg/l is achieved by sewage treatment system.

6. Provided discharge is not at shore and not within 10 miles of mangrove or other Important estuaries.

* The effluents should not result in temperature increase of more than 3°C at the edge of the zone where initial mixing and dilution take place in the receiving body. In case zone is not defined, use 100 meters from the point of discharge.

** The value for industry is 200 mg/l.

*** Discharge concentration at or below sea concentration (SC).

Note....1. Dilution of liquid effluents to bring them to the NEQS limiting value is not permissible through fresh water mixing with the effluents before discharge into the environment

2. The concentration of pollutants in water being used will be subtracted from the effluents for calculating the NEQS limits"

and

(2) for Annex II. The following shall be substituted, namely :-

NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR INDUSTRIAL GASEOUS EMISSION (mg/Nm^3, UNLESS OTHERWISE DEFINED).

S.NO.	Parameter	Source of emission	Existing Standards	Revised Standards
1	2	3	4	5
1	Smoke	Smoke capacity not to exceed	40% or 2 Ringle-mann Scale	40% or 2 Ringle-mann Scale or equivalent smoke number.
2	Particulate Matter`	(a) Boilers and furnaces		
		i) Oil fired	300	300
		ii) Coal fired	500	500
		iii) Cement kilns	200	200
		(b) Grinding crushing clinker cooler and related processes, metallurgical processes,converters,blast furnaces and cupolas.	500	500
3.	Hydrogen chloride	Any	400	400
4.	Chlorine	Any	150	150
5.	Hydrogen fluoride	Any	150	150
6.	Hydrogen sulphide	Any	10	10

1	2	3	4	5
7.	Sulphur Oxides(2)(3)	Sulfuric acid/Sulphonic acid plants	400	5000
		Other plants except power plants operating on oil and coal	400	1700
8.	Carbon monoxide	Any	800	800
9.	Lead	Any	50	50
10.	Mercury	Any	10	10
11.	Cadmium	Any	20	20
12.	Arsenic	Any	20	20
13.	Copper	Any	50	50
14.	Antimony	Any	20	20
15.	Zinc	Any	200	200
16.	Oxides of Nitrogen(3)	Nitric acid manufacturing unit	400	3000
		Other plants except power plant operating on oil or coal :		
		Gas fired	400	400
		Oil fired	-	600
		Coal fired	-	1200

Explanation:

1. Based on the assumption that the size of the particulate is 10 micron or more.
2. Based on 1 per cent sulphur contents in fuel oil. Higher content of sulphur will cause standards to be pro-rated.
3. In respect of emissions of sulphur dioxide and nitrogen oxides, the power plant operating on oil and coal as fuel shall in addition to NATIONAL ENVIRONMENTAL QUALITY STANDARDS (NEQS) specified above. Comply with the following standards:-

A . Sulphur dioxide

Sulphur dioxide Background levels Micro-gram per cubic meter (ug/m^3). Standards				
Background Air Quality(SO_2 Basis)	Annual Average	Max. 24-hours Interval	Criterion I Max.SO_2 Emission (Tons per day per plant)	Criterion II Max. allowable Ground level Increment to Ambient (ug/m^3)

Unpolluted	< 50	< 200	500	50
Moderately polluted*				
Low	50	200	500	50
High	100	400	100	10
Very polluted	>100	>400	100	10

* For intermediate values between 50 and 100 ug/m^3 linear interpolations should be true.

** No project with sulphur dioxide emissions will be recommended. *

B. Nitrogen Oxide

Ambient air concentration of nitrogen dioxides, expressed as NO_2 should not be exceed the following:-

Annual Arithmetic Mean	100ug/m^3 (0.05 ppm)

Emissions levels for stationary source discharges, before mixing with the atmosphere, should be maintained as follows:-

For fuel fired steam generator, as Nanogram (10-9ram)per joule of heat input :

Liquid fossil fuel	:	:	130
Solid fossil fuel	:	:	300
Lignite fossil fuel	:	:	260

Note:- Dilution of gaseous emissions to bring them to the NEQS limiting value is not permissible through excess air mixing, blowing before emitting into the environment "

[File No. 14 (3)/98-TO-PEPC.]

HAFIZ ABDULLAH AWAN.
Deputy Secretary (admn.)

SECTION-B
STACK MONITORING FOR PARTICULATE MATTER (PM)

1.0 GENERAL

This section deals with the particulate matter monitoring from stack of turbine of the power house. The turbine operates on gas.

2.0 MONITORING INSTRUMENT AND MEASUREMENT METHODOLOGY

Iso-kinetic The Casella (Particulate sampling system (Instrument) designed to comply with BS 3405 and ISO-9096 for compliance monitoring was used for stack monitoring of particulate matter. The PM was measured alongside the gaseous monitoring from stacks. Necessary details of the measuring instrument are appended as ANNEXURE-1.

The instrument sucks stack PM at a rate monitored by a calibrated volume measuring standard gauge. The volume of the stack gas drawn is indicated on the scale calibrated in liters and fractions thereof. The total time of stack gas inlet was noted with a stopwatch, which provides measurements in seconds with high precision and accuracy. This ensures the accuracy of the time even in seconds as far as the recording to measurement time is concerned.

Quantitative special filter media was used as the surface on which the particulate is retained quantitatively during a definite interval of time. The filter media is placed in the special port with leak proof assembly. This prevents escaping of fugitive stack particulate matter being monitored. Thus the accuracy of the measurement is ensured. The entire assembly is ultimately connected, through a special tuning to a probe of special steel, while with standing high temperatures as shown by the stacks.

The pre-weighted filter media, after monitored interval of time, is weighed on analytical balance measuring up to 0.0001g (0.1mg). The difference is the weight of the PM measured during a definite interval of time. The weight of the PM so obtained is further calculated into mg/Nm^3.

3.0 MONITORING

3.1.1 Stacks

Stack of one turbine was monitored for particulate matter emissions.

3.1.2 Monitoring

The monitoring was carried out from monitoring hole already provided on stack. The monitoring was carried out from each stack when the plant was operating at its full load. Total of three monitoring was carried out to ascertain the emission behavior.

4.0 RESULTS AND DISCUSSION

The monitored and processed data regarding particulate matter (PM) emissions are presented in the ANNEXURE-II.

The monitored values of Particulate matter ranges from 3.1 to 3.5 mg/Nm^3 with the average of 3.3 mg/Nm^3.

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ANNEXUER-I

Iso-Kinetic
Stack Sampling System

The Casella stack sampling system is designed to comply with BS3405 and ISO9096 for compliance monitoring under the environmental protection act. It is suitable for sampling particulates in stacks and ducts at temperatures up to 250 °C.

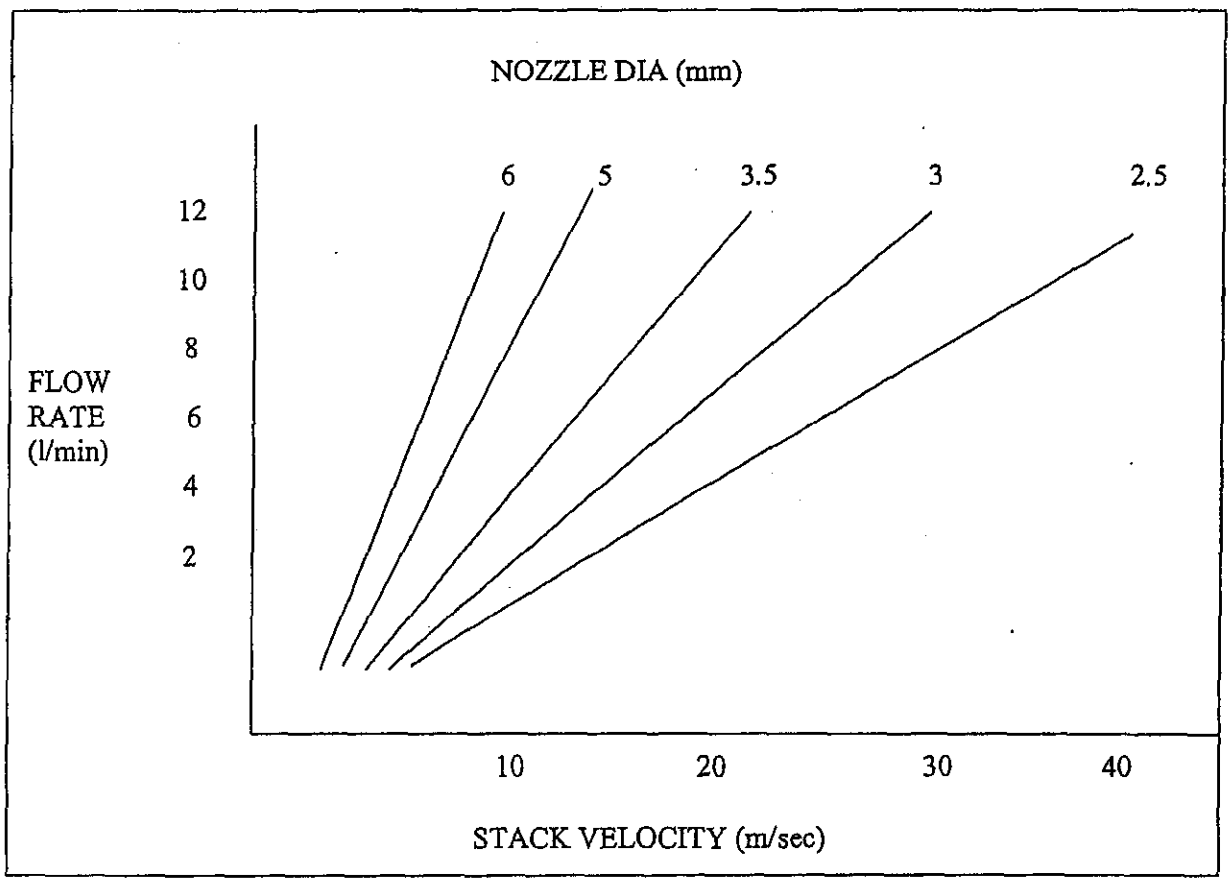
The filter holder can be positioned either inside or outside the stack. Positioning the filter holder within the stack enables accurate measurements to be taken of sticky particulates that might otherwise become stuck to the inside of probe assembly.

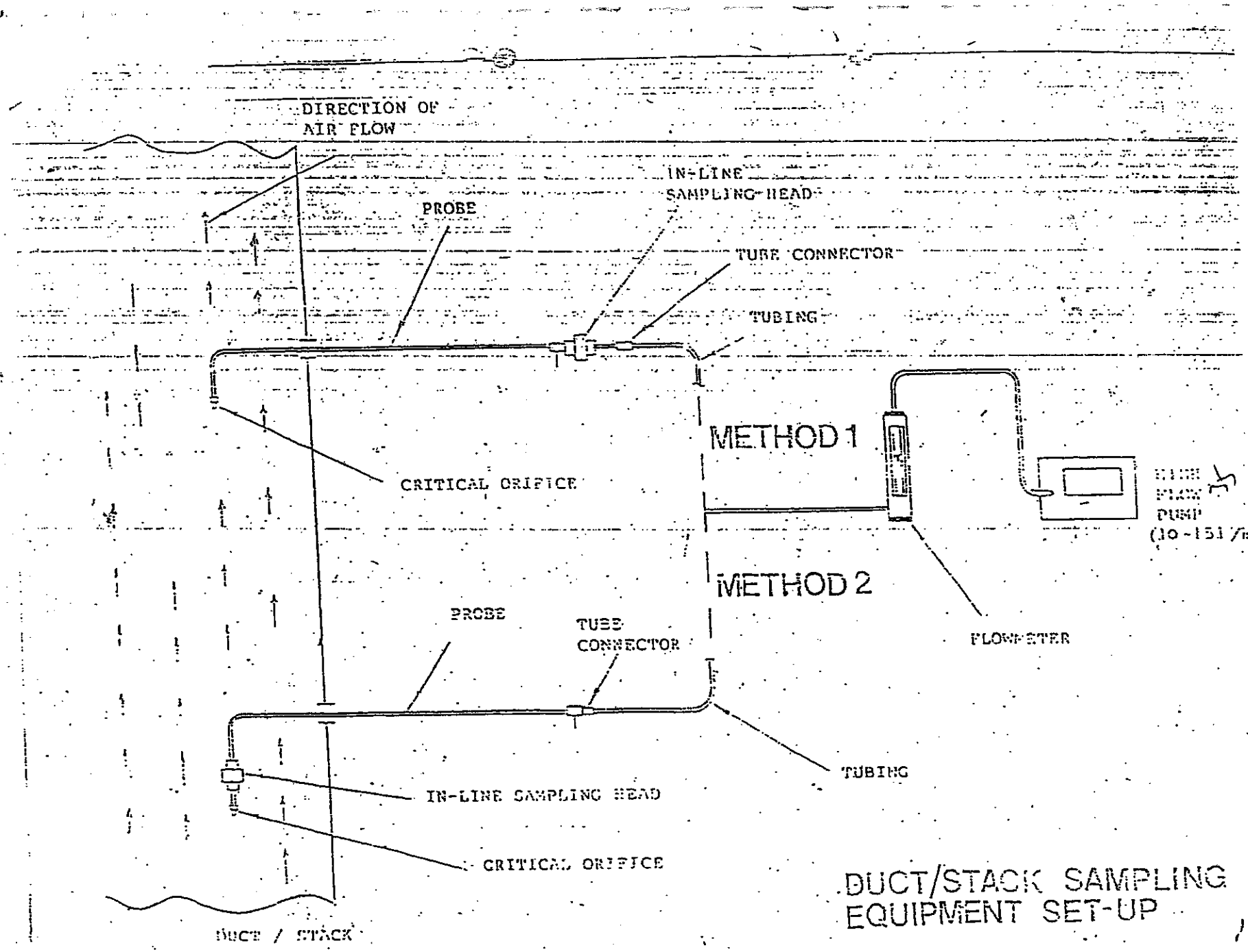
The basic kit comprises of a 1 m sampling probe, pump, flow meter, and all the necessary interconnections for the internal and external stack monitoring. Also available are a range of sampling nozzles, stack access ports and extension probe pieces.

The pump operates from 13-20 l/min which enables monitoring to be done in a wide variety of stack flow rates. Nozzle size can be calculated using the following formula.

Area of nozzle (mm) (pump flow rate (l/min) × 1000) / (Stack linear flow rate (m/sec) ×60).

Alternatively the following graph can be used.





DUCT/STACK SAMPLING
EQUIPMENT SET-UP

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Isokinetic kit with 25mm Filter Holder including: P118000

1m probe
Tube adaptor
25mm In-line filter holder
Spacer tube
3.14 l/min pump with rechargeable batteries
3m tubing (pump to probe)
Flow meter 2-25 l/min

Isokinetic kit with 37mm Filter Holder including: P118001

1m probe
Tube adaptor
37mm In-line filter holder
Spacer tube
13-20 l/min pump with rechargeable batteries
3m tubing (pump to probe)
Flow meter 2 -25 l/min

Accessories

Stack Access Kit	
2" BSP plug with support body	P118002
4" BSP plug with support body	P118003

Nozzles

4.0mm as specified in BS3405	P118033
4.0mm as specified in ISO9096	P118050
Other diameters available on request	

To monitor a stack under BS3405 or ISO9096 you will need a minimum of an isokinetic kit and a nozzle. In addition you may need a stack access flange of the appropriate size.

CARRLAGE & INSURANCE EXTRA. MINIMUM ORDER CHARGE £100.00 UNLESS ACCOMPANIED BY BANK TRANSFER.
LETTERS OF CREDIT WILL BE ACCEPTED ONLY FOR ORDERS IN EXCESS OF £1.479.00
This price guide was collect at the time of going to press. We reserve the right in amend prices without notice.
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ANNEXURE-II

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(Laboratory certified as "Environmental Laboratory" by the Environmental Protection Agency, Government of the Punjab vide its Memo No: 551/DD(Labs.)/ EPA, dated May 09, 2008, certificate No: 551/DD(Labs.)/EPD/08)

Monitored Data Regarding Particulate Matter (PM)-Stack

Reference point	Particulate Matter-PM (mg/Nm^3)	Average PM (mg/Nm^3)
Turbine Stack	3.5 3.1	3.3

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SECTION - C
GASEOUS MONITORING--AMBIENT

1.0 GENERAL

This section deals with the ambient gaseous monitoring at eleven points. Monitoring was carried out for SO_2, NO_x, CO and CH_4 as hydrocarbons.

2.0 MONITORING

2.1 Monitoring Instrument :

The monitoring of CO, SO_2, NO_2 and HCs was carried out by electrochemical sensor and results were obtained in parts per million (ppm). Drager Miniwarn (German) ANNUXERE-I monitoring instrument was used for the monitoring of ambient gasses.

2.2 Monitoring Points

A total of eight locations were monitored as described below:

1- Near the main gate
2- Inside the Control Room
3- Car Parking Area
4- Cooling Tower Area
5- Generator & Sub-Station Area
6- Intake Area
7- On the main road near the plant
8- Near Desalinization Plant
9- Near Fine Filtration
10- Near Emergency Engine
11- Open Area in front of CCR

3.0 RESULTS AND DISCUSSION

The monitored and processed data regarding the ambient gaseous monitoring are presented in the ANNEXURE-II. From monitored and processed data, it is evident that the concentration of CO, NOx, SO_2 and HCs as methane was below the detection limits at any of the monitored point.

National Environment Quality Standards (NEQS)-Pakistan (ANNEXURE-IV, SECTION-A) do not specify any limiting value for these gases in the ambient air. These values are also well incompliance with the WHO guidelines values for ambient air ANNEXURE-III and OSHA Standards.

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Dräger Sicherheitstechnik

Dräger

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MiniWarn

Mehrgas-Meßgerät

Multi-Gas Monitor

Software Version 2.nn

Anzeige:

1 Sonderzeichen im Messbetrieb:

- i Es liegt eine Warnung vor, oder
- ϟ es liegt eine Störung vor.
- Batterie-Voralarm, oder
- Batterie-Hauptalarm, oder
- Gerät beim Laden eingeschaltet.
- Pumpenbetrieb, oder
- Durchflussalarm im Pumpenbetrieb, oder
- Spitzenwert-Anzeige aktiv, oder
- H Messwert halten aktiv, oder
- Alarm-Stummschaltung, oder
- schnelle Konfigurationsumschaltung CA-Sensor aktiv

i	0.00	Vol.%	CH_4
	0	ppm	H_2S
	20.9	Vol.%	O_2
	0	ppm	CO
1	2	3	4

2 Messwert, bzw.

- ↑↑↑↑ bei Messbereichsüber- oder
- ↓↓↓↓ bei Unterschreitung oder
- – 0 bei negativen Messwerten oder
- ---- bei Messkanal- oder Gerätefehlern.

3 Messeinheit –
beim Konzentrationsalarm » A1 « bzw. » A2 « oder beim Expositionsalarm » STEV « bzw. » TWA « im Wechsel mit der Einheit.

4 Chemisches Symbol für das gemessene Gas.

Weitere Bedienfunktionen, die den Zustand und die Arbeitsweise des Gerätes verändern, sind nur im Menübetrieb erreichbar. Detaillierte Beschreibung siehe "Technisches Handbuch MiniWarn"

1 Special symbols in measurement mode:

- i a warning has occurred or
- ϟ a fault has occurred.
- battery pre-alarm or
- battery main alarm or
- Instrument is switched on while charging.
- pump operation or
- flow alarm during pump operation, or
- peak holding active, or
- H Measurement value holding active, or
- silent mode active, or
- fast configuration switching Cat sensor active.

2 The measured value, or

- ↑↑↑↑ if value is above the measuring range or
- ↓↓↓↓ if value is below the measuring range or
- – 0 if the measured value is negative,
- ---- for a measuring channel or instrument fault.

3 Measurement unit –
the measurement unit will be displayed alternately with » A1 « or » A2 « during a concentration alarm, or with » STEV « or » TWA « during a exposure alarm.

4 Chemical symbol for the measured gas.

Other operating functions that modify the status and mode of the instrument are only accessible in menu mode.
For a detailed description refer to "Technical Handbook MiniWarn".

Kurzanleitung

Vor der ersten Gerätebenutzung, siehe Seite 12!

Gerät einschalten

1 Taste » ↵ « drücken – Anzeige von Software Version, Alarmschwellen und Messbereichsendwerten. Danach Anzeige der Gaskonzentrationen, Gasarten und Einheiten.

Beleuchtung einschalten

- Beliebige Taste drücken: die Beleuchtung ist für ca. 2 Minuten eingeschaltet.

Geräteinformation anzeigen

2 Im Messbetrieb oder bei ausgeschaltetem Gerät, Taste » ▲ « gedrückt halten.

Alarm

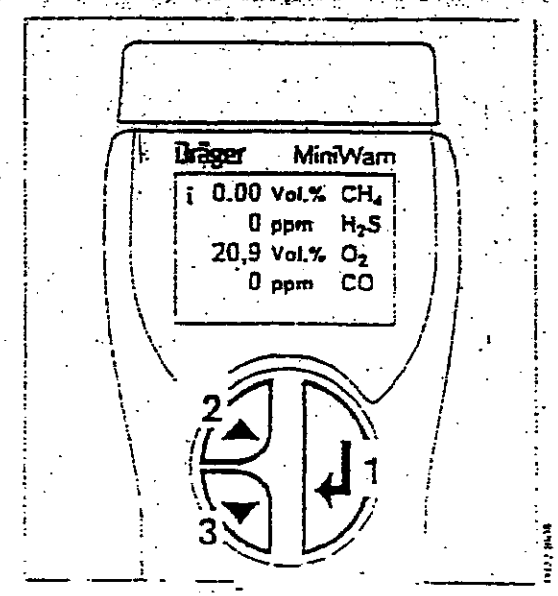
– Signalton und rote Alarmleuchte.
– Anzeige: Alarmart.
Alarm quittieren:
1 Taste » ↵ « drücken.

Menübetrieb

1 Taste » ↵ « drücken, das Auswahlmenü wird angezeigt.
2 Taste » ▲ « zum Wählen (aufwärts).
3 Taste » ▼ « zum Wählen (abwärts)

Gerät ausschalten

2.3 Taste » ▲ « und Taste » ▼ « gleichzeitig mind. 3 Sekunden drücken zum Ausschalten des Gerätes



Brief instructions

Before using the instrument for the first time, see page 12.

To turn on the instrument

1 Press the » ↵ « key, this displays the software version, alarm settings and the upper limits of the measuring ranges. Afterwards the gas concentration, -type and unit are displayed

To switch on the illuminated display

- Press any key or after an alarm is triggered: the illuminated display is switched on for about 2 minutes.

To display instrument information

2 In the measurement mode or when the instrument is switched off, hold the » ▲ « key pressed.

Alarm

– Signal tone and red alarm light.
– Display: alarm category.
To acknowledge an alarm:
1 Press the » ↵ « key.

Menu operation

1 Press the » ↵ « key – the selection menu will be displayed.
2 Key » ▲ « to select (up)
3 Key » ▼ « to select (down)

Too switch off the instrument

2.3 Press the » ▲ « and » ▼ « keys simultaneously for more than 3 seconds to switch off the instrument

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ANNEXURE-II

APEX ENVIRONMENT LABORATORY

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(Laboratory certified as "Environmental Laboratory" by the Environmental Protection Agency, Government of the Punjab vide its Memo No: 551/DD(Labs.)/ EPA, dated May 09, 2008, certificate No: 551/DD(Labs.)/EPD/08)

Ambient Gaseous Monitored Data

Reference Point	SO_2 (ppm)	NO_2 (ppm)	CO (ppm)	HCs as CH_4 (%)
1- Near the main gate	B.D.L	B.D.L	B.D.L	B.D.L
2- Inside the Control Room	B.D.L	B.D.L	B.D.L	B.D.L
3-Car Parking Area	B.D.L	B.D.L	B.D.L	B.D.L
4-Cooling Tower Area	B.D.L	B.D.L	B.D.L	B.D.L
5- Generator & Sub-Station Area	B.D.L	B.D.L	B.D.L	B.D.L
6- Intake Area	B.D.L	B.D.L	B.D.L	B.D.L
7- On the main road near the plant	B.D.L	B.D.L	B.D.L	B.D.L
8- Near Desalinization Plant	B.D.L	B.D.L	B.D.L	B.D.L
9- Near Fine Filtration	B.D.L	B.D.L	B.D.L	B.D.L
10- Near Emergency Engine	B.D.L	B.D.L	B.D.L	B.D.L
11- Open Area in front of CCR	B.D.L	B.D.L	B.D.L	B.D.L

B.D.L = Below Detection Limit

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GUIDELINES FOR AIR QUALITY

This WHO document on the *Guidelines for Air Quality* is the outcome of the WHO Expert Task Force meeting held in Geneva, Switzerland, in December 1997. It bases on the document entitled "Air Quality Guidelines for Europe" that was prepared by the WHO Regional Office for Europe and regional background papers.

Note to the user:
The electronic form of this document is available on the CD ROM of the Healthy Cities Air Management Information System AMIS and, in part, from the Web site of the World Health Organization (http://www.who.int/peh/).

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cultural conditions.

The *Guidelines* set out the range of ambient concentrations in exposure-response relationships and give guideline values; the air quality guideline value defines a concentration of air pollutant below which no adverse effect to human health is expected. Guideline values for 38 non-carcinogenic compounds and some carcinogens are set in relation to different exposure times. The table below gives some examples of the guideline value for common gaseous pollutants.

WHO Guidelines values (1999) for common pollutants

Pollutant	*Annual ambient air concentration ($\mu g/m^3$)*	*Guideline value ($\mu g/m^3$)*	*Concentration at which effects on health start to be observed ($\mu g/m^3$)*	*Exposure time*
CO	500-7000	100 000	Not applicable	15 min
		60 000		30 min
		30 000		1 hour
		10 000		8 hours
Lead	0.01-2.0	0.5	Not applicable	1 year
NO_2	10-150	200	365-565	1 hour
		40		1 year
O_3	10-100	120	Not applicable	8 hour
SO_2	5-400	500	1000	10 min
		125	250	24 hour
		50	100	1 year

Application of the *WHO Air Quality Guidelines* should help significantly to reduce the burden of excess mortality and preventable disability from a highly preventable source of ill-health.

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Text version

OSHA Occupational Safety & Health Administration, U.S. Department of Labor

Home Index Search

Regulations (Standards - 29 CFR)

TABLE Z-1 Limits for Air Contaminants. - 1910.1000TABLEZ-1

OSHA Regulations (Standards - 29 CFR) - Table of Contents

- **Standard Number:** 1910.1000TABLEZ-1
- **Standard Title:** TABLE Z-1 Limits for Air Contaminants.
- **SubPart Number:** Z
- **SubPart Title:** Toxic and Hazardous Substances

TABLE Z-1 LIMITS FOR AIR CONTAMINANTS

NOTE: Because of the length of the table, explanatory footnotes applicable to all substances are given below as well as at the end of the table. Footnotes specific only to a limited number of substances are also shown within the table.

Footnote(1) The PELs are 8-hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit. They are to be determined from breathing-zone air samples.

Footnote(a) Parts of vapor or gas per million parts of contaminated air by volume at 25 degrees C and 760 torr.

Footnote(b) Milligrams of substance per cubic meter of air. When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate.

Footnote(c) The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound measured as the metal, the CAS number for the metal is given - not CAS numbers for the individual compounds.

Footnote(d) The final benzene standard in 1910.1028 applies to all occupational exposures to benzene except in some circumstances the distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures; for the excepted subsegments, the benzene limits in Table Z 2 apply. See 1910.1028 for specific circumstances.

Footnote(e) This 8-hour TWA applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time-weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning and willowing) and garnetting. See also 1910.1043 for cotton dust limits applicable to other sectors.

Footnote(f) All inert or nuisance dusts, whether mineral

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rganic, or organic, not listed specifically by substance name are vered by the Particulates Not Otherwise Regulated (PNOR) limit ich is the same as the inert or nuisance dust limit of Table Z-3.

Footnote(2) See Table Z-2.

Footnote(3) See Table Z-3

Footnote(4) Varies with compound.

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Acetaldehyde	75-07-0	200	360	
Acetic acid	64-19-7	10	25	
Acetic anhydride	108-24-7	5	20	
Acetone	67-64-1	1000	2400	
Acetonitrile	75-05-8	40	70	
2-Acetylaminofluorene; see 1910.1014	53 96 3			
Acetylene dichloride; see 1,2-Dichloroethylene.				
Acetylene tetrabromide	79-27-6	1	14	
Acrolein	107-02-8	0.1	0.25	
Acrylamide	79-06-1	.....	0.3	x
Acrylonitrile; see 1910.1045	107-13-1			
Aldrin	309-00-2	.....	0.25	x
Allyl alcohol	107-18-6	2	5	x
Allyl chloride	107-05-1	1	3	
Allyl glycidyl ether (AGE)	106-92-3	(C)10	(C)45	
Allyl propyl disulfide	2179-59-1	2	12	
alpha-Alumina	1344-28-1			
Total dust		.....	15	
Respirable fraction		.....	5	
Aluminum Metal (as Al)	7429-90-5			
Total dust		.....	15	
Respirable fraction		.....	5	
4-Aminodiphenyl; see 1910.1011	92-67-1			
2-Aminoethanol; see Ethanolamine				
2-Aminopyridine	504-29-0	0.5	2	
Ammonia	7664-41-7	50	35	
Ammonium sulfamate	7773-06-0			
Total dust		.....	15	
Respirable fraction		.....	5	
n-Amyl acetate	628-63-7	100	525	
sec-Amyl acetate	626-38-0	125	650	
Aniline and homologs	62-53-3	5	19	x
Anisidine (o-,p-isomers)	29191-52-4	.....	0.5	x
Antimony and compounds (as Sb)	7440 36 0	.....	0.5	
ANTU (alpha Naphthylthiourea)	86-88-4	.....	0.3	
Arsenic, inorganic compounds (as As); see 1910.1018	7440-38-2			
Arsenic, organic compounds (as As)	7440-38-2	.....	0.5	
Arsine	7784-42-1	0.05	0.2	
Asbestos; see 1910.1001	(4)			
Azinphos-methyl	86-50-0	.....	0.2	x
Barium, soluble compounds (as Ba)	7440-39-3	.....	0.5	
Barium sulfate	7727-43-7			

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Respirable fraction..		.....	5	
Nonyl.....	17804-35-2			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Benzene; See 1910.1028. See Table Z-2 for the limits applicable in the operations or sectors excluded in 1910.1028(d)	71-43-2			
Benzidine; See 1910.1010.....	92-87-5			
p-Benzoquinone; see Quinone.				
Benzo(a)pyrene; see Coal tar pitch volatiles.....				
Benzoyl peroxide.....	94-36-0	.....	5	
Benzyl chloride.....	100-44-7	1	5	
Beryllium and beryllium compounds (as Be).....	7440-41-7		(2)	
Biphenyl; see Diphenyl.				
Bismuth telluride, Undoped.....	1304-82-1			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Boron oxide.....	1303-86-2			
Total dust.....		.....	15	
Boron trifluoride.....	7637-07-2	(C)1	(C)3	
Bromine.....	7726-95-6	0.1	0.7	
Bromoform.....	75-25-2	0.5	5	x
Butadiene (1,3-Butadiene); See 29 CFR 1910.1051; 29 CFR 1910.19(1).....	106-99-0	1 ppm/5 ppm STEL		
Butanethiol; see Butyl mercaptan.				
2-Butanone (Methyl ethyl ketone)	78-93-3	200	590	
2-Butoxyethanol.....	111-76-2	50	240	x
n-Butyl-acetate.....	123-86-4	150	710	
sec-Butyl acetate.....	105-46-4	200	950	
tert-Butyl-acetate.....	540-88-5	200	950	
n-Butyl alcohol.....	71-36-3	100	300	
sec-Butyl alcohol.....	78-92-2	150	450	
tert-Butyl alcohol.....	75-65-0	100	300	
Butylamine.....	109-73-9	(C)5	(C)15	x
tert-Butyl chromate (as CrO(3)).....	1189-85-1	.....	(C)0.1	x
Butyl glycidyl ether (BGE).....	2426-08-6	50	270	
Butyl mercaptan.....	109-79-5	10	35	
p-tert-Butyltoluene....	98-51-1	10	60	
Cadmium (as Cd); see 1910.1027.....	7440-43-9			
Calcium Carbonate.....	1317-65-3			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Calcium hydroxide.....	1305-62-0			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Calcium oxide.....	1305-78-8	.....	5	
Calcium silicate.....	1344-95-2			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Calcium sulfate.....	7778-18-9			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Camphor, synthetic.....	76-22-2	.....	2	
Carbaryl (Sevin).....	63-25-2	.....	5	
Carbon black.....	1333-86-4	.....	3.5	
Carbon dioxide.....	124-38-9	5000	9000	
Carbon disulfide.....	75-15-0		(2)	
Carbon monoxide.....	630-08-0	50	55	
[illegible]	[illegible]		[illegible]	

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Cellulose	9004-34-6			
Total dust		.....	15	
Respirable fraction		.....	5	
Chlordane	57-74-9	.....	0.5	x
Chlorinated camphene	8001-35-2	.....	0.5	x
Chlorinated diphenyl oxide	55720-99-5	.....	0.5	
Chlorine	7782-50-5	(c)1	(c)3	
Chlorine dioxide	10049-04-4	0.1	0.3	
Chlorine trifluoride	7790-91-2	(c)0.1	(c)0.4	
Chloroacetaldehyde	107-20-0	(c)1	(c)3	
a-Chloroacetophenone (Phenacyl chloride)	532-27-4	0.05	0.3	
Chlorobenzene	108-90-7	75	350	
o-Chlorobenzylidene malononitrile	2698-41-1	0.05	0.4	
Chlorobromomethane	74-97-5	200	1050	
2-Chloro-1,3-butadiene; See beta-Chloroprene.				
Chlorodiphenyl (42% Chlorine)(PCB)	53469-21-9	.....	1	x
Chlorodiphenyl (54% Chlorine)(PCB)	11097-69-1	.....	0.5	x
1-Chloro-2, 3-epoxypropane; See Epichlorohydrin.				
2-Chloroethanol; See Ethylene chlorohydrin				
Chloroethylene; See Vinyl chloride.				
Chloroform (Trichloromethane)	67-66-3	(c)50	(c)240	
bis(Chloromethyl) ether; see 1910.1008.	542-88-1			
Chloromethyl methyl ether; see 1910.1006.	107-30-2			
1-Chloro-1-nitropropane	600-25-9	20	100	
Chloropicrin	76-06-2	0.1	0.7	
beta-Chloroprene	126-99-8	25	90	x
2-Chloro-6 (trichloromethyl) pyridine	1929-82-4			
Total dust		.....	15	
Respirable fraction		.....	5	
Chromic acid and chromates (as CrO(3))	(4)		(2)	
Chromium (II) compounds (as Cr)	7440-47-3	.....	0.5	
Chromium (III) compounds (as Cr)	7440-47-3	.....	0.5	
Chromium metal and insol. salts (as Cr)	7440-47-3	.....	1	
Chrysene; see Coal tar pitch volatiles				
Clopidol	2971-90-6			
Total dust		.....	15	
Respirable fraction		.....	5	
Coal dust (less than 5% SiO(2)), respirable fraction			(3)	
Coal dust (greater than or equal to 5% SiO(2)), respirable fraction			(3)	
Coal tar pitch volatiles (benzene soluble fraction), anthracene, BaP, phenanthrene, acridine, chrysene, pyrene	65996-93-2	.....	0.2	
Cobalt metal, dust, and fume (as Co)	7440-48-4	.....	0.1	
Coke oven emissions; see 1910.1029				
Copper	7440-50-8			

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Dusts and mists (as Cu).....		.....	1	
Cotton dust (e), see 1910.1043.....		.....	1	
Crag herbicide (Sesone)	136-78-7			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Cresol, all isomers....	1319-77-3	5	22	x
Crotonaldehyde.....	123-73-9	2	6	
	4170-30-3			
Cumene.....	98-82-8	50	245	x
Cyanides (as CN).....	(4)	.....	5	x
Cyclohexane.....	110-82-7	300	1050	
Cyclohexanol.....	108-93-0	50	200	
Cyclohexanone.....	108-94-1	50	200	
Cyclohexene.....	110-83-8	300	1015	
Cyclopentadiene.....	542-92-7	75	200	
2,4-D (Dichlorophenoxyacetic acid).....	94-75-7	.....	10	
Decaborane.....	17702-41-9	0.05	0.3	x
Demeton (Systox).....	8065-48-3	.....	0.1	x
Diacetone alcohol (4-Hydroxy-4-methyl-2-pentanone).....	123-42-2	50	240	
1,2-Diaminoethane; see Ethylenediamine..				
Diazomethane.....	334-88-3	0.2	0.4	
Diborane.....	19287-45-7	0.1	0.1	
1,2-Dibromo-3-chloropropane (DBCP); see 1910.1044.....	96-12-8			
1,2-Dibromoethane; see Ethylene dibromide...				
Dibutyl phosphate.....	107-66-4	1	5	
Dibutyl phthalate.....	84-74-2	.....	5	
o-Dichlorobenzene.....	95-50-1	(C)50	(C)300	
p-Dichlorobenzene.....	106-46-7	75	450	
3,3'-Dichlorobenzidine; see 1910.1007.....	91-94-1			
Dichlorodifluoromethane	75-71-8	1000	4950	
1,3-Dichloro-5,5-dimethyl hydantoin.	118-52-5	.....	0.2	
Dichlorodiphenyltrichloroethane (DDT)...	50-29-3	.....	1	x
1,1-Dichloroethane.....	75-34-3	100	400	
1,2-Dichloroethane; see Ethylene dichloride..				
1,2-Dichloroethylene...	540-59-0	200	790	
Dichloroethyl ether....	111-44-4	(C)15	(C)90	x
Dichloromethane; see Methylene chloride...				
Dichloromonofluoromethane.....	75-43-4	1000	4200	
1,1-Dichloro-1-nitroethane.....	594-72-9	(C)10	(C)60	
1,2-Dichloropropane; see Propylene dichloride.				
Dichlorotetrafluoroethane.....	76-14-2	1000	7000	
Dichlorvos (DDVP).....	62-73-7	.....	1	x
Dicyclopentadienyl iron	102-54-5			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Dieldrin.....	60-57-1	.....	0.25	x
Diethylamine.....	109-89-7	25	75	
2-Diethylaminoethanol..	100-37-8	10	50	x
Diethyl ether; see Ethyl ether.....				
Difluorodibromomethane.	75-61-6	100	860	
Diglycidyl ether (DGE).	2238-07-5	(C)0.5	(C)2.8	
Dihydroxybenzene; see Hydroquinone.....				
Diisobutyl ketone.....	108-83-8	50	290	
Diisopropylamine.....	108-18-9	5	20	x
Dimethylaminoazo-				

ECTECH Environment Consultants
Suite # 4, 2nd Floor, Link Arcade; Link Model Town Road, Lahore

see 1910.1015	60-11-7			
Dimethoxymethane; see Methylal				
Dimethyl acetamide	127-19-5	10	35	x
Dimethylamine	124-40-3	10	18	
Dimethylaminobenzene; see Xylidine				
Dimethylaniline (N,N-Dimethylaniline)	121-69-7	5	25	x
Dimethylbenzene; see Xylene				
Dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate	300-76-5	.....	3	
Dimethylformamide	68-12-2	10	30	x
2,6-Dimethyl-4-heptanone; see Diisobutyl ketone				
1,1-Dimethylhydrazine	57-14-7	0.5	1	x
Dimethylphthalate	131-11-3	.....	5	
Dimethyl sulfate	77-78-1	1	5	x
Dinitrobenzene				
(all isomers)			1	x
(ortho)	528-29-0			
(meta)	99-65-0			
(para)	100-25-4			
Dinitro-o-cresol	534-52-1	.....	0.2	x
Dinitrotoluene	25321-14-6	.....	1.5	x
Dioxane (Diethylene dioxide)	123-91-1	100	360	x
Diphenyl (Biphenyl)	92-52-4	0.2	1	
Diphenylmethane diisocyanate; see Methylene bisphenyl isocyanate				
Dipropylene glycol methyl ether	34590-94-8	100	600	x
Di-sec octyl phthalate (Di-(2-ethylhexyl) phthalate)	117-81-7	.....	5	
Emery	12415-34-8			
Total dust		.....	15	
Respirable fraction		.....	5	
Endrin	72-20-8	.....	0.1	x
Epichlorohydrin	106-89-8	5	19	x
EPN	2104-64-5	.....	0.5	x
1,2-Epoxypropane; see Propylene oxide				
2,3-Epoxy-1-propanol; see Glycidol				
Ethanethiol; see Ethyl mercaptan				
Ethanolamine	141-43-5	3	6	
2-Ethoxyethanol (Cellosolve)	110-80-5	200	740	x
2-Ethoxyethyl acetate (Cellosolve acetate)	111-15-9	100	540	x
Ethyl acetate	141-78-6	400	1400	
Ethyl acrylate	140-88-5	25	100	x
Ethyl alcohol (Ethanol)	64-17-5	1000	1900	
Ethylamine	75-04-7	10	18	
Ethyl amyl ketone (5-Methyl-3-heptanone)	541-85-5	25	130	
Ethyl benzene	100-41-4	100	435	
Ethyl bromide	74-96-4	200	890	
Ethyl butyl ketone (3-Heptanone)	106-35-4	50	230	
Ethyl chloride	75-00-3	1000	2600	
Ethyl ether	60-29-7	400	1200	
Ethyl formate	109-94-4	100	300	
Ethyl mercaptan	75-08-1	(C)10	(C)25	
Ethyl silicate	78-10-4	100	850	
Ethylene chlorohydrin	107-07-3	5	16	x
Ethylenediamine	107-15-3	10	25	
Ethylene dibromide	106-93-4		(2)	
Ethylene dichloride				

ECOTECH Environment Consultants
Suite # 4, 2nd Floor, Link Arcade, Link Model Town Road, Lahore

(1,2-Dichloroethane)	107-06-2		(2)	
Ethylene glycol dinitrate	628-96-6	(C)0.2	(C)1	x
Ethylene glycol methyl acetate; see Methyl cellosolve acetate				
Ethyleneimine; see 1910.1012	151-56-4			
Ethylene oxide; see 1910.1047	75-21-8			
Ethylidene chloride; see 1,1-Dichlorethane				
N-Ethylmorpholine	100-74-3	20	94	x
Ferbam	14484-64-1			
Total dust		.....	15	
Ferrovanadium dust	12604-58-9	.....	1	
Fluorides (as F)	(4)	.....	2.5	
Fluorine	7782-41-4	0.1	0.2	
Fluorotrichloromethane (Trichloro-fluoromethane)	75-69-4	1000	5600	
Formaldehyde; see 1910.1048	50-00-0			
Formic acid	64-18-6	5	9	
Furfural	98-01-1	5	20	x
Furfuryl alcohol	98-00-0	50	200	
Grain dust (oat, wheat barley)	.....	.....	10	
Glycerin (mist)	56-81-5			
Total dust		.....	15	
Respirable fraction		.....	5	
Glycidol	556-52-5	50	150	
Glycol monoethyl ether; see 2-Ethoxyethanol				
Graphite, natural respirable dust	7782-42-5		(3)	
Graphite, synthetic				
Total dust		.....	15	
Respirable Fraction		.....	5	
Guthion; see Azinphos methyl				
Gypsum	13397-24-5			
Total dust		.....	15	
Respirable fraction		.....	5	
Hafnium	7440-58-6	.....	0.5	
Heptachlor	76-44-8	.....	0.5	x
Heptane (n-Heptane)	142-82-5	500	2000	
Hexachloroethane	67-72-1	1	10	x
Hexachloronaphthalene	1335-87-1	.....	0.2	x
n-Hexane	110-54-3	500	1800	
2-Hexanone (Methyl n-butyl ketone)	591-78-6	100	410	
Hexone (Methyl isobutyl ketone)	108-10-1	100	410	
sec-Hexyl acetate	108-84-9	50	300	
Hydrazine	302-01-2	1	1.3	x
Hydrogen bromide	10035-10-6	3	10	
Hydrogen chloride	7647-01-0	(C)5	(C)7	
Hydrogen cyanide	74-90-8	10	11	x
Hydrogen fluoride (as F)	7664-39-3		(2)	
Hydrogen peroxide	7722-84-1	1	1.4	
Hydrogen selenide (as Se)	7783-07-5	0.05	0.2	
Hydrogen sulfide	7783-06-4		(2)	
Hydroquinone	123-31-9	.....	2	
Iodine	7553-56-2	(C)0.1	(C)1	
Iron oxide fume	1309-37-1	.....	10	
Isomyl acetate	123-92-2	100	525	
Isomyl alcohol (primary and secondary)	123-51-3	100	360	
Isobutyl acetate	110-19-0	150	700	
Isobutyl alcohol	78-83-1	100	300	
Isophorone	78-59-1	25	140	
Isopropyl acetate	108-21-4	250	950	
Isopropyl alcohol	[illegible]	[illegible]	[illegible]	

ECTECH Environment Consultants
Suite # 4, 2nd Floor, Link Arcade, Link Model Town Road, Lahore

Isopropylamine.....	75-31-0	5	12	
Isopropyl ether.....	108-20-3	500	2100	
Isopropyl glycidyl ether (IGE).....	4016-14-2	50	240	
Kaolin.....	1332-58-7			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Ketene.....	463-51-4	0.5	0.9	
Lead inorganic (as Pb) see 1910.1025.....	7439-92-1			
Limestone.....	1317-65-3			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Lindane.....	58-89-9	.....	0.5	x
Lithium hydride.....	7580-67-8	.....	0.025	
L.P.G. (Liquified petroleum gas).....	68476-85-7	1000	1800	
Magnesite.....	546-93-0			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Magnesium oxide fume...	1309-48-4			
Total Particulate....		.....	15	
Malathion.....	121-75-5			
Total dust.....		.....	15	x
Maleic anhydride.....	108-31-6	0.25	1	
Manganese compounds (as Mn).....	7439-96-5	.....	(C)5	
Manganese fume (as Mn).	7439-96-5	.....	(C)5	
Marble.....	1317-65-3			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Mercury (aryl and inorganic)(as Hg)....	7439-97-6		(2)	
Mercury (organo) alkyl compounds (as Hg)....	7439-97-6		(2)	
Mercury (vapor) (as Hg)	7439-97-6		(2)	
Mesityl oxide.....	141-79-7	25	100	
Methanethiol; see Methyl mercaptan.	-			
Methoxychlor.....	72-43-5			
Total dust.....		.....	15	
2-Methoxyethanol; (Methyl cellosolve)..	109-86-4	25	80	x
2-Methoxyethyl acetate (Methyl cellosolve acetate).....	110-49-6	25	120	x
Methyl acetate.....	79-20-9	200	610	
Methyl acetylene (Propyne).....	74-99-7	1000	1650	
Methyl acetylene propadiene mixture (MAPP).....		1000	1800	
Methyl acrylate.....	96-33-3	10	35	x
Methylal (Dimethoxy-methane)..	109-87-5	1000	3100	
Methyl alcohol.....	67-56-1	200	260	
Methylamine.....	74-89-5	10	12	
Methyl amyl alcohol; see Methyl Isobutyl carbinol.....				
Methyl n-amyl ketone...	110-43-0	100	465	
Methyl bromide.....	74-83-9	(c)20	(c)80	x
Methyl butyl ketone; see 2-Hexanone.....				
Methyl cellosolve; see 2-Methoxyethanol.				
Methyl cellosolve acetate; see 2 Methoxyethyl acetate.....				
Methyl chloride.....	74-87-3		(2)	
Methyl chloroform (1,1,1-Trichloro-ethane).....	71-55-6	350	1900	
Methylcyclohexane.....	108-87-2	500	2000	
Methylcyclohexanol.....	25639-42-3	100	470	
[illegible]	[illegible]	[illegible]	[illegible]	

ECTECH Environment Consultants
Suite # 4, 2nd Floor, Link Arcade, Link Model Town Road, Lahore

ethylene chloride.....	75-09-2		(2)	
ethyl ethyl ketone (MEK); see 2-Butanone				
ethyl formate.....	107-31-3	100	250	
ethyl hydrazine (Monomethyl hydrazine).....	60-34-4	(C)0.2	(C)0.35	x
ethyl iodide.....	74-88-4	5	28	x
ethyl isoamyl ketone..	110-12-3	100	475	
ethyl isobutyl carbinol.....	108-11-2	25	100	x
ethyl isobutyl ketone; see Hexone.....				
ethyl isocyanate.....	624-83-9	0.02	0.05	x
ethyl mercaptan.....	74-93-1	(C)10	(C)20	
ethyl methacrylate....	80-62-6	100	410	
ethyl propyl ketone; see 2-Pentanone.....				
lpha-Methyl styrene...	98-83-9	(C)100	(C)480	
ethylene bisphenyl isocyanate (MDI).....	101-68-8	(C)0.02	(C)0.2	
ica; see Silicates....				
olybdenum (as Mo).....	7439-98-7			
Soluble compounds....		.....	5	
Insoluble compounds total dust.....		.....	15	
onomethyl aniline.....	100-61-8	2	9	x
onomethyl hydrazine; see Methyl hydrazine.				
orpholine.....	110-91-8	20	70	x
aphtha (Coal tar).....	8030-30-6	100	400	
aphthalene.....	91-20-3	10	50	
lpha-Naphthylamine; see 1910.1004.....	134-32-7			
eta-Naphthylamine; see 1910.1009.....	91-59-8			
ickel carbonyl (as Ni)	13463-39-3	0.001	0.007	
ickel, metal and insoluble compounds (as Ni).....	7440-02-0	.....	1	
ickel, soluble compounds (as Ni)....	7440-02-0	.....	1	
itroline.....	54-11-5	.....	0.5	x
itric acid.....	7697-37-2	2	5	
itric oxide.....	10102-43-9	25	30	
-Nitroaniline.....	100-01-6	1	6	x
itrobenzene.....	98-95-3	1	5	x
-Nitrochlorobenzene...	100-00-5	.....	1	x
-Nitrodiphenyl; see 1910.1003.....	92-93-3			
itroethane.....	79-24-3	100	310	
itrogen dioxide.....	10102-44-0	(C)5	(C)9	
itrogen trifluoride...	7783-54-2	10	29	
itroglycerin.....	55-63-0	(C)0.2	(C)2	x
itromethane.....	75-52-5	100	250	
-Nitropropane.....	108-03-2	25	90	
-Nitropropane.....	79-46-9	25	90	
-Nitrosodimethylamine; see 1910.1016				
itrotoluene (all isomers).....		5	30	x
-isomer.....	88-72-2			
-isomer.....	99-08-1			
-isomer.....	99-99-0			
itrotrichloromethane; see Chloropicrin.....				
etrachloronaphthalene..	2234-13-1	.....	0.1	x
etane.....	111-65-9	500	2350	
l mist, mineral.....	8012-95-1	.....	5	
smium tetroxide (as Os).....	20816-12-0	.....	0.002	
talic acid.....	144-62-7	.....	1	
xygen difluoride.....	7783-41-7	0.05	0.1	
zone.....	10028-15-6	0.1	0.2	
raquat, respirable dust.....	4685-14-7	.....	0.5	x

ECOTECH Environment Consultants
Suite # 4, 2nd Floor, Link Arcade, Link Model Town Road, Lahore

	2074-50-2			
Parathion.....	56-38-2	.....	0.1	x
Particulates not otherwise regulated (PNOR)(f).....				
Total dust.....		.....	15	
Respirable fraction..		.....	5	
PCB; see Chlorodiphenyl (42% and 54% Chlorine).....				
Pentaborane.....	19624-22-7	0.005	0.01	
Pentachloronaphthalene.	1321-64-8	.....	0.5	x
Pentachlorophenol.....	87-86-5	.....	0.5	x
Pentaerythritol.....	115-77-5			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Pentane.....	109-66 0	1000	2950	
2 Pentanone (Methyl propyl ketone).....	107-87-9	200	700	
Perchloroethylene (Tetrachloroethylene)	127-18-4		(7)	
Perchloromethyl mercaptan.....	594-42-3	0.1	0.8	
Perchloryl fluoride....	7616-94-6	3	13.5	
Petroleum distillates (Naphtha)(Rubber Solvent).....		500	2000	
Phenol.....	108-95-2	5	19	x
p-Phenylene diamine....	106-50-3	.....	0.1	x
Phenyl ether, vapor....	101-84-8	1	7	
Phenyl ether-biphenyl mixture, vapor.....		1	7	
Phenylethylene; see Styrene.....				
Phenyl glycidyl ether (PGE).....	122-60-1	10	60	
Phenylhydrazine.....	100-63-0	5	22	x
Phosdrin (Mevinphos)...	7786-34-7	.....	0.1	x
Phosgene (Carbonyl chloride).....	75-44-5	0.1	0.4	
Phosphine.....	7803-51-2	0.3	0.4	
Phosphoric acid.....	7664-38-2	.....	1	
Phosphorus (yellow)....	7723-14-0	.....	0.1	
Phosphorus pentachloride.....	10026-13-8	.....	1	
Phosphorus pentasulfide	1314-80-3	.....	1	
Phosphorus trichloride.	7719-12-2	0.5	3	
Phthalic anhydride.....	85-44-9	2	12	
Picloram.....	1918-02-1			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Picric acid.....	88-89-1	.....	0.1	x
Pindone (2-Pivalyl-1, 3-indandione).....	83-26-1	.....	0.1	
Plaster of paris.....	26499-65-0			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Platinum (as Pt).....	7440-06-4			
Metal.....		.....	.....	
Soluble Salts.....		.....	0.002	
Portland cement.....	65997-15-1			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Propane.....	74-98-6	1000	1800	
Beta-Propriolactone; see 1910.1013.....	57 57 8			
n-Propyl acetate.....	109 60 4	200	840	
n-Propyl alcohol.....	71-23-8	200	500	
n Propyl nitrate.....	627-13-4	25	110	
Propylene dichloride...	78 87-5	75	350	
Propylene imine.....	75-55-8	2	5	x
Propylene oxide.....	75-56-9	100	240	
Propyne; see Methyl acetylene.....				
Pyrethrum.....	8003-34-7	.....	5	
Pyridine.....	110-86-1	5	15	
[illegible]	[illegible]	[illegible]	[illegible]	

ECTECH Environment Consultants
Suite # 4, 2nd Floor, Link Arcade, Link Model Town Road, Lahore

RDX: see Cyclonite.....				
Rhodium (as Rh), metal fume and insoluble compounds.....	7440-16-6	.....	0.1	
Rhodium (as Rh), soluble compounds....	7440-16-6	.....	0.001	
Ronnel.....	299-84-3	.....	15	
Rotenone.....	83-79-4	.....	5	
Rouge.....				
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Selenium compounds (as Se).....	7782-49-2	.....	0.2	
Selenium hexafluoride (as Se).....	7783-79-1	0.05	0.4	
Silica, amorphous, precipitated and gel.	112926-00-8		(3)	
Silica, amorphous, diatomaceous earth, containing less than 1% crystalline silica	61790-53-2		(3)	
Silica, crystalline cristobalite, respirable dust.....	14464-46-1		(3)	
Silica, crystalline quartz, respirable dust.....	14808-60-7		(3)	
Silica, crystalline tripoli (as quartz), respirable dust.....	1317-95-9		(3)	
Silica, crystalline tridymite, respirable dust.....	15468-32-3		(3)	
Silica, fused, respirable dust.....	60676-86-0		(3)	
Silicates (less than 1% crystalline silica)				
Mica (respirable dust).....	12001-26-2		(3)	
Soapstone, total dust	.....		(3)	
Soapstone, respirable dust.....	.....		(3)	
Talc (containing asbestos): use asbestos limit: see 29 CFR 1910.1001.....			(3)	
Talc (containing no asbestos), respirable dust.....	14807-96-6		(3)	
Tremolite, asbestiform; see 1910.1001.....				
Silicon.....	7440-21-3			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Silicon carbide.....	409-21-2			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Silver, metal and soluble compounds (as Ag).....	7440-22-4	.....	0.01	
Soapstone; see silicates.....				
Sodium fluoroacetate...	62-74-8	.....	0.05	x
Sodium hydroxide.....	1310-73-2	.....	2	
Starch.....	9005-25-8			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Stibine.....	7803-52-3	0.1	0.5	
Stoddard solvent.....	8052-41-3	500	2000	
Strychnine.....	57-24-9	.....	0.15	
Styrene.....	100-42-5		(7)	
Sucrose.....	57-50-1			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Sulfur dioxide.....	7446-09-5	(5)	13	
Sulfuryl fluoride....	2699-79-8	100	5000	

ECTECH Environment Consultants
Suite # 4, 2nd Floor, Link Arcade, Link Model Town Road, Lahore

ulfuric acid.....	7664-93-9	.....	1	
ulfur monochloride....	10025-67-9	1	6	
ulfur pentafluoride...	5714-22-7	0.025	0.25	
ulfuryl fluoride.....	2699-79-8	5	20	
ystox; see Demeton...				
2,4,5-T (2,4,5-tri-chlorophenoxyacetic acid).....	93 76 5	.....	10	
alc; see silicates...				
antalum, metal and oxide dust.....	7440-25-7	.....	5	
EDP (Sulfotep).....	3689-24-5	.....	0.2	x
ellurium and compounds (as Te).....	13494-80-9	.....	0.1	
ellurium hexafluoride (as Te).....	7783-80-4	0.02	0.2	
emephos.....	3383-96-8			
otal dust.....		.....	15	
espirable fraction..		.....	5	
EPP (Tetraethyl pyrophosphate).....	107-49-3	.....	0.05	x
erphenyls.....	26140-60-3	(C)1	(C)9	
1,1,1,2-Tetrachloro-2,2-difluoroethane.....	76-11-9	500	4170	
1,1,2,2-Tetrachloro-1,2-difluoroethane.....	76-12-0	500	4170	
1,1,2,2-Tetrachloro-ethane.....	79-34-5	5	35	x
etrachoroethylene; see Perchloroethylene				
etrachloromethane; see Carbon tetrachloride.				
etrachloronaphthalene.	1335-88-2	.....	2	x
etraethyl lead (as Pb)	78-00-2	.....	0.075	x
etrahydrofuran.....	109-99-9	200	590	
etramethyl lead, (as Pb).....	75-74-1	.....	0.075	x
etramethyl succinonitrile.....	3333-52-6	0.5	3	x
etranitromethane.....	509-14-8	1	8	
etryl (2,4,6-Trinitro-phenylmethyl-nitramine).....	479-45-8	.....	1.5	x
hallium, soluble compounds (as Tl)....	7440-28-0	.....	0.1	x
4'-Thiobis(6-tert, butyl-m-cresol).....	96-69-5			
otal dust.....		.....	15	
espirable fraction..		.....	5	
iram.....	137-26-8	.....	5	
n, inorganic compounds (except xides) (as Sn).....	7440-31-5	.....	2	
n, organic compounds as Sn).....	7440-31-5	.....	0.1	
tanium dioxide.....	13463-67-7			
otal dust.....		.....	15	
luene.....	108-88-3		(2)	
luene-2, -diisocyanate (TDI).	584-84-9	(C)0.02	(C)0.14	
Toluidine.....	95-53-4	5	22	x
xaphene; see hlorinated camphene.				
emolite; ee Silicates.....				
ibutyl phosphate.....	126-73-8	.....	5	
1,1-Trichloroethane; ee Methyl chloroform				
1,2-Trichloroethane..	79-00-5	10	45	x
ichloroethylene.....	79-01-6		(2)	
ichloromethane; ee Chloroform				
ichloronaphthalene...	1321-65-9	.....	5	x
2,3-Trichloropropane.	96-18-4	50	300	
1,2-Trichloro-1,2,2-trifluoroethane....	76-13-1	1000	7600	

ECTECH Environment Consultants
Suite # 4, 2nd Floor, Link Arcade, Link Model Town Road, Lahore

Trifluorobromomethane..	75-63-8	1000	6100	
2,4,6-Trinitrophenol; see Picric acid.....				
2,4,6-Trinitrophenyl-methyl nitramine; see Tetryl.....				
2,4,6-Trinitrotoluene (INT).....	118-96-7	.....	1.5	x
Triorthocresyl phosphate.....	78-30-8	.....	0.1	
Triphenyl phosphate....	115-86-6	.....	3	
Turpentine.....	8006-64-2	100	560	
Uranium (as U).....	7440-61-1			
Soluble compounds....		.....	0.05	
Insoluble compounds..		.....	0.25	
Vanadium.....	1314-62-1			
Respirable dust (as V(2)O(5)).....		.....	(c)0.5	
Fume (as V(2)O(5))...		.....	(c)0.1	
Vegetable oil mist.....				
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Vinyl benzene; see Styrene.....				
Vinyl chloride; see 1910.1017.....	75-01-4			
Vinyl cyanide; see Acrylonitrile				
Vinyl toluene.....	25013-15-4	100	480	
Warfarin.....	81-81-2	.....	0.1	
Xylenes (o-, m-, p-isomers)..	1330-20-7	100	435	
Xylidine.....	1300-73-8	5	25	x
Yttrium.....	7440-65-5	.....	1	
Zinc chloride fume.....	7646-85-7	.....	1	
Zinc oxide fume.....	1314-13-2	.....	5	
Zinc oxide.....	1314-13-2			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Zinc stearate.....	557-05-1			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Zirconium compounds (as Zr).....	7440-67-7	.....	5	

Footnote(1) The PELs are 8-hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit. They are to be determined from breathing zone air samples.

Footnote(a) Parts of vapor or gas per million parts of contaminated air by volume at 25 degrees C and 760 torr.

Footnote(b) Milligrams of substance per cubic meter of air. When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate.

Footnote(c) The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound measured as the metal, the CAS number for the metal is given - not CAS numbers for the individual compounds.

Footnote(d) The final benzene standard in 1910.1028 applies to all occupational exposures to benzene except in some circumstances the distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures; for the excepted subsegments, the benzene limits in Table Z-2 apply. See 1910.1028 for specific circumstances.

Footnote(e) This 8-hour TWA applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time-weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning and willowing) and garnetting. See also 1910.1043 for cotton dust limits applicable to other sectors.

Footnote(f) All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the Particulates Not Otherwise Regulated (PNOR) limit which is the same as the inert or nuisance dust limit of Table Z-3.

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SECTION - D
PARTICULATE MATTER MONITORING--AMBIENT

1.0 GENERAL

Ambient particulate matter monitoring was carried out at a total of eleven points within the working facility and the monitoring points are given as below;

1- Near the main gate
2- Inside the Control Room
3- Car Parking Area
4- Cooling Tower Area
5- Generator & Sub-Station Area
6- Intake Area
7- On the main road near the plant
8- Near Desalinization Plant
9- Near Fine Filtration
10- Near Emergency Engine
11- Open Area in front of CCR

2.0 MONITORING INSTRUMENT AND MEASUREMENT METHODOLOGY

The instrument used for the monitoring of stack PM, after making the modifications recommended by its manufacturers, was used for the PM ambient monitoring. For details of the instrument refer to the SECTION—B-- STACK EMISSIONS MONITORING OF PARTICULATE MATTER (PM).

3.0 RESULTS AND DISCUSSION

The monitored data after its processing regarding the ambient particulate matter is presented in the ANNEXURE-I. From the monitored and processed data, it is evident that the value of PM in mg/Nm^3near the Gate stands at 2.41, at Control room stands at 0.29; Near the car parking area PM value stands at 1.73; Near cooling tower area it remain at 1.09, the value stands at 1.13 at generator and sub-station area, at intake area it stands at 3.15; inside the office building it remain at 0.21; On main road near the plant it stand at 2.09; near desalinization area it stand at 0.99; near fine filtration 0.94; near emergency engine it stand at 0.87 and open area in front of CCR the concentration of PM stands at 2.39 mg/Nm^3.

National Environment Quality Standards (NEQS)-Pakistan do not specify any limiting value for the particulate matter in ambient air.

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ANNEXURE-I

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(Laboratory certified as "Environmental Laboratory" by the Environmental Protection Agency, Government of the Punjab vide its Memo No: 551/DD(Labs.)/ EPA, dated May 09, 2008, certificate No: 551/DD(Labs.)/EPD/08)

Monitored Data for Ambient Particulate Matter

Reference point	Particulate Matter (mg/Nm^3)
Near the main gate	2.41
Inside the Control Room	0.29
Car Parking Area	1.73
Cooling Tower Area	1.09
Generator & Sub-Station Area	1.13
Intake Area	3.15
Inside the Office building	0.21
On the main road near the plant	2.09
Near Desalinization Plant	0.99
Near Fine Filtration	0.94
Near Emergency Engine	0.87
Open Area in front of CCR	2.39

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SECTION – E
WASTE WATER CHARACTERIZATION

1.0 GENERAL

This section deals with the monitoring of drinking and waste water characterization. Drinking water sample collected from main source of drink water within the plant premises. A waste water sample was also collected from the final discharge point of the plant.

2.0 SAMPLING

A grab sample of drinking and waste water was collected to monitor its quality. Specially cleaned high-density polyethylene (sterilized) bottles were used for sampling purposes. These samples were sealed, preserved and then transferred to the laboratory for their analysis. APHA standard methods used for the sampling and preservation of water and wastewater, ANNEXURE-III.

3.0 METHODS OF ANALYSIS

The following methods were used for the analysis of water and wastewater.

AMERICAN PUBLIC HEALTH ASSOCIATION (APHA)
AMERICAN WATER WORKS ASSOCIATION AND
WATER ENVIRONMENT FEDERATION, 18TH EDITION, 1992
HACH WATER ANALYSIS SYSTEM
&
MERCK WATER ANALYSIS SYSTEM

4.0 RESULTS AND DISCUSSION

Water quality data as generated after laboratory testing of drinking water and waste water samples are presented in ANNEXURES- I and II and discussion on result of the samples are given on the same annexure. All the tested parameters of drinking water are in compliance with the WHO guideline values for drinking water ANNEXURE-IV.

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Wastewater Characterization Data

Sr. #	Parameter	Unit	Result	NEQS Limiting Value
1.	Ph	---	8.1	6-9
2.	Total Suspended Solids (TSS)	(mg/l)	21	200.0
3.	Total Dissolved Solids (TDS)	(mg/l)	710	3500.0
4.	Temperature (of Thermal Discharge into the Sea)	°C	24	=<3°C
5.	Chemical Oxygen Demand (COD)	(mg/l)	51.9	150.0
6.	Biochemical Oxygen Demand (BOD_5)	(mg/l)	37.0	80.0
7.	Chloride	(mg/l)	48	1000.0
8.	Sulphate	(mg/l)	80	600.0
9.	Iron	(mg/l)	1.1	8.0
10.	Copper	(mg/l)	0.05	1.0
11.	Chromium	(mg/l)	0.01	1.0
12.	Oil & Grease	(mg/l)	2.1	10.0

Results and Discussion:
All the tested parameters are in compliance with the NEQS values for waste water as and where applicable.

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ANNEXURE-II

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Laboratory Analysis Report of Water Sample*

Sr. No.	Parameter	Unit	Result	WHO Maximum allowable Guideline value
1	pH	---	7.1	6.5-9.5
3	Color	TCU	2	15
4	Total Dissolved Solids (TDS)	mg/l	90	1200
5	Total Suspended Solids (TSS)	mg/l	1	---
6	Taste & Odor	---	Ok	Objectionable/unobj-
7	Total Hardness as $CaCO_3$	mg/l	28	500
8	Total Coliform	Number/100ml	0	0/1000 ml
9	E-Coli	Number/100ml	0	0/100 ml
10	Total Count	Number/100ml	0	10 Number/100ml
11	Nitrate as NO_3^-	mg/l	2.1	50
12	Ammonia	mg/l	0.03	1.5
13	Arsenic	mg/l	N.D	0.01
14	Turbidity	NTU	1	5
15	Calcium Harness as $CaCO_3$	mg/l	18	---
16	Magnesium Hardness as $CaCO_3$	mg/l	10	---
17	Chlorides as Cl^-	mg/l	18	250
18	Fluoride as F^-	mg/l	0.05	1.5
19	Sulphate as SO_4^{2-}	mg/l	10	400
20	Iron as Fe^{3+}	mg/l	0.06	0.3
21	Sodium	mg/l	10	200
22	Iodine	mg/l	N.D.	---
23	Zinc as Zn^{2+}	mg/l	0.01	3.0

Sampling Source = Main Drinking Water Source

Results and Discussion:
All the tested parameters are in compliance with the WHO Guidelines values for drinking water.

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for the Examination of Water and Wastewater

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1060 COLLECTION AND PRESERVATION OF SAMPLES*

1060 A. Introduction

It is an old axiom that the result of any testing method can be no better than the sample on which it is performed. It is not practical to specify detailed procedures for the collection of all samples because of varied purposes and analytical procedures. More detailed information appears in specific methods. This section presents general considerations, applicable primarily to chemical analyses. See appropriate sections for samples to be used in toxicity testing and microbiological or biological examinations.

The objective of sampling is to collect a portion of material small enough in volume to be transported conveniently and handled in the laboratory while still accurately representing the material being sampled. This objective implies that the relative proportions or concentrations of all pertinent components will be the same in the samples as in the material being sampled, and that the sample will be handled in such a way that no significant changes in composition occur before the tests are made.

In many instances the objective of sampling is to demonstrate compliance with specific regulatory requirements. Samples are presented to the laboratory for specific determinations with the sample collector taking responsibility for the validity of the sample. Because of the increasing importance of the ability to verify the accuracy and representativeness of data, greater emphasis is placed on proper sample collection and preservation techniques. Often, in water and wastewater work, the laboratory conducts or prescribes the sampling program, which is determined in consultation with the user of the test results. Such consultation is essential to insure selecting samples and analytical methods that provide a true basis for answering the questions that prompted the sampling.

This section addresses the collection and preservation of water and wastewater samples, although the general principles also apply to the sampling of solid or semi-solid matrices.

1. General Precautions

Obtain a sample that meets the requirements of the sampling program and handle it so that it does not deteriorate or become contaminated before it reaches the laboratory. In water sampling, before filling sample bottle, rinse it two or three times with the water being collected, unless the bottle contains a preservative or dechlorinating agent. Depending on determinations to be performed, fill container full (most organic compound determinations) or leave space for aeration, mixing, etc. (microbiological analyses). If bottle already contains preservative, take care not to overfill the bottle, as preservative may be lost or diluted. Except when sampling for analysis of volatile organic compounds, leave an air space equivalent to approximately 1% of the container volume to allow for thermal expansion during shipment.

Special precautions are necessary for samples containing organic compounds and trace metals. Because many constituents may be present at concentrations of micrograms per liter, they may be totally or partially lost when proper sampling and preservation procedures are not followed.

Representative samples of some sources can be obtained only by making composites of samples collected over a period of time or at many different sampling points. The details of collection vary with local conditions, so specific recommendations would not be universally applicable. Sometimes it is more informative to analyze numerous separate samples instead of one composite so as not to obscure variability, maxima, and minima.

Because of the inherent instability of certain properties and compounds, composite sampling is not recommended where quantitative values are desired. These include acidity, alkalinity, BOD, carbon dioxide, chlorine residual, iodine, hexavalent chromium, nitrate, nitrite, volatile organic compounds, dissolved oxygen, ozone, and pH. In certain cases, such as for BOD, the collection of composite samples is routinely required by regulatory agencies to monitor discharge limits and to take into account the relative uncertainty of analyses.

Sample carefully to insure that analytical results represent the actual sample composition. Important factors affecting results are the presence of suspended matter or turbidity, the method chosen for its removal, and the physical and chemical changes brought about by storage or aeration. Detailed procedures are essential when processing (blending, sieving, filtering) samples to be analyzed for trace constituents, especially metals and organic compounds. Some determinations, such as analyses for lead, can be invalidated by contamination from such processing. Treat each sample individually with regard to the substances to be determined, the amount and nature of turbidity present, and other conditions that may influence the results.

The choice of technique for collecting a homogeneous sample must be defined in the sampling plan. In general, separate any significant amount of suspended matter by decantation, centrifugation, or an appropriate filtration procedure. For metals it often is appropriate to collect both a filtered and an unfiltered sample to differentiate between total and dissolved metals present in the matrix. Beforehand, determine the acid requirements to bring the pH to <2 on a separate sample. Add the same relative amount of acid to all samples. Be sure that the dilution caused by acidifying is negligible or reproducible enough for a dilution correction factor. Filter samples in the field, or at the point of collection before preservation with acid to pH <2.0. Often slight turbidity can be tolerated if experience shows that it will cause no interference in gravimetric or volumetric tests and that its influence can be corrected in colorimetric tests, where it has potentially the greatest interfering effect. Sample collector must state whether or not the sample has been filtered. To measure the total amount of a constituent, do not remove suspended solids but treat them appropriately.

Make a record of every sample collected and identify every bottle, preferably by attaching an appropriately inscribed tag or

* Approved by Standard Methods Committee, 1994.

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label. Record sufficient information to provide positive sample identification at a later date, including the name of the sample collector, the date, hour, exact location, the water temperature, and any other data that may be needed for correlation, such as weather conditions, water level, stream flow, post-sampling handling, etc. Provide space on the label for the initials of those assuming sample custody and for the time and date of transfer. Fix sampling points by detailed description in the sampling plan, by maps, or with the aid of stakes, buoys, or landmarks in a manner that will permit their identification by other persons without reliance on memory or personal guidance. Particularly when sample results are expected to be involved in litigation, use formal "chain-of-custody" procedures (see ¶ B.2 below), which trace sample history from collection to final reporting.

Cool hot samples collected under pressure while they are still under pressure.

Before collecting samples from distribution systems, flush lines with 3 to 5 pipe volumes to insure that the sample is representative of the supply, taking into account the diameter and length of pipe to be flushed and the flow velocity. As an alternative when dimensions are unavailable, flush with tap fully open for 2 to 3 min before sampling.

Collect samples from wells only after the well has been pumped sufficiently to insure that the sample represents the groundwater source. Sometimes it will be necessary to pump at a specified rate to achieve a characteristic drawdown, if this determines the zones from which the well is supplied. Record pumping rate and drawdown.

When samples are collected from a river or stream, observed results may vary with depth, stream flow, and distance from shore and from one shore to the other. If equipment is available, take an integrated sample from top to bottom in the middle of the main channel of the stream or from side to side at mid-depth, in such a way that the sample is integrated according to flow. If only a grab or catch sample can be collected, take it in the middle of the main channel of the stream and at mid-depth. Integrated samples are described further in ¶ B.1*c* below.

Lakes and reservoirs are subject to considerable variations from normal causes such as seasonal stratification, rainfall, runoff, and wind. Choose location, depth, and frequency of sampling depending on local conditions and the purpose of the investigation.

For certain constituents, sampling location is extremely important. Avoid areas of excessive turbulence because of potential loss of volatile constituents and of potential presence of toxic vapors. Avoid sampling at weirs because such locations tend to favor retrieval of lighter-than-water, immiscible compounds. Generally, collect samples beneath the surface in quiescent areas and open sampling container below surface to avoid collecting surface scum. If composite samples are required, ensure that sample constituents are not lost during compositing because of improper handling of portions being composited. For example, casual dumping together of portions rather than addition to the composite through a submerged siphon can cause unnecessary volatilization. When necessary, refrigerate the composited portions to minimize volatilization.[1]

Use only representative samples (or those conforming to a sampling program) for examination.

2. Safety Considerations

Because sample constituents can be toxic, take adequate precautions during sampling and sample handling. Toxic substances can enter through the skin and, in the case of vapors, through the lungs. Ingestion can occur via direct contact of toxic materials with foods or by adsorption of vapors onto foods. Precautions may be limited to wearing gloves or may include coveralls, aprons, or other protective apparel. Always wear eye protection. When toxic vapors might be present, sample only in well-ventilated areas or use a respirator or self-contained breathing apparatus. In a laboratory, open sample containers in a fume hood. Never have food near samples or sampling locations; always wash hands thoroughly before handling food.[1]

If flammable organic compounds are present, prohibit smoking near samples, sampling locations, and in the laboratory. Keep sparks, flames, and excessive heat sources away from samples and sampling locations. If flammable compounds are suspected or known to be present and samples are to be refrigerated, use only specially designed *explosion-proof* refrigerators.[1]

When in doubt as to the level of safety precautions needed, consult a knowledgeable industrial hygienist. Samples with radioactive contaminants require other safety considerations; consult a health physicist.

Label adequately any sample known or suspected to be hazardous because of flammability, corrosivity, toxicity, or radioactivity, so that appropriate precautions can be taken during sample handling, storage, and disposal.

3. Reference

1. WATER POLLUTION CONTROL FEDERATION. 1986. Removal of Hazardous Wastes in Wastewater Facilities—Halogenated Organics. Manual of Practice FD-11, Water Pollution Control Fed., Alexandria, Va.

1060 B. Collection of Samples

1. Types of Samples

a. Grab or catch samples: A sample collected at a particular time and place can represent only the composition of the source at that time and place. However, when a source is known to be relatively constant in composition over an extended time or over substantial distances in all directions, then the sample may be said to represent a longer time period or a larger volume, or both, than the specific time and place at which it was collected. In such circumstances, a source may be represented adequately by single grab samples. Examples are some water supplies, some surface waters, but rarely, wastewater streams.

When a source is known to vary with time, grab samples collected at suitable intervals and analyzed separately can document

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ne extent, frequency, and duration of these variations. Choose ampling intervals on the basis of the expected frequency of hanges which may vary from as little as 5 min to as long as 1 h r more. Seasonal variations in natural systems may necessitate ampling over months. When the source composition varies n space rather than time, collect samples from appropriate ocations.

The same principles apply to sampling wastewater sludges, udge banks, and muds, although these matrices are not specifically addressed in this section. Take every possible precaution o obtain a representative sample or one conforming to a sampling program.

b. Composite samples: In most cases, the term "composite ample" refers to a combination of grab samples collected at the ame sampling point at different times. Sometimes the term "time-omposite" is used to distinguish this type of sample from others. Time-composite samples are most useful for observing average oncentrations used in calculating such variables as the loading or the efficiency of a wastewater treatment plant. As an alternative to the separate analysis of a large number of samples, followed by computation of average and total results, the use of composite samples represents substantial saving in laboratory effort and expense. For these purposes, a composite sample representing a 24-h period is considered standard for most determinations. Under other circumstances, however, a composite sample representing one shift, or a shorter time period, or a complete cycle of a periodic operation, may be preferable. To evaluate the effects of variable or irregular discharges and operations, collect composite samples representing the period during which such discharges occur.

For determining components or characteristics subject to significant and unavoidable changes on storage, do not use composite samples. Make such determinations on individual samples as soon as possible after collection and preferably at the sampling point. Analyses for all dissolved gases, residual chlorine, soluble sulfide, temperature, and pH are examples of this type of determination. Changes in components such as dissolved oxygen or carbon dioxide, pH, or temperature may produce secondary changes in certain inorganic constituents such as iron, manganese, alkalinity, or hardness. Use time-composite samples only for determining components that can be demonstrated to remain unchanged under the conditions of sample collection, preservation, and storage.

Collect individual portions in a wide-mouth bottle every hour (in some cases every half hour or even every 5 min) and mix at the end of the sampling period or combine in a single bottle as collected. If preservatives are used, add them to the sample bottle initially so that all portions of the composite are preserved as soon as collected. Analysis of individual samples sometimes may be necessary.

It is desirable, and often essential, to combine individual samples in volumes proportional to flow. A final sample volume of 2 to 3 L usually is sufficient for the analysis of sewage, effluents, and wastes.

Automatic sampling devices are available; however, do not use them unless the sample is preserved as described below. Clean sampling devices, including bottles, daily to eliminate biological growths and other deposits.

c. Integrated samples: For certain purposes, the information needed is provided best by analyzing mixtures of grab samples collected from different points simultaneously, or as nearly so as possible. An example of the need for integrated sampling occurs in a river or stream that varies in composition across its width and depth. To evaluate average composition or total loading, use a mixture of samples representing various points in the cross-section, in proportion to their relative flows. The need for integrated samples also may exist if combined treatment is proposed for several separate wastewater streams, the interaction of which may have a significant effect on treatability or even on composition. Mathematical prediction of the interactions may be inaccurate or impossible and testing a suitable integrated sample may provide more useful information.

Both natural and artificial lakes show variations of composition with both depth and horizontal location. However, there are conditions under which neither total nor average results are especially useful, but local variations are more important. In such cases, examine samples separately rather than integrate them.

Preparation of integrated samples usually requires equipment designed to collect a sample from a known depth without contaminating it with overlying water. Knowledge of the volume, movement, and composition of the various parts of the water being sampled usually is required. Collecting integrated samples is a complicated and specialized process that must be described adequately in a sampling plan.

2. Chain-of-Custody Procedures

It is essential to insure sample integrity from collection to data reporting. This includes the ability to trace possession and handling of the sample from the time of collection through analysis and final disposition. This process is referred to as chain of custody and is important in demonstrating sample control when litigation is involved. Where litigation is not involved, chain-of-custody procedures are useful for routine control of samples.

A sample is considered to be under a person's custody if it is in the individual's physical possession, in the individual's sight, secured in a tamper-proof way by that individual, or secured in an area restricted to authorized personnel. The following procedures summarize the major aspects of chain of custody. More detailed discussions are available.[1,2]

a. Sample labels: Use labels to prevent sample misidentification. Gummed paper labels or tags generally are adequate. Include at least the following information: sample number, name of collector, date and time of collection, place of collection, and sample preservative.

Affix tags or self-adhesive labels to sample containers before, or at the time of, sample collection. Use waterproof ink to provide the label information.

b. Sample seals: Use sample seals to detect unauthorized tampering with samples up to the time of analysis. Use self-adhesive paper seals that include at least the following information: sample number (identical with number on sample label), collector's name, and date and time of sampling. Plastic shrink seals also may be used.

Attach seal in such a way that it is necessary to break it to open the sample container. Affix seal to container before sample leaves custody of sampling personnel.

c. Field log book: Record all information pertinent to a field survey or sampling in a bound log book. As a minimum, include the following in the log book: purpose of sampling; location of sampling point; name and address of field contact; producer of

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material being sampled and address, if different from location; type of sample and method of preservation if applicable. If sample is wastewater, identify process producing waste stream. Also provide suspected sample composition, including concentrations; number and volume of sample taken; description of sampling point and sampling method; date and time of collection; collector's sample identification number(s); sample distribution and how transported; references such as maps or photographs of the sampling site; field observations and measurements; and signatures of personnel responsible for observations. Because sampling situations vary widely, it is essential to record sufficient information so that one could reconstruct the sampling event without reliance on the collector's memory. Protect the log book and keep it in a safe place.

d. Chain-of-custody record: Fill out a chain-of-custody record to accompany each sample or group of samples. The record includes the following information: sample number; signature of collector; date, time, and address of collection; sample type; signatures of persons involved in the chain of possession; and inclusive dates of possession.

e. Sample analysis request sheet: The sample analysis request sheet accompanies sample to the laboratory. The collector completes the field portion of such a form that includes most of the pertinent information noted in the log book. The laboratory portion of such a form is to be completed by laboratory personnel and includes: name of person receiving the sample, laboratory sample number, date of sample receipt, and determinations to be performed.

f. Sample delivery to the laboratory: Deliver sample(s) to laboratory as soon as practicable after collection, typically within 2 d. Where shorter sample holding times are required, make special arrangements to insure timely delivery to the laboratory. Where samples are shipped by a commercial carrier, include the waybill number in the sample custody documentation. Insure that samples are accompanied by a completed chain-of-custody record and a sample analysis request sheet. Deliver sample to sample custodian.

g. Receipt and logging of sample: In the laboratory, the sample custodian inspects the condition and seal of the sample, reconciles label information and seal against the chain-of-custody record, assigns a laboratory number, logs sample in the laboratory log book, and stores it in a secured storage room or cabinet until it is assigned to an analyst.

h. Assignment of sample for analysis: The laboratory supervisor usually assigns the sample for analysis. Once sample is in the laboratory, the supervisor or analyst is responsible for its care and custody.

3. Sampling Methods

a. Manual sampling: Manual sampling involves minimal equipment but may be unduly costly and time-consuming for routine or large-scale sampling programs.

b. Automatic sampling: Automatic samplers can eliminate human errors in manual sampling, can reduce labor costs, may provide the means for more frequent sampling,[3] and are used increasingly. Be sure that the automatic sampler does not contaminate the sample. For example, plastic components may be incompatible with certain organic compounds that are soluble in the plastic parts. If sample constituents are generally known, contact the manufacturer of an automatic sampler regarding potential incompatibility of plastic components. Manual sampling with a glass container and in accordance with appropriate safety procedures may be best.[3] Manually collect certain samples, such as waters containing oil and grease.

Program an automatic sampler in accordance with sampling needs. Carefully match pump speeds and tubing sizes to the type of sample to be taken.

4. Sample Containers

The type of sample container used is of utmost importance. Containers typically are made of plastic or glass, but one material may be preferred over the other. For example, silica and sodium may be leached from glass but not plastic, and trace levels of metals may sorb onto the walls of glass containers. For samples containing organic compounds, avoid plastic containers except those made of fluorinated polymers such as polytetrafluoroethylene (TFE).[3]

Some volatile organic compounds in samples may dissolve into the walls of plastic containers or may even leach substances from the plastic. Container failure due to breakdown of the plastic is possible. Some organic compounds are compatible with certain plastics (see manufacturer's literature). However, even if compatibility is assured, recognize that the walls of a plastic container can be porous to volatile organic substances. Use glass containers for all organics analyses such as volatile organics, semi-volatile organics, pesticides, PCBs, and oil and grease. Avoid plastics wherever possible because of potential contamination from phthalate esters contained in the plastic. Container caps, typically plastic, also can be a problem. Use foil or TFE liners. Serum vials with TFE-lined rubber or plastic septa are useful.

In certain situations it may be necessary to sample a waste in containers that were not specifically prepared for use, or were unsuitable for the particular situation. Thoroughly document deviations from recommended protocols to validate the representativeness of the results obtained. Documentation should include type and source of container, preparation technique, i.e., acid washed with reagent water rinse. For critical situations, the inclusion of a bottle blank may be adequate to demonstrate freedom from interference.

5. Number of Samples

Given the random variations in both an analytical procedure and the occurrence of a constituent at a point of sampling, a single sample may be insufficient for a desired level of uncertainty. If an overall standard deviation is known, the required number of samples may be established by the following relationship:[4]

$$N \geq \left(\frac{ts}{U}\right)^2$$

where:

N = number of samples,

t = Student-t statistic for a given confidence level,

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TABLE 1060:1. SUMMARY OF SPECIAL SAMPLING OR HANDLING REQUIREMENTS*

Determination	Container†	Minimum Sample Size mL	Sample Type‡	Preservation§	Maximum Storage Recommended/ Regulatory‖
Acidity	P, G(B)	100	g	Refrigerate	24 h/14 d
Alkalinity	P, G	200	g	Refrigerate	24 h/14 d
BOD	P, G	1000	g	Refrigerate	6 h/48 h
Boron	P	100	g, c	None required	28 d/6 months
Bromide	P, G	100	g, c	None required	28 d/28 d
Carbon, organic, total	G	100	g, c	Analyze immediately; or refrigerate and acid H_3PO_4 or H_2SO_4 to pH<2	7 d/28 d
Carbon dioxide	P, G	100	g	Analyze immediately	stat/N.S.
COD	P, G	100	g, c	Analyze as soon as possible, or add H_2SO_4 to pH<2; refrigerate	7 d/28 d
Chloride	P, G	50	g, c	None required	28 d
Chlorine, residual	P, G	500	g	Analyze immediately	0.5 h/stat
Chlorine dioxide	P, G	500	g	Analyze immediately	0.5 h/N.S.
Chlorophyll	P, G	500	g, c	30 d in dark	30 d/N.S.
Color	P, G	500	g, c	Refrigerate	48 h/48 h
Conductivity	P, G	500	g, c	Refrigerate	28 d/28 d
Cyanide:					
Total	P, G	500	g, c	Add NaOH to pH>12, refrigerate in dark#	24 h/14 d; 24 h if sulfide present
Amenable to chlorination	P, G	500	g, c	Add 100 mg $Na_2S_2O_3$/L	stat/14 d; 24 h if sulfide present
Fluoride	P	300	g, c	None required	28 d/28 d
Hardness	P, G	100	g, c	Add HNO_3 to pH<2	6 months/6 months
Iodine	P, G	500	g, c	Analyze immediately	0.5 h/N.S.
Metals, general	P(A), G(A)	500	g	For dissolved metals filter immediately, add HNO_3 to pH<2	6 months/6 months
Chromium VI	P(A), G(A)	300	g	Refrigerate	24 h/24 h
Copper by colorimetry*					
Mercury	P(A), G(A)	500	g, c	Add HNO_3 to pH<2, 4°C, refrigerate	28 d/28 d
Nitrogen:					
Ammonia	P, G	500	g, c	Analyze as soon as possible or add H_2SO_4 to pH<2, refrigerate	7 d/28 d
Nitrate	P, G	100	g, c	Analyze as soon as possible or refrigerate	48 h/48 h (28 d for chlorinated samples)
Nitrate + nitrite	P, G	200	g, c	Add H_2SO_4 to pH<2, refrigerate	none/28 d
Nitrite	P, G	100	g, c	Analyze as soon as possible or refrigerate	none/48 h
Organic, Kjeldahl*	P, G	500	g, c	Refrigerate; add H_2SO_4 to pH<2	7 d/28 d
Odor	G	500	g	Analyze as soon as possible; refrigerate	6 h/N.S.
Oil and grease	G, wide-mouth calibrated	1000	g, c	Add HCl to pH<2, refrigerate	28 d/28 d
Organic compounds:					
MBAS	P, G	250	g, c	Refrigerate	48 h
Pesticides*	G(S), TFE-lined cap	1000	g, c	Refrigerate; add 1000 mg ascorbic acid/L if residual chlorine present	7 d/7 d until extraction; 40 d after extraction
Phenols	P, G	500	g, c	Refrigerate, add H_2SO_4 to pH<2	*/28 d
Purgeables* by purge and trap	G, TFE-lined cap	2×40	g	Refrigerate; add HCl to pH <2; add 1000 mg ascorbic acid/L if residual chlorine present	7 d/14 d
Oxygen, dissolved:	G, BOD bottle	300	g		
Electrode				Analyze immediately	0.5 h/stat
Winkler				Titration may be delayed after acidification	8 h/8 h
Ozone	G	1000	g	Analyze immediately	0.5 h/N.S.
pH	P, G	50	g	Analyze immediately	2 h/stat
Phosphate	G(A)	100	g	For dissolved phosphate filter immediately; refrigerate	48 h/N.S.
Salinity	G, wax seal	240	g	Analyze immediately or use wax seal	6 months/N.S.
Silica	P	200	g, c	Refrigerate, do not freeze	28 d/28 d
Sludge digester gas	G, gas bottle	—	g	—	N.S.

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TABLE 1060:1. CONT.

Determination	Container†	Minimum Sample Size mL	Sample Type‡	Preservation§	Maximum Storage Recommended/ Regulatory‖
Solids	P, G	200	g, c	Refrigerate	7 d/2–7 d; see cited reference
Sulfate	P, G	100	g, c	Refrigerate	28 d/28 d
Sulfide	P, G	100	g, c	Refrigerate; add 4 drops 2*N* zinc acetate/100 mL; add NaOH to pH>9	28 d/7 d
Taste	G	500	g	Analyze as soon as possible; refrigerate	24 h/N.S.
Temperature	P, G	—	g	Analyze immediately	stat/stat
Turbidity	P, G	100	g, c	Analyze same day; store in dark up to 24 h, refrigerate	24 h/48 h

* See text for additional details. For determinations not listed, use glass or plastic containers; preferably refrigerate during storage and analyze as soon as possible.
† P = plastic (polyethylene or equivalent); G = glass; G(A) or P(A) = rinsed with 1 + 1 HNO_3; G(B) = glass, borosilicate; G(S) = glass, rinsed with organic solvents or baked.
‡ g = grab; c = composite.
§ Refrigerate = storage at 4°C, in the dark.
‖ Environmental Protection Agency, Rules and Regulations. 40 CFR Parts 100–149, July 1, 1992. See this citation for possible differences regarding container and preservation requirements. N.S. = not stated in cited reference; stat = no storage allowed; analyze immediately.
If sample is chlorinated, see text for pretreatment.

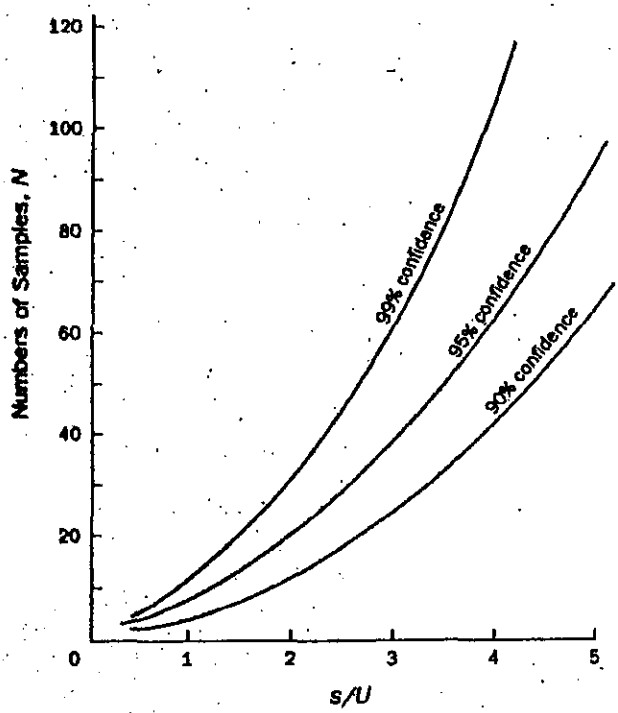

Figure 1060:1. Approximate number of samples required in estimating a mean concentration. Source: Methods for the Examination of Waters and Associated Materials: General Principles of Sampling and Accuracy of Results. 1980. Her Majesty's Stationery Off., London, England.

s = overall standard deviation, and
U = acceptable level of uncertainty.

To assist in calculations, use curves such as those in Figure 1060:1. As an example, if s is 0.5 mg/L, U is ± 0.2 mg/L, and a 95% confidence level is desired, approximately 25 to 30 samples must be taken.

6. Quantity

Collect a 2-L sample for most physical and chemical analyses. For certain determinations, larger samples may be necessary. Table 1060:1 shows the volumes ordinarily required for analyses.

Do not use sample from the same container for chemical (organic and inorganic), bacteriological, and microscopic examinations because methods of collecting and handling are different. Always collect enough sample volume in the appropriate container to allow measurements to be made to comply with sample handling, storage, and preservation requirements.

7. References

1. U.S. ENVIRONMENTAL PROTECTION AGENCY. 1986. Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, 3rd ed. Publ. No. SW-846, Off. Solid Waste and Emergency Response, Washington, D.C.
2. U.S. ENVIRONMENTAL PROTECTION AGENCY. 1982. NEIC Policies and Procedures. EPA-330/9/78/001/-R (rev. 1982).
3. WATER POLLUTION CONTROL FEDERATION. 1986. Removal of Hazardous Wastes in Wastewater Facilities—Halogenated Organics. Manual of Practice FD-11, Water Pollution Control Fed., Alexandria, Va.
4. Methods for the Examination of Waters and Associated Materials: General Principles of Sampling and Accuracy of Results. 1980. Her Majesty's Stationery Off., London, England.

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1060 C. Sample Preservation

Complete and unequivocal preservation of samples, whether domestic wastewater, industrial wastes, or natural waters, is a practical impossibility. Regardless of the sample nature, complete stability for every constituent never can be achieved. At best, preservation techniques only retard chemical and biological changes that inevitably continue after sample collection.

1. Sample Storage before Analysis

a. Nature of sample changes: Some determinations are more likely than others to be affected by sample storage before analysis. Certain cations are subject to loss by adsorption on, or ion exchange with, the walls of glass containers. These include aluminum, cadmium, chromium, copper, iron, lead, manganese, silver, and zinc, which are best collected in a separate clean bottle and acidified with nitric acid to a pH below 2.0 to minimize precipitation and adsorption on container walls.

Temperature changes quickly; pH may change significantly in a matter of minutes; dissolved gases (oxygen, carbon dioxide) may be lost. Because changes in such basic water quality properties may occur so quickly, determine temperature, pH, and dissolved gases in the field immediately after taking sample.

Changes in the pH-alkalinity-carbon dioxide balance may cause calcium carbonate to precipitate, decreasing the values for calcium and total hardness.

Iron and manganese are readily soluble in their lower oxidation states but relatively insoluble in their higher oxidation states; therefore, these cations may precipitate or they may dissolve from a sediment, depending on the redox potential of the sample. Microbiological activity may be responsible for changes in the nitrate-nitrite-ammonia content, for decreases in phenol concentration and in BOD, or for reducing sulfate to sulfide. Residual chlorine is reduced to chloride. Sulfide, sulfite, ferrous iron, iodide, and cyanide may be lost through oxidation. Color, odor, and turbidity may increase, decrease, or change in quality. Sodium, silica, and boron may be leached from the glass container. Hexavalent chromium may be reduced to chromic ion.

Biological changes taking place in a sample may change the oxidation state of some constituents. Soluble constituents may be converted to organically bound materials in cell structures, or cell lysis may result in release of cellular material into solution. The well-known nitrogen and phosphorus cycles are examples of biological influences on sample composition.

Zero head-space is important in preservation of samples with volatile organic compounds. Avoid loss of volatile materials by collecting sample in a completely filled container. Achieve this by carefully filling so that top of meniscus is above the top of the bottle rim. Take care not to dilute preservatives by overfilling. Serum vials with septum caps are particularly useful in that a sample portion for analysis can be taken through the cap by using a syringe,[1] although the effect of pressure reduction in the head-space must be considered.

b. Time interval between collection and analysis: In general, the shorter the time that elapses between collection of a sample and its analysis, the more reliable will be the analytical results. For certain constituents and physical values, immediate analysis in the field is required. For composited samples it is common practice to use the time at the end of composite collection as the sample collection time.

It is impossible to state exactly how much elapsed time may be allowed between sample collection and analysis; this depends on the character of the sample, the analyses to be made, and the conditions of storage. Changes caused by growth of microorganisms are greatly retarded by keeping the sample in the dark and at a low temperature (<4°C but above freezing). When the interval between sample collection and analysis is long enough to produce changes in either the concentration or the physical state of the constituent to be measured, follow the preservation practices given in Table 1060:1. Record time elapsed between sampling and analysis, and which preservative, if any, was added.

2. Preservation Techniques

To minimize the potential for volatilization or biodegradation between sampling and analysis, keep samples as cool as possible without freezing. Preferably pack samples in crushed or cubed ice or commercial ice substitutes before shipment. Avoid using dry ice because it will freeze samples and may cause glass containers to break. Dry ice also may effect a pH change in samples. Keep composite samples cool with ice or a refrigeration system set at 4°C during compositing. Analyze samples as quickly as possible on arrival at the laboratory. If immediate analysis is not possible, storage at 4°C is recommended for most samples.[1]

Use chemical preservatives only when they are shown not to interfere with the analysis being made. When they are used, add them to the sample bottle initially so that all sample portions are preserved as soon as collected. No single method of preservation is entirely satisfactory; choose the preservative with due regard to the determinations to be made. Because a preservation method for one determination may interfere with another one, samples for multiple determinations may need to be split and preserved separately. All methods of preservation may be inadequate when applied to suspended matter. Because formaldehyde affects so many chemical analyses, do not use it as a preservative.

Methods of preservation are relatively limited and are intended generally to retard biological action, retard hydrolysis of chemical compounds and complexes, and reduce volatility of constituents.

Preservation methods are limited to pH control, chemical addition, the use of amber and opaque bottles, refrigeration, filtration, and freezing. Table 1060:1 lists preservation methods by constituent.

The foregoing discussion is by no means exhaustive and comprehensive. Clearly it is impossible to prescribe absolute rules for preventing all possible changes. Additional advice will be found in the discussions under individual determinations, but to a large degree the dependability of an analytical determination rests on the experience and good judgment of the person collecting the sample.

3. Reference

1. WATER POLLUTION CONTROL FEDERATION. 1986. Removal of Hazardous Wastes in Wastewater Facilities—Halogenated Organics. Manual of Practice FD-11, Water Pollution Control Fed., Alexandria, Va.

4. Bibliography

KEITH, L.H., ed. 1988. Principles of Environmental Sampling. ACS Professional Reference Book, American Chemical Soc.

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Guidelines for Drinking-water Quality

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Volume 1
Recommendations

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2004

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Table A4.3 Continued

Chemical	Guideline value (mg/litre)	Remarks
Dichlorobenzene, 1,4-	0.3 (C)	
Dichloroethane, 1,2-	0.03[b]	
Dichloroethene, 1,1-	0.03	
Dichloroethene, 1,2-	0.05	
Dichloromethane	0.02	
1,2-Dichloropropane (1,2-DCP)	0.04 (P)	
1,3-Dichloropropene	0.02[b]	
Dichlorprop	0.1	
Dimethoate	0.006	
Edetic acid (EDTA)	0.6	Applies to the free acid
Endrin	0.0006	
Epichlorohydrin	0.0004 (P)	
Ethylbenzene	0.3 (C)	
Fenoprop	0.009	
Fluoride	1.5	Volume of water consumed and intake from other sources should be considered when setting national standards
Formaldehyde	0.9	
Hexachlorobutadiene	0.0006	
Isoproturon	0.009	
Lead	0.01	
Lindane	0.002	
Manganese	0.4 (C)	
MCPA	0.002	
Mecoprop	0.01	
Mercury	0.001	For total mercury (inorganic plus organic)
Methoxychlor	0.02	
Metolachlor	0.01	
Microcystin-LR	0.001 (P)	For total microcystin-LR (free plus cell-bound)
Molinate	0.006	
Molybdenum	0.07	
Monochloramine	3	
Monochloroacetate	0.02	
Nickel	0.02 (P)	
Nitrate (as NO_3^-)	50	Short-term exposure
Nitrilotriacetic acid (NTA)	0.2	
Nitrite (as NO_2^-)	3	Short-term exposure
	0.2 (P)	Long-term exposure
Pendimethalin	0.02	
Pentachlorophenol	0.009[b] (P)	
Pyriproxyfen	0.3	
Selenium	0.01	
Simazine	0.002	
Styrene	0.02 (C)	
2,4,5-T	0.009	
Terbuthylazine	0.007	
Tetrachloroethene	0.04	
Toluene	0.7 (C)	

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Table A4.3 Guideline values for chemicals that are of health significance in drinking-water

Chemical	Guideline value[a] (mg/litre)	Remarks
Acrylamide	0.0005[c]	
Alachlor	0.02[b]	
Aldicarb	0.01	Applies to aldicarb sulfoxide and aldicarb sulfone
Aldrin and dieldrin	0.00003	For combined aldrin plus dieldrin
Antimony	0.02	
Arsenic	0.01 (P)	
Atrazine	0.002	
Barium	0.7	
Benzene	0.01[c]	
Benzo[a]pyrene	0.0007[c]	
Boron	0.5 (T)	
Bromate	0.01[b] (A, T)	
Bromodichloromethane	0.06[c]	
Bromoform	0.1	
Cadmium	0.003	
Carbofuran	0.007	
Carbon tetrachloride	0.004	
Chloral hydrate (trichloroacetaldehyde)	0.01 (P)	
Chlorate	0.7 (D)	
Chlordane	0.0002	
Chlorine	5 (C)	For effective disinfection, there should be a residual concentration of free chlorine of ≥0.5 mg/litre after at least 30 min contact time at pH <8.0
Chlorite	0.7 (D)	
Chloroform	0.2	
Chlorotoluron	0.03	
Chlorpyrifos	0.03	
Chromium	0.05 (P)	For total chromium
Copper	2	Staining of laundry and sanitary ware may occur below guideline value
Cyanazine	0.0006	
Cyanide	0.07	
Cyanogen chloride	0.07	For cyanide as total cyanogenic compounds
2,4-D (2,4-dichlorophenoxyacetic acid)	0.03	Applies to free acid
2,4-DB	0.09	
DDT and metabolites	0.001	
Di(2-ethylhexyl)phthalate	0.008	
Dibromoacetonitrile	0.07	
Dibromochloromethane	0.1	
1,2-Dibromo-3-chloropropane	0.001[b]	
1,2-Dibromoethane	0.0004[b] (P)	
Dichloroacetate	0.05 (T, D)	
Dichloroacetonitrile	0.02 (P)	
Dichlorobenzene, 1,2-	1 (C)	

continued

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SECTION – F
NOISE LEVELS MONITORING

1.0 GENERAL

This section deals with the noise level measurement carried within workplace and at four boundary walls of the plant. Meteorological conditions prevailing during the monitoring period are described as background information. It also gives due details of the noise level meter used for the measurements of noise levels together with an account of noise level measurement methodology. The methodology of calculation is also described.

2.0 NOISE LEVEL MEASUREMENTS

2.1 Prevailing Conditions

During the measurements following conditions prevailed on the site.

2.1.1 Meteorological Conditions

During the noise levels measurements the sky was clear and wind was blowing at normal speed.

2.1.2 Plant Operational Status

Plant was operating at full capacity.

2.2 Instrument

The description of the instrument used for noise levels monitoring is given below.

2.2.1 Name

Leader Test Instruments
Model OS-11
Sound level Meter.
Leader Electronics Corporation, TSUNASHIMA-HIGASHI, KOHOKU-KU, YOKOHAMA, JAPAN & Leader Instruments Corporations,
380 OSER AVENUE, HAUPPAGE, N.Y.11787 USA

2.2.2 General Description

The sound level meter OS-11 that conforms to TIS & IEC is capable of measuring sounds in factories, offices, schools etc. with a wide coverage and high accuracy.

2.2.3 Features

- Being small in size, lightweight, portable and convenient design it allows one hand operation.

- It has a cone shape microphone, which minimizes fluctuations of frequency characteristics caused by reflection.
- It has A, B and C weighted networks.
- Range: 25 dB to 130 dB for each A, B and C scales.
- Dial cover with an aperture allows correct level dial reading.
- High output terminals can be connected directly to various instruments and analyzers.
- High impedance input terminals; OS-11 can be used as audio frequency amplifier with high sensitivity and low noise as well.
- Induced magnetic field level measurement is available.
- Fast and slow indicator response.
- It operates for about 20 days with a set of batteries in case of 4 hrs. /day operation.

2.2.4 Calibration

Instrument has an in built calibration mechanism. Before each round, calibration was made & also checked during measurement period.

2.2.5 Battery Check

Battery check was done, with in built mechanism, twice during each monitoring round.

3.0 NOISE LEVEL MEASUREMENTS

3.1 Methodology

Noise level measurements were carried out in a way that monitoring round was completed in one go.

3.2 Selection of Noise Level Monitoring Points

Monitoring of noise levels was carried out at a total of sixteen points within the factory and at four points at four boundary walls of the plant. The monitored and processed data regarding noise levels monitoring at four boundary walls are presented in the ANNEXURE-I while data regarding noise levels monitoring within workplace are presented in the ANNEXURE-II.

Measurements of noise sources were made at specific locations inside the plant and on the boundary walls. The measurements were obtained at a distance of about 7.5 meters from the source. Additional measurements were obtained at intermediate locations between two or more sources and also at the open areas, the purpose being to measure sound levels to which workers are routinely exposed.

3.3 Distribution of measuring points

Distribution of the noise level measuring points is as below:

- **Within the plant site = 16 locations**

1. Near Gate # 2
2. Near Parking Area + GIS
3. Northern Boundary Open Area
4. Near Intake
5. Desalinization Plant
6. Fine Filtration
7. Near Fire Engine
8. Unit Transformer
9. Near Boiler
10. Main Gate (Muster Point)
11. Main Entrance (Near Water Inlet)
12. Condensation Unit Area
13. Near the Fire Engine
14. Unit Transformer
15. Near Emergency Engine /Diesel
16. Main Gate (Near Entrance)

- **At plant boundary walls**

Noise levels monitoring was carried out on four points at four boundary walls of the plant. These points are mentioned in Annexure-I

3.4 Noise Level Measurements

Measurement of the noise levels was made on the "A Weighted Scale" in slow response mode in terms of decibel scale dB (A). It must be remembered that a four fold decrease in energy (due to each doubling of distance from the reference point) results in a 6-dB (A) decrease in sound pressure level.

The noise level meter, during measurements, was held at a distance of about 5 feet above the ground level. In order to measure noise levels objectively, necessary precautions were taken to avoid interference from wind, external magnetic inductions, vibrations, high temperature and humidity. Since reflection of sound from the monitoring engineer is not negligible, hence during monitoring, engineer always stood with 30^0 angle to the direction of the sound source to which the engineer's arm was extending while holding the meter in his hand.

Five minutes measurements, at 0 each point were taken while recording reading after every half a minute. A set of 10 readings was recorded at each point during every 5 minute measurement. Thus four sets of reading were taken at each monitoring point at different times on the boundary lines.

The entire noise measurement data for inside the factory are presented in the Annexure-II. The collected data were processed to find out the average for the inside plant. The minimum and the maximum values found out as a result of the calculation at each of the four boundary lines are presented in the serial # 5.1.

3.5 Calculation Methods

3.5.1 Average and the Leq Values Calculation:

i) Average:

The following equation is used (Introduction to Environmental Engineering, II-Edition, by MACKENZIE L. DAVID A. CORP-NWELL) to find the ultimate average value inside the plant at various monitored points:

$$Lp = 20\text{Log } 1/N \sum 10^{Lj/20}$$

Where:

Lp = Average sound level pressure dB (A)
N = No. of measurements
Lj = jth sound pressure level in dB (A)
j = 1,2,3,....., N

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ii) log Equivalent (Leq):

Leq value is calculated by using the following formula (Introduction to Environmental Engineering, II-Edition, by MACKENZIE L. DAVID A. CORP-NWELL):

$$\mathbf{leq = 10 \log \sum 10^{Li/10} (ti)}$$

Where:
Leq = Equivalent continuous equal energy level
N = No. of samples (monitoring) taken
Li = The Noise level in dBA of the ith sample
ti = fraction of total sample time

e.g.
The data are collected for five minutes and ten readings have been taken with an interval of ½ minute as under:

dB (A)									
35	35	40	38	36	35	37	35	35	36

Total measurement time at each point = 5 minutes

Total measurements taken during 5 minutes at each point = 10

Time interval between two consecutive readings at a point during each measurement = 0.5 minutes
Time fraction (ti) for each measurement = 0.5/5 = 0.1
putting this value in the above formula Leq is calculated as under:

$$\begin{aligned} Leq = 10 \log \sum [&10^{35/10}(.1) + 10^{35/10}(.1) + 10^{40/10}(.1) \\ &+10^{38/10}(.1) + 10^{36/10}(.1) + 10^{35/10}(.1) \\ &+10^{37/10}(.1) + 10^{35/10}(.1) + 10^{35/10}(.1) \\ &+10^{36/10}(.1)] \\ =10\log\sum[&316.23+316.23+1000+630.96+398.11+316.23+ \\ &501.19+316.23+316.23+316.23] \end{aligned}$$

Leq 5m = 10 log 4509.498
Leq 5m = 10* 3.65
Leq 5m = 36.5

4.0 LIMITING CRITERIA FOR NOISE

The criteria considered for noise is based on NEQS Pakistan 85 dB (A).

5.0 RESULTS AND DISCUSSION

5.1 Noise levels at four boundary walls

From the Annexure-II it is evident that the noise levels at four boundaries of the plant fluctuate as:

Boundary Wall A:	65 to 67 dB(A)
Boundary Wall B:	63 to 65 dB(A)
Boundary Wall C:	79 to 81 dB(A)
Boundary Wall D:	62 to 63 dB(A)

Resultantly, noise levels at all the four boundary walls of the plant remain within prescribed limit of 85 dB(A) as set by National Environment Quality Standards (NEQS).

5.2 Noise Levels within the Plant Site

As described earlier noise levels were measured at 16 points within the workplace. From the monitored and processed data presented in Annexure-II it is evident that noise levels at four monitored locations within factory exceed the NEQS limiting value.

The value of noise levels in Fine filtration area stands at 88.4 dB (A), In the unit transformer it stands at 93.0 dB (A) and near boiler stands at is 109.0 dB (A). These values are in violation of the NEQS limiting value of 85.0dB (A). **The practical solution for this is to provide earplugs to the workers working in these areas.**

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ANNEXURE-I

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(Laboratory certified as "Environmental Laboratory" by the Environmental Protection Agency, Government of the Punjab vide its Memo No: 551/DD(Labs.)/ EPA, dated May 09, 2008, certificate No:551/DD(Labs.)/EPD/08)

Noise Levels Monitoring (Plant Boundary Walls)

Reference Point # 1: Boundary Wall A (Eastern Direction)

Date	dB(A)										Leq/ Average
27-08-08	66	65	66	66	67	65	66	66	66	66	66.0

Reference Point # 2: Boundary Wall B (Western Direction)

Date	dB(A)										Leq/ Average
27-08-08	64	63	64	63	64	64	64	65	65	64	64.0

Reference Point # 3: Boundary Wall C (Northern Direction)

Date	dB(A)										Leq/ Average
27-08-08	80	81	80	81	80	81	80	79	79	79	80.0

Reference Point # 4: Boundary Wall D (Southern Direction)

Date	dB(A)										Leq/ Average
27-08-08	62	62	63	62	62	62	62	63	63	62	62.3

Reference Point # 5: Main Gate (Near Entrance)

Date	dB(A)										Leq/ Average
27-08-08	67	68	65	68	68	67	67	67	68	67	67.2

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ANNEXURE-II

APEX ENVIRONMENT LABORATORY

Suite # 4, 2nd Floor, Link Arcade, Model Town Link Road, Lahore
Phone: 92-042-5887517; 0300-8486673; Fax: 042-5855508,5830087; E-mail: ectech_ectech@yahoo.com

(Laboratory certified as "Environmental Laboratory" by the Environmental Protection Agency, Government of the Punjab vide its Memo No: 551/DD(Labs.)/ EPA, dated May 09, 2008, certificate No:551/DD(Labs.)/EPD/08)

Noise Levels Monitoring (Within the Plant)

Reference Point # 1: Near Gate # 2

Date	dB(A)										Leq/ Average
27/08/08	71	71.5	71.5	72	72	73	72	73	73	72	72.1

Reference Point #2: Near Parking Area + GIS

Date	dB(A)										Leq/ Average
27/08/08	80	80.5	81	80	80.5	80.5	81	82	82	82	80.9

Reference Point # 3: Northern Boundary Open Area

Date	dB(A)										Leq/ Average
27/08/08	63	63.5	63.5	63	63.5	64	64	63	63	63	63.3

Reference Point # 4: Near Intake

Date	dB(A)										Leq/ Average
27/08/08	60	65	65	64	60	61	63	62	62	64	62.6

Reference Point # 5: Near Desalinization Plant

Date	dB(A)										Leq/ Average
27/08/08	85.5	86	86	85.5	86	86	85.5	85.5	86	86	62.6

Reference Point # 6: Fine Filteration

Date	dB(A)										Leq/ Average
27/08/08	88	88.5	88.5	88	89	89	88.5	88	88	88.5	88.4

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Reference Point #7: Near Fire Engine

Date	dB(A)										Leq/ Average
27/08/08	78	78	78.5	79	78.5	79	80	80	80	81	79.2

Reference Point # 8: Unit Transformer

Date	dB(A)										Leq/ Average
27/08/08	92	92	93	93	92	94	94	92	94	94	93.0

Reference Point # 9: Near Boiler

Date	dB(A)										Leq/ Average
27/08/08	108	108	109	108	109	110	110	110	109	109	109.0

Reference Point # 10: Main Gate (Muster Point)

Date	dB(A)										Leq/ Average
26/08/08	49	49	48	48	48	58	59*	59	58	59	

Reference Point # 11:Main Entrance (Near Water Inlet)

Date	dB(A)										Leq/ Average
26/08/08	54	55	60	60	61	53	53	54	53	54	53.8

Reference Point # 12: Condensation Unit Area

Date	dB(A)										Leq/ Average
26/08/08	58	58	58	52	52	58	52	58	58	57	56.1

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Reference Point # 13: Near the Fire Engine

Date	dB(A)										Leq/ Average
26/08/08	62	62	61	61	60	60	60	60	60	60	60.6

Reference Point # 14: Unit Transformer

Date	dB(A)										Leq/ Average
26/08/08	67	67	67	68	68	68	67	67	67	67	67.3

Reference Point # 15: Near Emergency Engine /Diesel

Date	dB(A)										Leq/ Average
26/08/08	74	74	75	74	74	75	75	75	75	74	74.5

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SECTION-G
THERMAL DISCHARGES (TDs)

APEX Environment Laboratory

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ECTECH Environment Consultants
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Link Arcade,
Link Model
Town Road,
Lahore

1.0 THERMAL DISCHARGES (TDs)

Hot water/Thermal Discharge (TD) from the power plant, after cooling the condensers, is discharged into the sea. Before its discharge into the sea, TD is thrown on a heap of stones which is quite above the sea water level. As a result of splashing this hot water, it gets tremendously and quickly cooled down with air before it finally reaches the sea water. Measurements of the temperature of this TD Heat Discharge Behaviour were made at various points in the sea water from its discharge point. It was found that the temperature of this TD gets equalized with that of the ambient sea water at a distance of about 35 meters form its discharge point into the sea.

SPECIAL ANNEXURE

Certificate Issued by the Environment Protection Agency
Government of the Punjab, Lahore
Regarding APEX Environment Laboratory
as Certified Environment Laboratory

ENVIRONMENTAL PROTECTION AGENCY
Government of the Punjab
2-Lake Road, Lahore.
Ph: 7122986 Fax: 7322962

CERTIFICATE REGARDING CERTIFICATION AS AN ENVIRONMENTAL LABORATORY

In exercise of power conferred by the clause (k) of sub section (1) of section 6 of Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Environmental Protection Agency, Punjab is pleased to certify the Laboratory mentioned below as an Environmental Laboratory.

Name: **APEX Environmental Laboratory**

Address: **Model Town Link Road, Link Arcade, 2nd Floor, Suite # 4, Lahore**

Certificate No. _____**/DD(Labs)/EPA/08**

1. This certification is conditional & valid for:

   a) Liquid effluent/wastes.
   b) Gaseous Emissions
   c) Noise

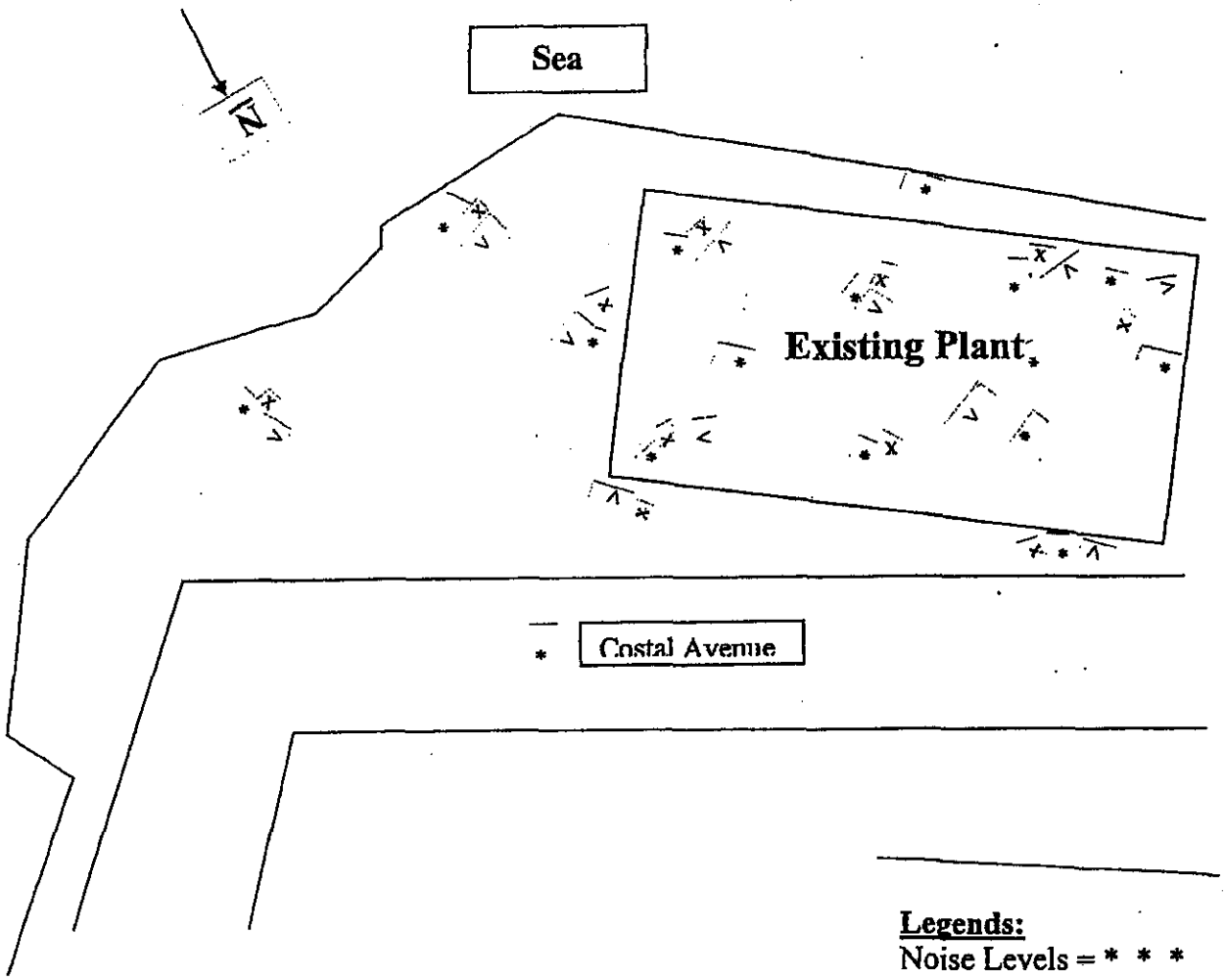
2. This certification is subject to the conditions laid down in regulation 9 of the National Environmental Quality Standard (Certification of Environmental Laboratories) regulations, 2000.

3. This certificate is valid up till 31st December, 2008 unless earlier suspended or revoked.

Dated _____/05/2008

DIRECTOR (ML&I)
For DIRECTOR GENERAL

Map Showing the Monitoring Points



Legends:
Noise Levels = * * *
Ambient Gas = x x x
Ambient PM = < < <