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Exposure Assessment, Illumination and Waste analysis after the fire accident in Power Station in Kuwait

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Abstract:

The primary purpose of this study is to evaluate the exposure subsequent to accident occurrence through an onsite monitoring with laboratory analysis, waste identification and illumination study after the fire accident in a power station in Kuwait. The scope of this work includes assessment of major air borne contaminants like metal fumes, Volatile Organic Compounds, Respirable particulate matter and total dust etc.,. The assessment will be made at the facility, 12 locations to be selected for air quality assessment and emission exposure covering critical areas (such as area near turbines) and adjacent office rooms. After the onsite assessment the samples will be collected from all target areas or with diffusion for a quick, direct reading. YESAIR Air Quality Monitoring equipment will be used for the direct detection monitoring. Respirable dust and VOC monitoring will be carried out as per protocol 0600 and 0500 prescribed in the NIOSH Manual of Analytical Methods using personal air samplers in conjunction with PVC filters (37 mm diameter, 5 μm pore size). Sampling for Volatile Organic Compounds to be conducted in accordance with OSHA (Occupational Safety and Health Administration, USA) protocol 0007 using air samplers in conjunction with Charcoal tubes (CT). Major indoor pollutants like Carbon Dioxide (CO2), Carbon Monoxide (CO), Hydrogen Sulphide (H2S), Nitric Oxide (NO), Nitrogen Dioxide (NO2), Oxygen (O2), Sulphur Dioxide (SO2), and TVOCs (PID) will be monitored during the limited time frame at 12 locations in the power station. The results will be compared with Kuwait Environment Public Authority standards and TLV-TWA set by American Conference of Governmental Industrial Hygienists (ACGIH).

Keywords: Exposure Assessment for Chemicals and Physical Hazard's

INTRODUCTION

This document presents the results of Indoor Air Quality Monitoring conducted at Sabiya Power Plant Facility. Techniques and procedures for the assessment of indoor air quality, evaluation, and control of occupational hazards related to both chemical and physical hazards etc. This report also provides recommendations to be followed based on Engineering and preventive work practices. Included are ways

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of predicting the risks, procedures for control of indoor Air contaminants, and techniques for prevention and treatment of health related illnesses. This document is advisory in nature and informational in content.

Scope

The scope of this work includes assessment of major air borne contaminants like metal fumes, Volatile Organic Compounds, Respirable particulate matter, Total dust etc in the Sabiya Power and Water Distillation station, Sabiya, Kuwait. The assessment was carried out in the locations of SGT 10, 20, and 30 in Sabiya power plant.The above said exposure assessment was conducted in the places, where high level of emissions levels are suspected which may be attributed to the recent fire hazard happened in the facility.The results of chemical exposure were assessed in compliance with the Permissible Limits of Exposure (PLEs) prescribed by The Factories Act, 1948, Threshold Limit Values (TLVs) recommended by the American Conference of Governmental Industrial Hygienists (ACGIH), USA.

Guidelines:

OSHA Regulations

The Occupational Safety and Health Act allows OSHA to issue workplace health and safety regulations. These regulations include limits on chemical exposure, employee access to information, requirements for the use of personal protective equipment, and requirements for safety procedures.Under the OSH Act, employers are responsible for providing a safe and healthful workplace. OSHA's mission is to assure safe and healthful workplaces by setting and enforcing standards, and by providing training, outreach, education and assistance. Employers must comply with all applicable OSHA standards. Employers must also comply with the General Duty Clause of the OSH Act, which requires employers to keep their workplace free of serious recognized hazards.

American Conference of Governmental Industrial Hygienists (ACGIH):

The American Conference of Governmental Industrial Hygienists (ACGIH) has adopted a threshold limit value (TLV) for gaseous pollutants and metal fume contaminants. The Comparison of values of chemicals measured at the work place with the standards specified by ACGIH (TLV-TWA) is applicable only when the workers are exposed to that air borne contaminants during cleaning and renovation of STG site. By default of time-adapted values, the use of TLV-TWA or similar concepts may be used.

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Methodology:

Identification of gaseous air pollutants and waste category due to fire accident was carried out through indoor air monitoring and hazardous analysis of waste. Samples were taken from all target areas or with diffusion for a quick, direct reading. Eight sensors are viewed live on the multi-line, backlit, LCD display as well as battery and data logging status using YESAIR Air Quality Monitoring equipment. Respirable dust monitoring were carried out as per protocol 0600 and 0500 prescribed in the NIOSH Manual of Analytical Methods respectively, using personal air samplers. Sampling for Volatile Organic Compounds (VOCs) were conducted in accordance with OSHA protocol 0007 using air samplers in conjunction with Charcoal tubes (CT). The flow rates were set at 0.1 l/min. Samplings for Metal fumes were conducted in accordance with NIOSH protocol 7300 using air samplers in conjunction with MCE filters. The flow rates were set at 2.5 l/min.

INDOOR AIR QUALITY MEASUREMENT

Samples were taken from all target areas or with diffusion for a quick, direct reading. Eight sensors are viewed live on the multi-line, backlit, LCD display as well as battery and data logging status using YESAIR Air Quality Monitoring equipment.YESAIR is equipped with top mounted temperature and relative humidity sensors to aid in verifying readings providing a comprehensive indication of air quality. Information readings are written to a plug-in flash card providing bullet-proof memory to protect your recorded information. The sample rate can be adjusted using the supplied software or through the instrument menu. The instrument may be hand-held, will easily stand on a flat surface, or fastened to a wall for permanent or semi-permanent use.

Respirable Dust and VOC Monitoring

Respirable dust and VOC monitoring were carried out as per protocol 0600 and 0500 prescribed in the NIOSH Manual of Analytical Methods respectively, using personal air samplers (Figure 2) in conjunction with PVC filters (37 mm diameter, 5 µm pore size). For respirable dust monitoring, the flow was set at 2.5 l/min and 2.0 l/min for total dust. The dust samples were taken during a representative part of the shift as long-term personal and area samples. The collected filters were evaluated gravimetrically in the laboratory of NAPESCO using an analytical balance and related data processing.

Sampling for Volatile Organic Compounds were conducted in accordance with OSHA (Occupational Safety and Health Administration, USA) protocol 0007 using air samplers (Figure 1) in conjunction with

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Charcoal tubes (CT). The flow rates were set at 0.1 l/min. Sampling for Metal fumes were conducted in accordance with NIOSH (National Institute for Occupational Safety and Health) protocol 7300 using air samplers in conjunction with MCE (Mixed Cellulose Ester) filters. The flow rates were set at 2.5 l/min. Refer figures below.

Findings were noted during monitoring:

- The influence of Carbon dioxide and metal fumes odor was observed during site visit.
- No Ventilation was found
- No light and hand light was used for walk through
- Solid waste with hydro carbon was found in building wall and floor
- During monitoring at STG 10 ground Floor near CEP area, an alarm was observed in the VOC monitor due to high range. Monitoring was repeated periodically at the same place for VOC after proper ventilation. It was observed that the VOC level was rectified and no alarm obtained after ventilation.
- Fire water mixed with oil and burned material
- We have found very low oxygen level in Basement Cable room (below 20).

RESULTS

Major indoor pollutants like Carbon Dioxide (CO2),Carbon Monoxide (CO), Hydrogen Sulphide (H2S), Nitric Oxide (NO), Nitrogen Dioxide (NO2), Oxygen (O2), Sulphur Dioxide (SO2), and TVOCs (PID) were monitored during the limited time frame at various locations. The results were compared with Kuwait Environment Public Authority standards and TLV-TWA set by American Conference of Governmental Industrial Hygienists (ACGIH).

The results are presented in the following tables and subsections.

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Table 1 : Results of STG 20 Measurement Floor

Location : **STG 20 Measurement Floor**

Type of measurement : Indoor

Respirable Dust and Volatile Organic Compound

S.No	Name of the Contaminants	Result (ppm)	ExposureLimits [TLV-TWA] (ppm)	Comments
1.	Respirable Dust	0.36	3	Below Limit
2.	TVOC	0.69	3 KEPA Standard	Below Limit

Gaseous Pollutant

S.No	Name of the Contaminants	Result (ppm)	ExposureLimits [TLV-TWA](ppm)	Comments
1.	Carbon Dioxide (CO_2)	1300	5000	Below Limit
2.	Carbon Monoxide (CO)	0.94	25	Below Limit
3.	Hydrogen Sulphide (H_2S)	0.35	10	Below Limit
4.	Nitric Oxide (NO)	1.87	25	Below Limit
5.	Nitrogen Dioxide (NO_2)	2.49	3	Below Limit
6.	Oxygen (O_2)%	21.01	--	--
7.	Sulphur Dioxide (SO_2)	0.53	2	Below Limit

Heavy Metals

#	Name of the Contaminants	Result (ppm)	ExposureLimits [TLV-TWA] (ppm)	Comments
1.	Arsenic As	0.0003	0.01	Below Limit
2.	Barium Ba	0.0021	0.5	Below Limit
3.	Cadmium Cd	0.0018	0.01	Below Limit
4.	Chromium Cr	0.0013	0.5	Below Limit
5.	Mercury Hg	0.0002	0.01	Below Limit
6.	Lead Pb	0.0031	0.05	Below Limit
7.	Selenium Se	0.0013	0.2	Below Limit
8.	Copper	0.015	0.2	Below Limit

Polycyclic aromatic hydrocarbons (PAHs),

S.No	Parameter	Result (mg/m3)	ExposureLimits [TLV-TWA] (ppm)	Comments
1.	Acenaphthene	<0.01	0.2	Below Limit
2.	Anthracene	<0.01	0.2 mg/m3 PEL	Below Limit
3.	Benz(a)anthracene	<0.01	0.2 mg/m3	Below Limit
4.	Benzo(b)fluoranthene	<0.01	0.2 mg/m	Below Limit
5.	Benzo(k)fluoranthene	<0.01	0.2 mg/m3	Below Limit
6.	Benzo(a)pyrene	<0.01	--	--
7.	Benzo(ghi)pe	<0.01	0.2 mg/m3	Below Limit
8.	Chrysene	<0.01	--	--
9.	Dibenz(a,h,)anthracene	<0.01	--	--
10.	Fluoranthene	<0.01	1 ppm	Below Limit
11.	Fluorene	<0.01	--	--
12.	Indeno(1,2,3-cd)pyrene	<0.01	10 ppm	Below Limit
13.	Naphthalene	<0.01	--	--
14.	Pyrene	<0.01	10 mg/m3	Below Limit
15.	Phenanthrene	<0.01	0.2	Below Limit

Table 2 : Results of STG 20 Operation Floor Floor

Location : STG 20 Operation Floor

Type of measurement : Indoor

Respirable Dust and Volatile Organic Compound

#	Name of the Contaminants	Result (ppm)	ExposureLimits [TLV-TWA] (ppm)	Comments
1.	Respirable Dust	1.26	3	Below Limit
2.	TVOC	0.89	3 (KEPA Standard)	Below Limit

Gaseous Pollutant

#	Name of the Contaminants	Result (ppm)	ExposureLimits [TLV-TWA] (ppm)	Comments
1.	Carbon Dioxide (CO_2)	1500	5000	Below Limit
2.	Carbon Monoxide	2.1	25	Below Limit
3.	Hydrogen Sulphide	0.6	10	Below Limit
4.	Nitric Oxide (NO)	0.3	25	Below Limit
5.	Nitrogen Dioxide	0.5	3	Below Limit

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6.	Oxygen (O_2)%	20.25	--	--
7.	Sulphur Dioxide (SO_2)	0.5	2	Below Limit

Heavy Metals

#	Name of the Contaminants	Result (ppm)	ExposureLimits [TLV-TWA] (ppm)	Comments
1.	Arsenic As	0.00012	0.01	Below Limit
2.	Barium Ba	0.0006	0.5	Below Limit
3.	Cadmium Cd	0.0026	0.01	Below Limit
4.	Chromium Cr	0.0032	0.5	Below Limit
5.	Mercury Hg	0.0008	0.01	Below Limit
6.	Lead Pb	0.0031	0.05	Below Limit
7.	Selenium Se	0.0023	0.2	Below Limit
8.	Copper	0.0028	0.2	Below Limit

Polycyclic aromatic hydrocarbons (PAHs),

S.No	Parameter	Result	ExposureLimits [TLV-TWA] (ppm)	Comments
1.	Acenaphthene	<0.01	0.2	Below Limit
2.	Anthracene	<0.01	0.2 mg/m3 PEL	Below Limit
3.	Benz(a)anthracene	<0.01	0.2 mg/m3	Below Limit
4.	Benzo(b)fluoranthene	<0.01	0.2 mg/m	Below Limit
5.	Benzo(k)fluoranthene	<0.01	0.2 mg/m3	Below Limit
6.	Benzo(a)pyrene	<0.01		Below Limit
7.	Benzo(ghi)pe	<0.01	0.2 mg/m3	Below Limit
8.	Chrysene	<0.01	--	--
9.	Dibenz(a,h,)anthracene	<0.01	--	--
10.	Fluoranthene	<0.01	1 ppm	Below Limit
11.	Fluorene	<0.01	--	--
12.	Indeno(1,2,3-cd)pyrene	<0.01	10 ppm	Below Limit
13.	Naphthalene	<0.01	--	--
14.	Pyrene	<0.01	10 mg/m3	Below Limit
15.	Phenanthrene	<0.01	0.2	Below Limit

INDOOR AIR QUALITY RESULTS SUMMARY

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Based on the time constraints, air monitoring was carried out at indoor locations (12 locations) and waste identification analysis at five locations. Following points are summarized based on results obtained.The results of all PAH show a concentration of less than 0.01ppm against a 10 ppm limit set by ACGIH. The values of TVOC is found to be less than 3 ppm against KEPA limit set as indoor air quality limit

Waste Analysis and Identification

The types of wastes observed during the visit by NAPESCO team to assess the waste generated due to the accident are (liquid waste) Complete burning product (ash)are:

- Fire Ash
- Fire water
- Liquid wastes mixed with Oil and sludge
- Solid waste with burned lightings, glasses, metals and melted aluminum pieces

A total of five locations were selected for waste identification based on the visual hazardous nature during preliminary site visit. The results are presented in the following tables.

Results of STG 20 G/F (Near Condenser)

Parameter		Unit	Test Method	Results
1	Arsenic as As	mg/Kg	APHA-3111 E	< 0.5
2	Barium as Ba	mg/Kg	APHA-3111 D	< 0.5
3	Cadmium as Cd	mg/Kg	APHA-3111 B	< 0.5
4	Chromium as Cr	mg/Kg	APHA-3111 B	< 0.5
5	Copper as Cu	mg/Kg	APHA-3111 B	2.1
6	Iron as Fe	mg/Kg	APHA-3111 B	73.2
7	Lead as Pb	mg/Kg	APHA-3111 B	4.5
8	Mercury as Hg	mg/Kg	APHA-3112 B	< 0.5
9	Nickel as Ni	mg/Kg	APHA-3111 B	2.1
10	Selenium as Se	mg/Kg	APHA-3112 B	< 0.5
11	Silver as Ag	mg/Kg	APHA-3111 C	7.5

Results of STG 20 G/F (Vacuum Pump)

Parameter		Unit	Test Method	Results
1	Arsenic as As	mg/Kg	APHA-3111 E	< 0.5
2	Barium as Ba	mg/Kg	APHA-3111 D	< 0.5
3	Cadmium as Cd	mg/Kg	APHA-3111 B	5.1
4	Chromium as Cr	mg/Kg	APHA-3111 B	2.1

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5	Copper as Cu	mg/Kg	APHA-3111 B	1566
6	Iron as Fe	mg/Kg	APHA-3111 B	4750
7	Lead as Pb	mg/Kg	APHA-3111 B	117.3
8	Mercury as Hg	mg/Kg	APHA-3112 B	< 0.5
9	Nickel as Ni	mg/Kg	APHA-3111 B	78.2
10	Selenium as Se	mg/Kg	APHA-3112 B	< 0.5
11	Silver as Ag	mg/Kg	APHA-3111 C	42.6

Results of STG 20 O/F

Parameter		**Unit**	**Test Method**	**Results**
1	Arsenic as As	mg/Kg	APHA-3111 E	< 0.5
2	Barium as Ba	mg/Kg	APHA-3111 D	< 0.5
3	Cadmium as Cd	mg/Kg	APHA-3111 B	< 0.5
4	Chromium as Cr	mg/Kg	APHA-3111 B	3.0
5	Copper as Cu	mg/Kg	APHA-3111 B	745.0
6	Iron as Fe	mg/Kg	APHA-3111 B	9550
7	Lead as Pb	mg/Kg	APHA-3111 B	3925
8	Mercury as Hg	mg/Kg	APHA-3112 B	< 0.5
9	Nickel as Ni	mg/Kg	APHA-3111 B	53.2
10	Selenium as Se	mg/Kg	APHA-3112 B	< 0.5
11	Silver as Ag	mg/Kg	APHA-3111 C	9.1

RESULTS OF WASTE ANALYSIS

The results of Waste analysis show that the hazardous concentrations are high in terms of iron, mercury and lead in all the four samples collected from the operational area except at one location collected near the condenser.

REMOVAL OF WASTE DUE TO FIRE ACCIDENTS

Safety precautions

Following procedures to be implemented strictly during removal of waste:

- Sign boards and Barricades: Suitable sign boards indicating RESTRICTED ENTRY and Proper barricades must be provided before entering the area for cleaning.
- Ensure full PPE before entering the site, like Safety Coverall, Safety Goggles, Safety Shoes, proper rubber gloves, and Safety Hat.

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- Employee awareness: Provide information on Quantity, location, manner of use, release, and storage of chemicals to employees prior to or on initial job assignment and the specific nature of operations that result in their exposures.
- Spraying or fumigating fungicide (Non toxic) completely eliminates the chances of fungal spores in the environment. Moist free, good air circulation, periodic and good housekeeping certainly promote healthier and safe environment.

Effective cleaning method

Vacuum cleaning: Effective vacuum Services to be used for the cleaning of melted aluminium and fire water generated. Ash and debris inside burned structures may contain more toxic substances and Common vacuum cleaners do not filter out small particles,HEPA filter vacuums could be used. All possible methods should be employed to transfer the hazardous waste though vacuum Services to suitable labelled enclosed containers. These containers should be of adequate size and closed tightly without causing leakages.

While doing the cleaning all personal involved in the activity including the vehicle driver should be selected as a designated agent for handling the waste and should be aware of the procedures and hazardous nature of the contents. Refer waste segregation, storage and disposal methods as per Kuwait EPA guidelines.

Collection, Segregation and storage of waste

Based on Waste management procedure, any waste generated will be segregated, properly stored and will be disposed as follows:

Following segregation procedure to be considered while managing the waste collection and disposal:

- The dumping of any waste in power plant premises, or indeed any other area not approved by the Kuwait EPA, will be strictly forbidden. Wastes to be collected on site in compatible containers to prevent it from leaking.
- Hazardous wastes to be stored separately from non-hazardous waste.
- The hazardous waste storage area should be secured and the access shall be restricted only to personnel assigned with the responsibility of handling hazardous.
- Waste that has been identified as hazardous should not be stored more than 90 days before it is shipped for disposal.

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- All shipping/packaging will be separated and disposed accordingly. Reuse or recycle materials if possible.
- No hazardous waste should be allowed into storage areas unless it has been properly identified and labelled.

Waste storage Containers

All Waste containers should be kept in good condition. Wastes should be transferred to another container if the container in which they are stored is leaking, severely rusted or has structural defects.

- Damaged containers previously containing hazardous and toxic waste that cannot be reused will be treated as a hazardous and toxic waste.
- All containers should be managed so that the ability of the container to hold the waste is not impaired.
- All hazardous waste containers should be kept closed at all times, except when adding or removing wastes. They should be fitted with a strong lid to prevent spills during transfer or transport.
- Containers should be handled in a manner that will not cause a rupture or leaks.
- Reuse of containers for hazardous waste storage will be allowed provided the all of the following conditions are met:
- The hazardous waste to be stored is the same as the previous waste or is compatible with the previous waste.
- The shipper puts the waste into the used container at least 24 hours before the shipment is to leave the site.
- The container is inspected immediately before the shipment is loaded.
- Loading is performed by the shipper, and unloading is performed by the consignee.
- The characteristics and type of waste, the effect of waste expansion, the formation of gas and increase in pressure during storage shall be taken into consideration when placing hazardous and toxic wastes into a container.
- For liquid hazardous and toxic waste, space shall be included for gas formation and volume

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Chemical Hazards

Harmful chemical compounds in the form of solids, liquids, gases, mists, dusts, fumes, and vapors exert toxic effects by inhalation (breathing), absorption (through direct contact with the skin). Some of these are toxic through inhalation and some can irritate the skin on contact.

The degree of worker risk from exposure to any given substance depends on the nature and potency of the toxic effects and the magnitude and duration of exposure. Based on the type and chemical analysis of wastes, location wise recommendations were suggested in the following sections.

Biological Hazards

Any works that result in contact with bodily fluids pose a risk to workers from biological hazards. These include bacteria, viruses, fungi, and other living organisms that can cause acute and chronic infections by entering the body either directly or through breaks in the skin.

During the waste cleaning activity, occupations where there is potential exposure to biological hazards, workers should practice proper personal hygiene, particularly hand washing, Proper ventilations, use of personal protective equipment such as gloves and respirators to be strictly followed to avoid contamination and biological hazards.

Moisture and low temperature is suitable environment to grow for fungi. Regular uses of air purifiers can make the air clean and destroy the fungal spores from it.

Physical Hazards

These include falling objects from height, noise & vibration, illumination and temperature.

- Falling objects from height: In the STG floor, falling hazards are identified. Hard Hats/Helmet: Hard hats shall be worn at all times at these locations to protect workers injury from Falling Objects.Only approved safety helmets shall be issued and used by the employees. Removal of objects from top should be done with support of signal man and safety officer.
- For each type of operations, separate safety officer should be involved to avoid missing or overseeing of any incidents or accidents which may arise from single supervisor.
- Safety Glasses: Safety glasses shall be worn at all times as advised by the concerned safety instructors.

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- Full Body Harness: In areas where a person may fall a distance of more than 2 meters (6’ 6”) a safety belt or harness shall be worn while working at Height. Specific fall protection (live line ...etc) shall be provide depend of the work location requirements.
- Handling of Loads: All work involves lifting and handling of loads and in case of any work done manually, to be carefully planned on a timely manner. The risk of the injury can be greatly reduced by knowledge and application of correct lifting and handling techniques and by taking a few elementary precautions.

Based on the results obtained in the previous sections, it was observed that the Indoor gaseous air quality, Polycyclic Aromatic Hydrocarbons and Total Volatile Organics Carbon (VOC) concentrations show acceptable limits as per ACGIH and KEPA standards.

DISCUSSIONS

- The results of PAH show a concentration of less than 0.01ppm against a 10 ppm limit set by ACGIH.
- The values of TVOC is found to be less than 3 ppm against KEPA limit set as indoor air quality limit.
- The results of Waste analysis show that the hazardous concentrations are high in terms of iron, mercury and lead in all the four samples collected from the operational area except at one location collected near the condenser.
- Based on the results, recommendations and safety controls were discussed in the following sections.

GENERAL RECOMMENDATION

Controlling exposures due to fire accident site to occupational hazards is the fundamental method of protecting workers. Traditionally, NIOSH uses a hierarchy of controls as a means of determining how to implement feasible and effective solutions to reduce or eliminate workplace hazards. One representation of this hierarchy can be summarized as follows:

- Elimination or substitution
- Engineering controls
- Administrative controls
- Personal protective equipment

These include appropriate engineered ventilation systems, proper management, adequate and proper housekeeping and personal hygiene practices to limit exposures to air contaminants due to fire accident.

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Safety Instructions and responsibility

A senior responsible officer should be in charge of all the activities of fire affected area who will be contacted to and able to take appropriate decision to handle all critical situations. He will be responsible for but not limited to the following:

- Ensuring proper functioning (as per plan) and proper interaction between site and the concerned Project Office.

Occupational Control:

Medical Checkup& First Aid

It is to be ensured that all personnel working in the cleaning and maintenance activity had undergone a valid medical check up. In addition, it should be ensured that all personnel's are formally trained by a recognized First Aid Training organization.

First aid facility should be available at the immediate reach location. First Aid equipment register should be maintained to ensure and verify the availability and validity of the kit/contents as well as restocking.

Training to workers:

Workers should be given training on Safety and Health Program Management. According to OSHA guidelines, Effective management of employee safety and health protection is a decisive factor in reducing the extent and severity of work-related injuries and illnesses and their related costs.

The Safety and health training recommends guidelines on specific actions, under each of these general elements, to achieve an effective safety and health program. The training for employees will be done through Identifying Training Needs through personal interviews or discussions and conduct a Job Hazard Analysis as per OSHA 3071. This training provides a procedure for studying and recording each step of a job, identifying existing or potential hazards, and determining the best way to perform the job in order to reduce or eliminate the risks.

Personal Hygiene:

It is very important for all personnel to observe general Health & Hygiene requirements and to take reasonable care to ensure the safety, health and welfare of himself and other persons who may be affected by his acts or omissions.

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- A more cautious approach should be taken in the removal of ash and other debris from inside burned structures. A well-fitting dust masks rated N-95 or P-100 will be more effective than simpler dust masks in blocking particles from ash and provide protection during cleanup. Use of Face Mask will be effective as the area will have particles coming out from the burnt materials while cleaning.
- Persons with heart or lung disease should consult their physician before using a mask during post-fire cleanup. For most clean-up work activities, need the following personal protective equipment: hard hats, safety goggles, heavy work gloves, and watertight boots with steel toe and insole (not just steel shank).
- If water has been present anywhere near electrical circuits and electrical equipment, turn off the power at the main breaker or fuse on the service panel. Do not turn the power back on until electrical equipment has been inspected by a qualified electrician. NEVER handle a downed power line. No not use electrical equipment that has been exposed to heat from the fire until checked by an electrician.
- Hazardous waste generated at the particular area often requires transport to an approved treatment, storage, or disposal facility (TSDF).

Use of PPE and Masks

Recommended masks during cleaning activity can be used as below:

3M 5000 series mask

3M 9913 mask

N95 Respirable mask

Other controls

Noise and vibrations: Noise and vibrations from cleaning operations and transportation of burned equipments can be reduced by installing suitably engineered and designed systems, and built to operate quietly and also by enclosing or shielding noisy equipment. Harmful exposure to sound intensity in the working areas shall be eliminated or minimized by proper planning. Measurement of sound intensity should be taken by qualified personnel. When the sound intensity in a working area exceeds 85 decibels, personal ear protective devices should be

provided to the concerned personnel. Excessive noise from equipment may cause ringing in the ears and subsequent hearing damage. Workers should wear earplugs or other hearing protection devices.

- Illumination and temperature: Ensure proper illumination is available and it should be minimum of 400 Lux.

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