Environmental Analysis for Jamaica Energy Management and Efficiency Program (Project Number JA-L1056)

Prepared for:

IDB
Inter-American Development Bank

Performed by:

Acorn INTERNATIONAL

Inter-American Development Bank
1300 New York Avenue, N.W.
Washington, D.C. 20577
USA

Acorn International, LLC
75 Federal Street
Suite 2105
Boston, MA 02110
USA

August 2016

Contents

List of Figures

List of Tables

1 Introduction

Jamaica depends on petroleum products for essentially all the country's energy needs in both the power and transportation sectors. Inter-American Development Bank (IDB) reports that in 2015 20.4 million barrels of oil equivalent (BOE) were imported to Jamaica, with 30% used for transportation and 28% used for electricity generation.[1] This reliance on petroleum products has resulted in unpredictable and significant price fluctuations for the Government of Jamaica (GoJ) and its residents, and produced a large greenhouse gas (GHG) footprint relative to the size of Jamaica's economy.

IDB identified two key areas for reducing fossil fuel use that will be addressed by the Jamaica Energy Management and Efficiency Program (EMEP, or the program), Project Number JA-L1056:

1) Energy efficiency (EE) in public sector buildings: in 2015, 7.4% of all electricity generated (approximately 393 GWh, or 750,660 BOE) were consumed by Public Sector Facilities (PSF), costing GOJ around US$36 million in oil imports, or estimated US$102 million in electricity bills.
2) Energy conservation (EC) in the transport sector: Traffic growth along some of the Kingston Metropolitan Area (KMA) key corridors has increased between 39% -50% over the last ten years (2005-2015) without any associated improvements in road or intersection capacity. In downtown Kingston, 30% of intersections in main corridors suffer from overcapacity due to poor geometric designs. Studies from the National Works Agency (NWA) show that the absence of a complete Urban Traffic Management System (UTMS) to synchronize the operation of 140 traffic lights with average spacing of 300 meters between is a key factor causing congestion in the KMA. Most of the population commutes within urban centers, resulting in significant amount of congestion, lost time and wasted gasoline during idling or stalled traffic, especially the capital city Kingston.

In addition, a third component will involve institutional strengthening of the GoJ to implement the program.

The program has been classified as low-medium risk Category "B", likely to have only "local and short-term negative environmental and associated social impacts for which effective mitigation measures are readily available". For Category B projects, the IDB Environment and Safeguards Compliance Policy requires an environmental analysis (EA), as well as an Environmental and Social Management System (ESMS) that defines provisions to avoid, mitigate or compensate for specific environmental, social, health and safety impacts and risks of the project.

This EA is focused on the key risks and impacts from the project and fit-for purpose ESMS, including stand-alone Waste Management Plan (WMP).

[1] IDB. 2016. Project Profile for Energy Management and Efficiency Program (Project number JA-L1056)

2 Project Description

2.1 Objective

The general objective of this project is to contribute to the government's National Energy Conservation and Efficiency Policy 2010-2030 (NECEP) target of 70% reduction energy intensity and to the 10% reduction of greenhouse gas emissions below business as usual case by 2030 target through the design and implementation of EE and EC measures in government facilities and through fuel conservation in the transport sector.

2.2 Program Components

This program will include the following components:

Component 1 (US$24.6 million) will finance EE and EC measures in government facilities, concentrated in the health and education sectors. Activities include:

i. Investment-grade audits
ii. Purchase, installation, maintenance and operation of appropriate EE and EC technologies and measures within selected government facilities. Examples of these upgrades presented on Table 2-1 were developed by DNV-GL for this Program.
iii. Technical expertise and support for the Project Execution Unit (PEU), including training in EE maintenance (highlighted by gender) that would be extended to facilities teams in each building
iv. Set up of an instrument to manage the financial savings accruing from the reduction in energy consumption within government facilities

Component 2 (US$3.7 million) will finance fuel efficiency in the transport sector. Activities include:

i. Purchase and installation of equipment to facilitate the implementation of an Urban Traffic Management System (UTMS) in Kingston, such as fiber optic cables, traffic lights, cameras, sensors, planning software, communication technology maintenance equipment and training support
ii. Technical study to assess how the public transport sector, which is a fairly heavy user of oil and heavy fuel, can obtain EE from diversifying their fuel sources.

Component 3 (US$1.8 million) will finance institutional strengthening for energy planning. This component will build on previous studies commissioned by the IDB regarding institutional weaknesses and gaps in systems and technical capacity for wider energy planning. Activities include:

i. Development of information systems
ii. Training and technical support for energy planning in Jamaica with a particular focus on planning and supervision of EE and RE.

Table 2-1: Examples of System Recommendations

Measure Description	KPH/VJH	Cornwall RH	Ebony Park Academy	Falmouth Hospital	Mandeville Hospital	Marcus Garvey
Automatic Door Closers	Yes	Yes	Yes	Yes	Yes	Yes
Air Seals on Doors (and Windows)	Yes	Yes	Yes	Yes	Yes	Yes
Proper Spacing between Units	Yes	Yes			Yes	Yes
Replace Split Systems with High Efficiency, Inverter-driven Units	Yes		Yes		Yes	Yes
Variable Refrigerant Flow (VRF) Systems	Yes					
Variable Flow Drive (VFD) Installation on Kitchen Fans	Yes				Yes	
VFD Installation on Chiller Pumps	Yes				Yes	
VFD on Supply and Return Fans		Yes		Yes		
VFD on Exhaust Fans		Yes				
VFD on Constant Volume Pumps		Yes				
Compressed Air Leakage	Yes	Yes			Yes	
Centralized Chiller Controls	Yes	Yes			Yes	
BAS Upgrades		Yes		Yes	Yes	
Fluorescent to LED Fixture Retrofit	Yes	Yes	Yes	Yes	Yes	Yes
Occupancy Sensor for Interior Lights	Yes	Yes	Yes	Yes	Yes	Yes
Exterior Light Retrofit to LED		Yes	Yes		Yes	
Solar PV	Yes	Yes	Yes	Yes	Yes	Yes
Replace Louver Windows w/Insulated Glazing		Yes				
Solar Thermal for Domestic Hot Water Usage		Yes		Yes		
Window Replacements w/Insulated Glazing	Yes					Yes
Installation of Solar Tubes			Yes	Yes		Yes
Rainwater Catchment System			Yes	Yes		
Replace Broken Windows				Yes		

Source: DNV, 2016[2]

2.3 Activities

2.3.1 Component 1 Activities: EE and EC measures

Component 1 will include deep retrofitting of government owned and operated facilities' energy-using equipment (mostly air conditioners) around the country. However, the retrofitting also includes improvements in building envelopes to lower insolation loads, the application of solar films on windows, the use of passive solar equipment, and the installation of solar electricity

[2] DNV. 2016. Unpublished Technical Assessment Reports prepared by DNV on behalf of the program.

generating equipment to lower the load on the central electricity grid provided by the Jamaica Public Service Company, and the reduction in fossil fuel use in the selected facilities.

The types of upgrades to be performed are expected to be similar to those shown in Table 2-1. As indicated in the Table, different facilities will receive different technologies to optimize their energy consumptions. Not all technologies will be applied to all facilities. A sample of five of the facilities to receive upgrades identified five technologies that are common to the five examples:

1) Automatic door closers
2) Air seals on doors (and in some cases windows)
3) Fluorescent to LED lighting fixture retrofits
4) Occupancy sensors for interior lights
5) Solar photovoltaics (PV)

2.3.2 Component 2 Activities: UTMS Upgrades

National Works Authority (NWA) will complete civil works components (trenching and tubing) of the UTMS upgrades by September 2016. Other components to be financed by this program include the installation of inter-connected traffic lights and sensors along various routes, particularly in Kingston, as well as camera systems located on existing poles, at strategic locations. The inter-connection of the traffic lights, cameras and sensors is to be made by means of fiber-optic cables, and a central control system, located in NWA's office building. Installation of the fiber-optic cables is being performed in conjunction with telephone companies Digicel and Flow; in both instances, the telephone companies are allowing access to their rights-of-way in exchange for the availability of some ducting.

The ducting consists of flexible plastic tubing, bundled into a plastic sheathing. The duct is installed in either a two-inch wide trench in the sidewalk, or in a four-inch wide trench in the street. Trenching is performed by specialized trenching machines to a depth of up to 18 inches.

Installation activity is being performed at night and on Sundays, to minimize the adverse impact to traffic – vehicles and pedestrians, as well as to the construction crews. The program is underway, with production of approximately 600m per shift. Once the trench has been dug and the ducting installed, the trench is backfilled with excavated material, and topped with granular fill, over which the traffic may cross to provide compaction. When considered complete, the duct trench is topped with asphalt.

There are no physical aspects to component 3.

2.4 Location

The specific buildings to be upgraded as part of Component 1, EE and EC measures for government buildings, have not yet been confirmed. The buildings will be selected according to results provided by comprehensive, investment-grade EE/renewable energy (RE) audits and the following criteria:

- High Energy Users: High energy users provide the biggest immediate impact and result in lower administrative costs per kWh saved.
- High Profile: Projects which the community will identify with, and which will show up in local news cycles help provide project momentum and expand in-country knowledge
- Best Investments: In order for the loan to be successful, focusing on projects with high ROI and high kWh saved per capital dollar spent is critical

- Ease of Implementation: Projects that are easy to manage, have eager stakeholders, and are along transit corridors reduce risk.
- Facilities Conditions Index (FCI): Knowing the facility is in good enough condition to handle a retrofit is critical to safe and aesthetically pleasing project success.
- Quality of Life Improvements: Projects where the retrofits will include educational opportunities, emergency response (shelters), thermal comfort, etc.

It is expected that up to 30 government buildings will receive energy upgrades and up to 50 will be upgraded with energy, across Jamaica.

Physical works related to Component 2, UTMS system, will be implemented in 9 road segments. Of these, most road segments are located in Kingston (Figure 2-1) and 1 is located approximately 15 km west of Kingston in Spanish Town (Figure 2-2).

Figure 2-1: Location of Road Segments in Kingston

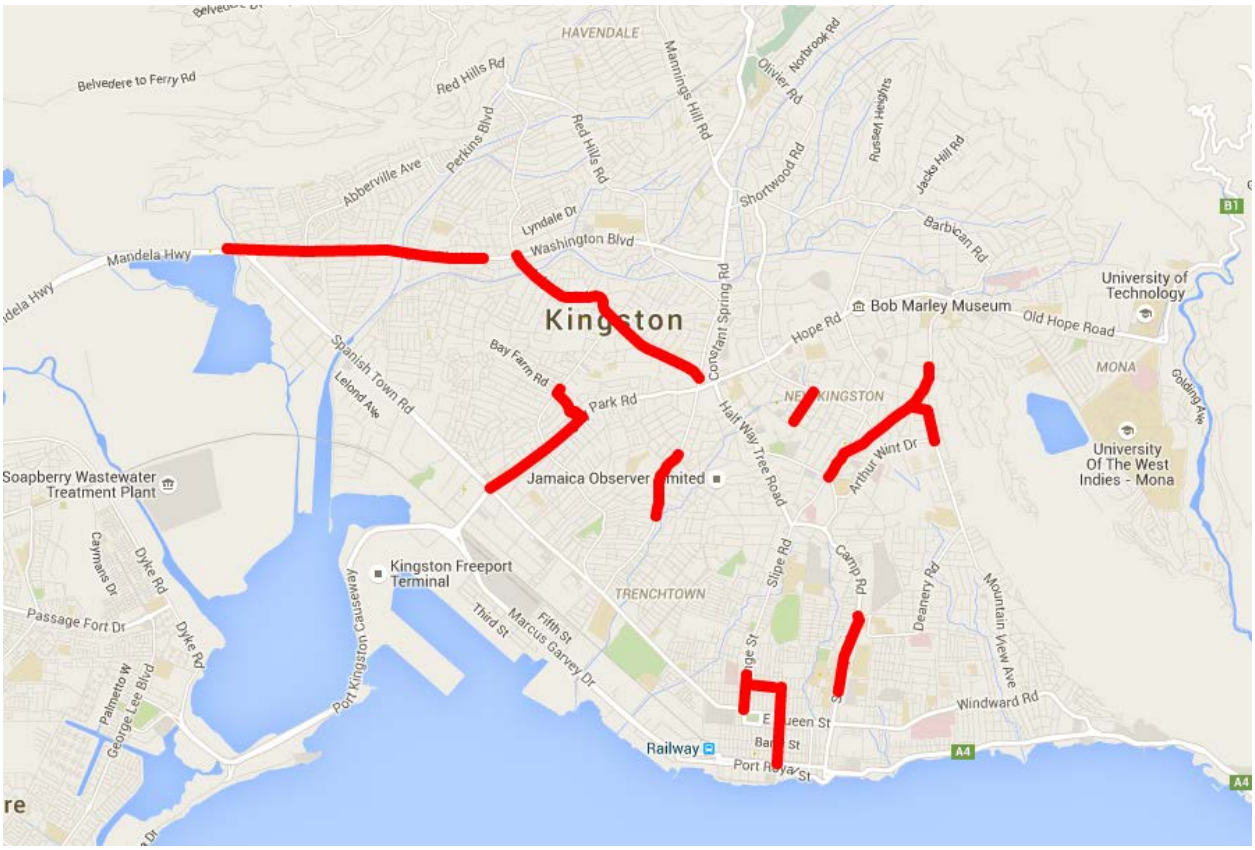
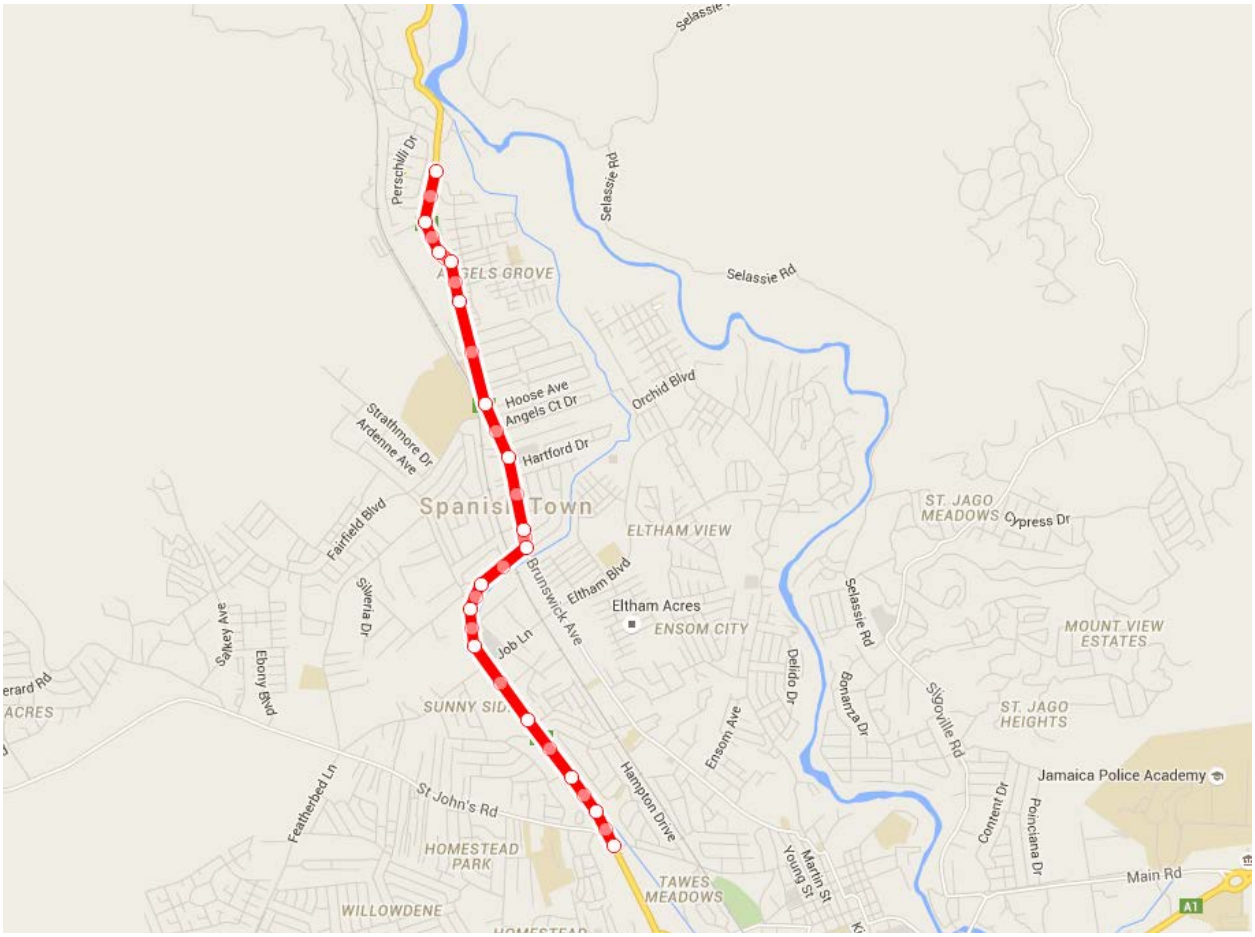


Figure 2-2: Location of Road Segment in Spanish Town (West of Kingston)



2.5 Schedule

Civil works for the UTMS component are anticipated to be completed in September 2016.

The schedule for implementation of the EE upgrades could commence in 2017 (possibly later), and be completed in approximately six years.

2.6 Alternatives

Key alternatives include EE technologies and selection of buildings for EE upgrades. Road selection for UTMS also an alternative, but this work is near completion so will not be discussed.

2.6.1 EE Technologies

As indicated in Table 2-1 , at least 24 technologies have been identified as recommendations for use in one or more of the five example facilities. In addition, there are other EE technologies that could be considered. A notable exception is the use of passive solar, to reduce insolation loads.

Choice of technologies is being determined on a case by case basis after completion of Investment Grade Audits. The Audits determine which EE upgrades to make based on cost benefit analysis.

2.6.2 Choice of Building

The focus of this program is on upgrading of public buildings, especially schools, hospitals and offices. Determination of which buildings to upgrade is based a number of criteria, as listed in Section 2.4.

2.7 Project Justification

This project aims to reduce in electricity consumption of up to 30% within selected public sector health, education and public administrative facilities, producing savings in the GoJ electricity bills and therefore in imported oil barrels for those public facilities.

Preliminary models show that the fuel efficiency component could increase average car speeds in corridors of Kingston from the current 22 km/h to 28 km/h, and this would imply reducing the traffic fuel consumption in those corridors by 40% and associated harmful GHG emissions. Investments in traffic control management could therefore help reduce fuel imports for public transport (which currently accounts for 8% of total national fuel imports).

2.8 Area of Influence

The EMEP will be implemented in developed areas across Jamaica (Figure 2-3), but most will be in Kingston. Existing buildings will be refurbished and civil works will only take place in areas with existing roads. The Area of Influence for the project is therefore quite broad, but limited in intensity and located primarily near the buildings to be refurbished.

Figure 2-3: Map of Jamaica

Source: University of Texas, 2015[3]

3 Environmental and Social Setting

Jamaica is a mountainous island in the Caribbean Sea, approximately the size of Connecticut (10,911 km^2 island), located half way between the southern tip of Florida and the Panama Canal. [4] Population density in Jamaica is greatest in the southeast, surrounding Kingston, and northwest, surrounding Montego Bay (Figure 3-1 and Table 3-1).

[3] University of Texas (UofT). 2016. Accessed from the UofT website: http://www.lib.utexas.edu/maps/americas/jamaica_physio-2002.jpg

[4] CIA. 2016. CIA Word Factbook: Jamaica Country Profile. Accessed from the CIA website: https://www.cia.gov/library/publications/the-world-factbook/geos/jm.html

Figure 3-1: Main Cities in Jamaica

Source: City Population, 2011[5]

Table 3-1: Population of Major Population Centers in Jamaica (2011)

Name	Population
Kingston	584,627
Portmore	182,153
Spanish Town	147,152
Montego Bay	110,115
May Pen	61,548
Mandeville	49,695
Old Harbour	28,912
Savanna-la-Mar	22,633

Source: City Population, 2011

Temperatures in Jamaica are fairly constant throughout the year, averaging 25 to 30 °C (77 to 86 °F) in the lowlands and 15 to 22 °C (59.0 to 71.6 °F) at higher elevations. [6] The mean temperature over Jamaica has increased by around 0.6 ° since 1960, an average rate of 0.14 °C per decade.[7] The mean annual temperature is projected to increase by 1.2 °C to 1.6 °C by 2030.[8]

There are two primary types of climate found in Jamaica.

1) Upland tropical climate on the windward side of the mountains (north and east)
2) Semiarid climate on the leeward side of the mountains (south and west).

While it rains throughout the year, the rainfall is heaviest from May to October. The average rainfall is 1,960 millimeters (77.2 in) per year. The mean precipitation over Jamaica has decreased in June – August and September – November by 6.2 and 4.5 mm per month per

[5] City Population. 2011. Jamaica. Accessed from the City Population website: http://www.citypopulation.de/Jamaica.html

[6] Meteorological Service of Jamaica. 2016. General Climate. Accessed from the Meteorological Service of Jamaica website: http://www.metservice.gov.jm/climate.asp

[7] FAO and IDB. 2013. Climate Change and Agriculture in Jamaica: Agriculture Sector Support Analysis. Accessed from the FAO website: http://www.fao.org/3/a-i3417e.pdf

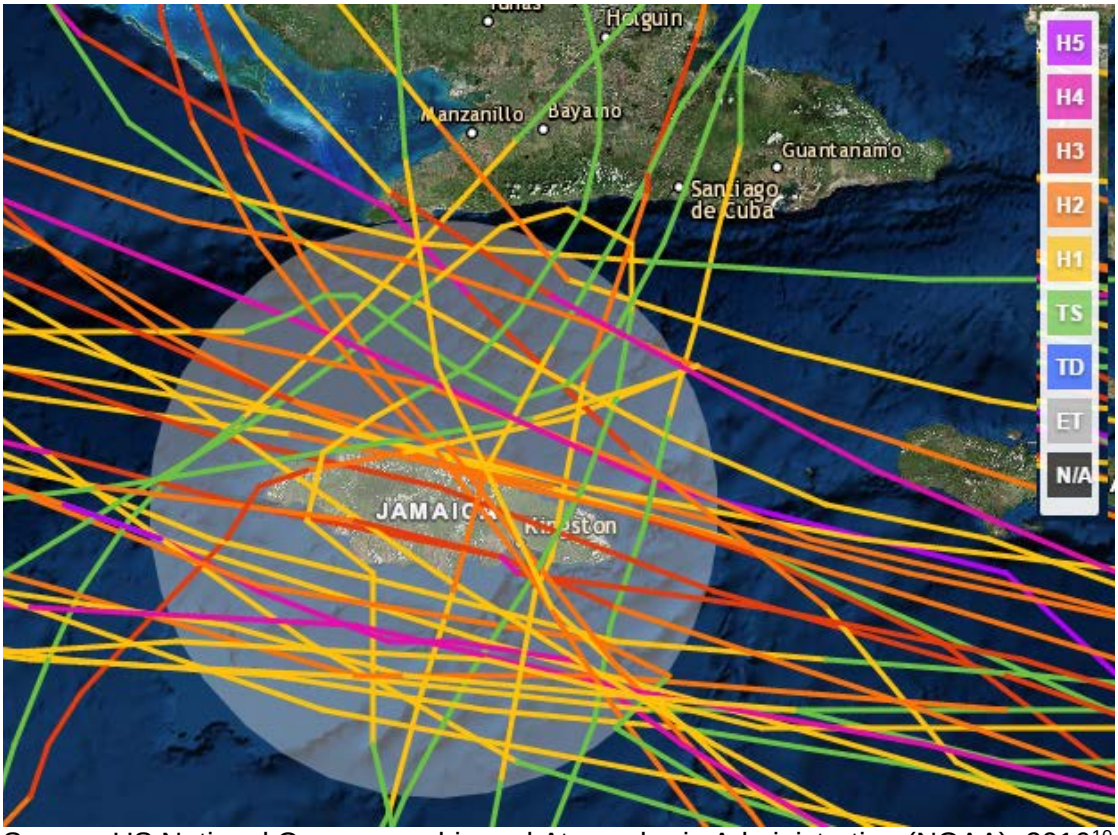
[8] IDB. 2014. UD&CC: Probabilistic Hazards and Risk Assessment Study for Montego Bay.

decade since 1960, respectively, and the projections of mean annual rainfall from different models indicate decreasing rainfall for Jamaica by -12% to -26%.[8]

Between 1852 and 2011, 27 hurricanes have passed within approximately 70 miles of Jamaica (Figure 3-2), of which 1 was a Category 5 (Hurricane Allen, 1980), 5 were Category 4 (Cleo, 1964; Dean, 2007; Dennis, 2005; Gilbert, 1998; and Ivan, 2004), and 5 were Category 3 (Charlie, 1951, and 4 unnamed storms in 1903, 1912, 1915 and 1944)[9]. The official hurricane season is from June to November, although tropical weather systems occur from April to December.

Several studies indicate frequency of hurricanes may decrease as a result of climate change, but the intensity of storms that do develop will be greater, potentially twice as many per year by 2100.[9]

Figure 3-2: Hurricane Tracks within 75 Miles of Jamaica (1852-2012)



Source: US National Oceanographic and Atmospheric Administration (NOAA), 2016[10]

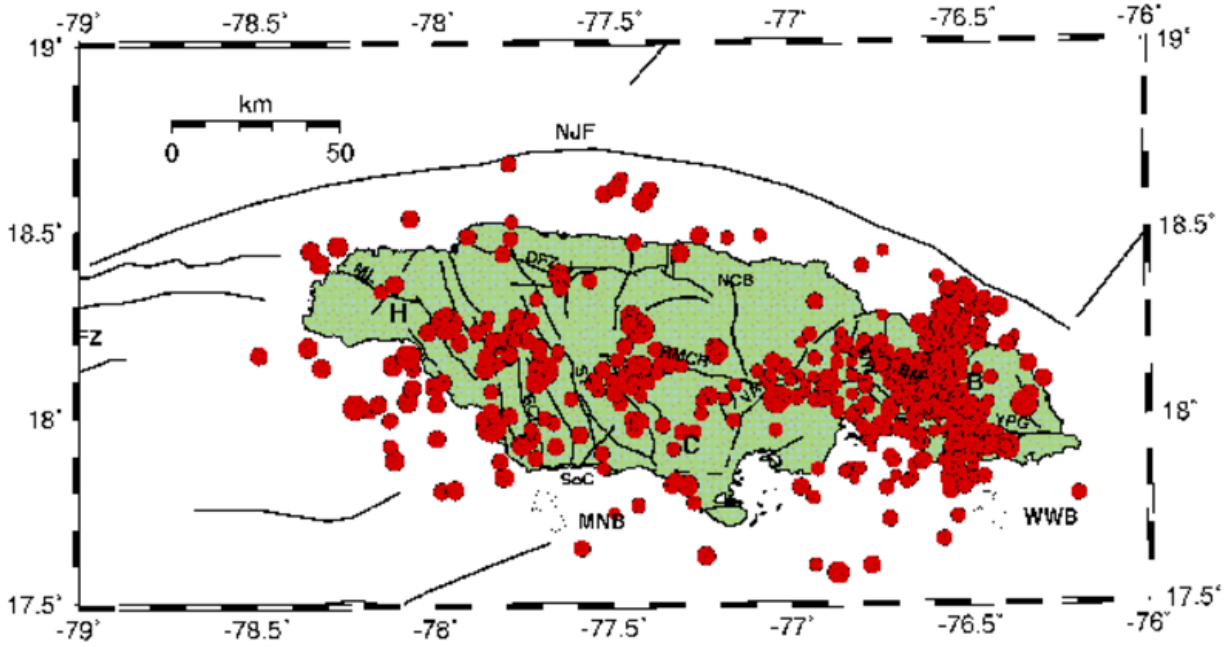
Jamaica is seismically active. 200 earthquakes occur in and around Jamaica per year (Figure 3-3). While most earthquakes in Jamaica are minor (having magnitudes less than 4.0), there

[9] University of West Indies (UWI). 2012. State of the Jamaica Climate 2012. Accessed from the UWI website: https://www.mona.uwi.edu/physics/sites/default/files/physics/uploads/SOJC%20-%20Full%20Document%20-%20January%2024v2.pdf

[10] NOAA. 2016. Historical Hurricane Tracks. Accessed from the NOAA website: https://coast.noaa.gov/hurricanes/

have been a number of large earthquakes that have resulted in significant damage and fatalities. [11] [12]

Figure 3-3: Earthquakes in Jamaica (1997-2007)



Source: UWI, 2007

Jamaica, and Kingston in particular, is subject to routine landslides resulting from a combination of geology, seismicity and precipitation.[13] Landslides cover approximately 4.77% of Kingston's mountainous terrain and the frequency is increasing with urbanization and development of geologically active slopes.

4 Legal and Regulatory Framework

This section presents a summary of the applicable laws, regulations and other norms that apply to the Project. This is based on information provided by IDB, interviews with regulators, and supplementary research.

4.1 Administrative Framework

4.1.1 Petroleum Corporation of Jamaica

Petroleum Corporation of Jamaica (PCJ) is a statutory corporation under Ministry of Science Energy & Technology (MSET), mandated to develop and promote energy supply, diversification and EE. Since 1978, PCJ has been involved with energy security for the country, operates the

[11] UWI. 2007. Earthquakes in Jamaica. Accessed from the UWI website: http://www.mona.uwi.edu/earthquake/jaequake.php
[12] UWI. 2007. Jamaica's Earthquake History. Accessed from the UWI website: http://www.mona.uwi.edu/earthquake/history.htm
[13] UWI. 1999. Landslides in Jamaica: Natural Hazards and Disasters. Accessed from the UWO website: http://www.mona.uwi.edu/uds/Land_Jam.html

PetGen refinery, and until recently, operated a network of retail gas stations (PetCom) across the country. However, that business was recently sold. In addition to its involvement with fossil fuels, PCJ is also charged with developing renewable energy sources and energy efficiency.

PCJ will be the Project Executing Agency and, with the Ministry of Finance (MoF), will staff the Project Execution Unit (PEU).

4.1.2 Ministry of Finance

The Asset Management Unit (AMU) of the MoF provides policy advice and documentation on all areas of asset management, including development of asset management policies and systems. In addition the AMU:

1. Manages and oversees disposal of government assets
2. Reviews and approves documentation related to the transfer and disposal of government assets
3. Provides asset disposal services to all government bodies, including:
   a. Documented procedural guidelines for asset disposal
   b. Administration of Board of Survey (BOS) inspections and other related activities
   c. Board Of Survey Auction Sales; and Guidance and monitoring activities for seized and overtime goods to be auctioned, conducted by Customs Department offices island-wide
4. Maintains centralized inventory of government-owned motor vehicles and other fixed assets
5. Negotiates framework contracts for fuel supplies to Ministries, Departments and Agencies and manage related support services for compliance and effectiveness
6. Manages designated government properties overseas and the Ministry's complex at Shalimar Avenue

MOF's role in the EMEP is to transparently dispose of, or re-assign, the old air conditioning equipment replaced by new higher efficiency units as part of the program. If assets are designated for disposal, NSWMA takes responsibility for pick-up and disposal at a local landfill.

4.1.3 Ministry of Science Energy & Technology

MSET is a ministerial body with a broad range of functions related to science, technology, energy and mining. Its mandate, relevant to the program, is to:

- Encourage private sector innovation in the science, technology, energy and mining sectors
- Lead legal and regulatory reform of the electricity and gas sectors
- Improve national energy efficiency and conservation
- Increase the percentage of electricity generation from renewable sources

MSET will take part in the program through representation by PCJ, a wholly owned subsidiary.

4.1.4 National Works Authority

National Works Authority (NWA) is responsible for managing all aspects of the road network of Jamaica, including its safety, reliability, availability, efficiency and growth. To meet these objectives, NWA conducts routine maintenance, develops new roads, and optimizes the road network to reduce congestion.

NWA is centrally involved in the UTMS component of the EMEP, and is responsible for installing duct work, fiber optic cables, traffic lights, sensors, and cameras. It will also manage the traffic through a new control room.

4.1.5 National Environment and Planning Agency

National Environment and Planning Agency (NEPA) is the primary environmental regulator in Jamaica and provides technical and administrative mandate of three statutory bodies:

1) Natural Resources & Conservation, Authority (NRCA)
2) Town & Country Planning Authority (TCPA)
3) Land Development & Utilisation Commission (LDUC)

Its mandate includes:

- Conservation & Protection (Natural Resources Management)
- Environmental Management
- Spatial Planning
- Compliance & Enforcement
- Applications Management
- Public Education
- Policy and Research
- Legal Services & Standards Management

The EMEP will need to follow the laws, regulations and guidelines overseen by NEPA, as described in Section 4.2.

4.1.6 National Solid Waste Management Authority

The National Solid Waste Management Authority (NSWMA) is responsible for managing solid waste in Jamaica, including:

- Providing standards, regulations and expertise with regard to solid waste management
- Achieving acceptable environmental standards of public waste disposal operations
- Coordinating with other agencies on pollution prevention and environmental controls
- Enforcing national solid waste management laws

The EMEP will need to dispose of wastes according to NSWMA laws, regulations and standards, as described in Section 4.2. However, NSWMA has few applicable laws at present, and are supplemented by NEPA rules and guidelines. For example, NEPA has guidelines for management of asbestos and refrigerants. The project will need to comply with both sets of standards.

4.2 Legislative Framework

4.2.1 Energy Policies

The National Energy Conservation and Efficiency Policy 2010-2030 (NECEP) provides the overarching framework for EE in Jamaica, seeking a reduction in energy consumption of 15% in the short to medium term. By diversifying the country's fuel mix, the current National Energy Policy (NEP) seeks to create a modern, efficient, diversified and environmentally-sustainable energy sector for the island, and under the National Renewable Energy Policy 2010-2030 (NREP), the objective is that 20% of the country's energy mix should be derived from

Renewable Energy (RE) by 2030, with Liquefied Natural Gas (LNG)[14] replacing oil as the main energy source.

4.2.2 Waste Policies

The most recent waste policy, the National Solid Waste Policy of 2000[15], is obsolete. NSWMA was established in 2001 and has the sole jurisdiction for solid waste management in the country. However, NEPA also provides guidance on environmental protection relative to disposal and handling of some wastes. Prior to the establishment of the NSWMA, garbage collection was vested under the respective Parish Councils within each parish. NSWMA was given its legal mandate with the enactment of the National Solid Waste Management Policy and the National Solid Waste Management Act (2002). Most hazardous materials are currently sent for disposal in landfills. NSWMA doesn't have any international agreements for waste disposal.

Also worth noting that the Ministry of Economic Growth and Job Creation (MEGJC) is currently finalizing a policy for hazardous waste management in Jamaica and e-waste regulations.

4.2.3 National Environmental Requirements

No Environmental Impact Assessment (EIA) is required for the proposed works, as described in the Guidelines for Conducting Environmental Impact Assessment, 2007[16], nor is a building permit, as described in the Town and Country Planning Act, 2001[17]

The applicable local requirements include:

- The Natural Resources (Hazardous Wastes) (Control of Transboundary Movements) Regulations, 2002[18]
- User's Guide Natural Resources (Hazardous Wastes) (Control of Transboundary Movements) Regulations, 2015[19]
- Guidelines for the Management of Asbestos, 2014[20]
- Procedures for Handling of Asbestos, 2014[21]

---

[14] US-based New Fortress Energy is expected to supply LNG to the newly converted Bogue Power Plant (120MW) by mid-September 2016 and to Old Harbour (190MW) by 2018.

[15] NEPA. 2000. National Solid Waste Policy. Accessed from the NEPA website: http://www.nepa.gov.jm/symposia_03/Policies/NationalSolidWasteManagementPolicy.pdf

[16] NEPA. 2007. Guidelines for Conducting Environmental Impact Assessment. Accessed from the NEPA website: http://www.nepa.gov.jm/new/services_products/applications/eias/docs/guidelines/general/EIA-Guidelines-and-Public-presentation-2007.pdf

[17] NEPA. 2001. Town and Country Planning Act. Accessed from the Ministry of Justice website: http://moj.gov.jm/sites/default/files/laws/Town%20and%20Country%20Planning%20Act.pdf

[18] NEPA. 2002. The Natural Resources (Hazardous Wastes) (Control of Transboundary Movements) Regulations. Accessed from the NEPA website: http://www.nepa.gov.jm/regulations/hazardous/HazardousWasteRegs_2002.pdf

[19] NEPA. 2015. User's Guide Natural Resources (Hazardous Wastes) (Control of Transboundary Movements) Regulations, 2002. Accessed from the NEPA website: http://www.nepa.gov.jm/new/legal_matters/policies_standards/docs/standards/users_guide_hazardous_wastes_feb2015.pdf

[20] NEPA. 2014. Guidelines for the Management of Asbestos. Accessed from the NEPA website: http://www.nepa.gov.jm/new/services_products/guidelines/docs/Asbestos_Management_Guidelines_2014.pdf

[21] NEPA. 2014. Procedures for Handling of Asbestos. Accessed from the NEPA website: http://www.nepa.gov.jm/new/services_products/guidelines/docs/ProceduresHandlingASBESTOS.pdf

- Code of Practice for the Refrigeration and Air-conditioning Industry, 2008[22]
- Building Operations and Works of Engineering Construction (Safety, Health and Welfare) Regulations, 1968

Each of these are described below.

MEGJC is currently finalizing policies for hazardous waste management and disposal of e-wastes in the country, however these are not currently available.

There are no relevant legislation or guidelines related to disposal of used oils, mercury or Polychlorinated biphenyls (PCBs).

The Ministry of Labour and Social Security is currently in the process of developing a new Occupational Health and Safety Act that will take place of the Building Operations and Works of Engineering Construction (Safety, Health and Welfare) Regulations, 1968, but this act is not currently available. The act will likely apply to the program, but it is unclear how or when the new regulation will be passed.

4.2.3.1 Trans-boundary Movement of Hazardous Waste

The Natural Resources (Hazardous Wastes) (Control of Transboundary Movements) Regulations, 2002 describe the requirements for importing and exporting of hazardous wastes to/from Jamaica. The process is further clarified by the User's Guide Natural Resources (Hazardous Wastes) (Control of Transboundary Movements) Regulations, 2015. These documents clarify what type of waste are included, process for applying for an import/export permit, inspection of wastes, notification requirements and use of approved forms.

The rules are consistent with requirements under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. The fundamental requirements include providing notice, consent by both countries, and tracking for movement of wastes across national boundaries.

Mercury containing materials (i.e. lightbulbs), asbestos, Freon, or other hazardous materials that may result from the project would fall under these regulations if they were to be exported for final disposal.

4.2.3.2 Management of Asbestos

The Guidelines for the Management of Asbestos, 2014 and the Procedures for Handling of Asbestos, 2014, outline the procedures and precautions to be taken for the management of asbestos. They indicate notification requirements, give minimum safety requirements, sampling requirements, quality control/quality assurance for taking and handling samples, reporting requirements and include sections which discuss the procedures for testing and abating asbestos. The appendices of the guidelines contain supplemental information, as well as, form templates for reporting.

It is unclear if the project may involve work that will require removal of asbestos, but many of the buildings are >50 years old and asbestos may be present. If disturbance or removal of asbestos

[22] NEPA. 2008. Code of Practice for the Refrigeration and Air-conditioning Industry. Accessed from the NEPA website: http://www.nepa.gov.jm/ozoneunit/code-of-practice/code.pdf.

is required, all related works to abate, transport and dispose of asbestos would need to follow the rules described in these documents.

4.2.3.3 Management of Refrigeration and Air-conditioning Units

The Code of Practice for the Refrigeration and Air-conditioning Industry, 2008 was developed to meet the recommendations of the Parties to the Montreal Protocol. The Code of Practice provides information for servicing refrigeration systems and defines minimum standards of good practices in refrigeration.

The guidelines stress recovery, reuse and recycling of refrigerates to the extent possible. There are no facilities in Jamaica capable of disposing of refrigerants, so spent refrigerants are often stored locally in perpetuity.

NEPA has trained local refrigeration technicians within the country in best practices and proper disposal techniques, and there are a number of companies in Jamaica that are licensed to store or dispose of refrigerants. Practices described in the guidelines include identification of leaks and motor problems, how to remove and recover refrigerant and oil from systems, how to dispose of refrigerants, how to store containers, how to transport refrigerants, and import/export requirements.

A key component of the EMEP will be replacement of old air-conditioning units. These guidelines will directly apply to these activities and must be followed.

4.2.3.4 Occupational Health and Safety

The Building Operations and Works of Engineering Construction (Safety, Health and Welfare) Regulations, 1968 describe requirements for protecting workers from hazards often found in construction sites, including working at heights (i.e. use and standards for scaffolding, ladders, hoists, platforms, gang planks, etc.), heavy lifting, explosives, work on/near water, transportation and demolition. The regulations include previsions for use of safety equipment, supervisions, inspection, and first aid.

Requirements are standard good practice for the construction industry. All construction activities undertaken for the EMEP will need to follow these regulations and standard of care expected for the construction industry.

4.2.4 International Agreements

Jamaica is party to 91 international treaties, conventions and protocols. Relevant agreements are summarized in Table 4-1.

Table 4-1: Relevant International Agreements

International Agreement	Relevance
Vienna Convention for the Protection of the Ozone Layer (Vienna Convention), 1985	The Vienna Convention is a framework for the international efforts to protect the ozone layer. Specific actions are presented in the Montreal Protocol.
Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol), 1987	The Montreal Protocol restricts or eliminate production and use of substances that deplete the ozone layer, including Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs), and Hydrofluorocarbons (HFCs).
Minamata Convention on Mercury, 2013 (the Minamata Convention)	The Minamata Convention is designed to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. Mercury in lighting, for example, compact fluorescent lightbulbs (CFLs), are a key focus of the convention.
Stockholm Convention on Persistent Organic Pollutants, 2001 (Stockholm Convention)	The Stockholm Convention aims to eliminate or restrict the production and use of persistent organic pollutants (POPs). Relevant POPs include PCBs that have historically been used in electrical transformers.
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel Convention), 1989	The Basel Convention was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries. Hazardous wastes covered under this convention include refrigerants, mercury and asbestos.
Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Area (Cartagena Convention), 1983	The Cartagena Convention seeks to promote regional cooperation towards the protection and sustainable development of the Wider Caribbean Region.
Protocol Concerning Pollution from Land-Based sources and activities to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (LBS Protocol), 2001	The LBS Protocol provides the framework for addressing pollution based on national and regional needs and priorities, focusing on addressing the sources of pollution and the development of best management practices to prevent, reduce and control pollution in the Wider Caribbean Region. Key provisions include proper disposal of wastes.

4.3 International Standards

4.3.1 IDB Requirements and other Guidance

According to the IDB Safeguard Policy procedures, the program is expected to be classified as low-medium risk Category “B” in that it does not pose any significant environmental and social risk. The IDB is not requiring an EIA for the EMEP, but is requiring this EA report, and Environmental and Social Management System (ESMS), primarily an Environmental and Social Management Plan (ESMP) and stand-alone Waste Management Plan (WMP), presented later in this report.

Evaluation will be further guided by IFC Performance Standards on Environmental and Social Sustainability (IFC Performance Standards), as well as the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines).

5 Consultation

Stakeholder consultation is a critical step in EA process. It is a two way communication process that allows:

1) Information to be disseminated to stakeholders, including:
   a. Project details
   b. Potential impacts
   c. Proposed mitigation measures
2) Information to be collected from stakeholders, including:
   a. Baseline data
   b. Opinions, perspectives, concerns, and expectations that could lead to identification of potential impacts, mitigation measures and alternatives.

Consultation also builds relationships with key stakeholders to allow continued communication during project implementation.

As the project is expected to have minimal environmental impact, the EA team focused engagement activities during the initial stage of review to relevant government agencies, managers of representative facilities interviewed during the audits, and a private sector waste provider in Jamaica.

Engagement activities included:

1) Telephone interviews
2) Written correspondence
3) Interviews with managers of representative facilities (conducted during building audits)
4) In-person meetings with key government authorities

A summary of stakeholder engagement conducted is shown in Table 5-1 and additional detail on meeting content provided in the Environmental Audit and Consultation Mission Report provided in Appendix A and photographs of the site visit provided in Appendix B

Table 5-1: Summary of Stakeholder Engagement Conducted

Date & Time	Stakeholder	Meeting Type and Location	Objective	Participants for IDB
Wednesday, July 20th, 2016				
3pm	Taquise Gordon Smith, Director of Operations for Garbage Disposal & Sanitation Systems Limited (private sector waste provider in Jamaica)	Telephone interview	Call to gain an understanding of current waste management practices in Jamaica	John Black (Acorn International)
Thursday, July 20th, 2016				
2pm	Dr. Peter Ruddock, Manager, Renewable Energy and Energy Efficiency Department (REEED) and Winston Watson, Managing Director, PCJ/MSET	Telephone interview	Call to introduce team members, get a brief overview of each organization and their role in the project, and describe our scope of work.	John Black and Atma Khalsa (Acorn International)

Date & Time	Stakeholder	Meeting Type and Location	Objective	Participants for IDB
2:30pm	Meeting with Ms. Sacha Lawrence-Rose, Acting Director, Asset Management Unit, Ministry of Finance	Telephone interview	Call to introduce team members, get a brief overview of each organization and their role in the project, and describe our scope of work.	John Black and Atma Khalsa (Acorn International)
Monday, July 25th				
9am	Clifford Mahlung, Project Manager, Climate Change Division, Ministry of Economic Growth and Job Creation (MEGJC)	In-person interview, 25 Dominica Drive Kingston 5	Interview to gain better understanding of their role in the project, understand their questions and concerns, and identify potential laws and regulations that would apply to the proposed activities.	Ms Anaitee Mills & Wayne Williams (IDB), John Black (Acorn Intl)
11 am	Dr. Peter Ruddock, Manager, Renewable Energy and Energy Efficiency Department (REEED) PCJ/MSET	In-person interview, PCJ Office 36 Trafalgar Road, Kingston 10	Interview to gain better understanding of their role in the project, understand their questions and concerns, and identify potential laws and regulations that would apply to the proposed activities.	Wayne Williams (IDB), John Black (Acorn Intl) and Ms Jannelle James, (PCJ)
Tuesday, July 26th				
9 am	Raul Morgan, Services Manager, Kingston Public Hospital	Interview with management and audit of Kingston Public Hospital – Victoria Jubilee Hospital, KPH/VJH North Street, Kingston	Interview to better understand scope of works to be conducted, and audit to understand nature and extent of existing liabilities and potential impacts of proposed works.	Wayne Williams (IDB), John Black (Acorn Intl)
11 am	Meeting with Ms. Sacha Lawrence-Rose, Acting Director, Asset Management Unit, Ministry of Finance	In-person interview, MOF offices. 30 National Heroes Circle, Kingston 4	Interview to gain better understanding of their role in the project, understand their questions and concerns, and identify potential laws and regulations that would apply to the proposed activities.	Wayne Williams (IDB), John Black (Acorn Intl)

Date & Time	Stakeholder	Meeting Type and Location	Objective	Participants for IDB
Wednesday, July 27th				
11 am	Joseph Ramsay, Operations Manager, Cornwall Regional Hospital	Visit to Cornwall Regional Hospital, Mount Salem, Montego Bay	Interview to better understand scope of works to be conducted, and audit to understand nature and extent of existing liabilities and potential impacts of proposed works.	John Black (Acorn Intl)
Thursday, July 28th				
10:00 am – 11:00pm	Robert Green, Director/Principal, Heart Trust NTA - Ebony Park Academy	Visit to Heart Trust NTA – Ebony Park Academy, Toll Gate, Clarendon	Interview to better understand scope of works to be conducted, and audit to understand nature and extent of existing liabilities and potential impacts of proposed works.	John Black (Acorn Intl), Kevin Gallimore (PCJ)
12:00pm – 1:00pm	Ms Chevanese Risden, Property Manager, May Pen Revenue Centre	Visit to May Pen Revenue Centre (Tax Building), 7 Windsor Avenue, May Pen	Interview to better understand scope of works to be conducted, and audit to understand nature and extent of existing liabilities and potential impacts of proposed works.	John Black (Acorn Intl), Wayne Williams (IDB) and Kevin Gallimore (PCJ)
3:00 pm	Peter Knight, CEO, et al., NEPA	In-person interview, NEPA offices, 10 & 11 Caledonia Avenue, Kingston 5	Interview to gain better understanding of their role in the project, understand their questions and concerns, and identify potential laws and regulations that would apply to the proposed activities.	Wayne Williams (IDB), John Black (Acorn Intl)
Friday, July 29th				
8:00 am	Mike Saunderson, Traffic Management Specialist, NWA	In-person interview, NWA offices, 140 Maxfield Avenue, Kingston 10, and tour of civil work sites in Kingston	Interview to gain better understanding of their role in the project, understand their questions and concerns, identify potential laws and regulations that would apply to the proposed activities, and tour of civil works.	John Black (Acorn Intl)

In addition to the above, routine correspondence was conducted with IDB and other consultants to gather information on project scope.

A meeting with Percival Stewart, National Solid Waste Management Authority (NSWMA) was planned, but cancelled at their request. The EA team attempted to conduct a follow-up telephone interview but were unable to due to tropical storm.

Further, a public meeting is scheduled in early September to identify and integrate stakeholder concerns into the EA analysis and management plan, and a grievance mechanism will be implemented to ensure continued engagement and ensure stakeholders have a process to submit feedback and obtain a response from the government.

6 Risk and Impact Evaluation

The scope of activities is largely consistent with minor building renovations, thus the environmental, social, health and safety (ESHS) and labor impacts and risks associated with the program are expected to be limited. The program is expected to be classified as low-medium risk Category "B", largely because of the lack of waste management infrastructure in Jamaica.

There are four key potential ESHS concerns:
1) Potential contamination of soil and groundwater from improper hazardous waste management
2) Capacity of facilities to accept non-hazardous solid wastes
3) Risks to workers from occupational, health and safety hazards
4) Risks to facility upgrades from natural disaster

In addition, there are a number of positive impacts from the project, including:
1) Reduction of greenhouse gas (GHG) emissions
2) Reduction in traffic congestion and associated benefits (improved air quality, better fuel efficiency, well-being of commuters, etc.)

Each of these is described below.

6.1 Potential Contamination of Soil and Groundwater from Improper Hazardous Waste Management

EE upgrades will result in generation of wastes from renovation of government buildings. Most of the waste streams (i.e. scrap wood, concrete, glass, and cardboard) can be safely disposed of in available landfills. However, there are three waste stream that cannot, including:
1) Fluorescent light bulbs and thermostats that contain mercury
2) Air conditioning units that contain refrigerants
3) Asbestos containing materials

In addition the above, other potential sources of hazardous solid wastes could be generated (i.e. used oils). Management of other hazardous wastes is included in the Waste Management Plan found in Appendix C.

6.1.1 Fluorescent Light Bulbs and Thermostats that Contain Mercury

There are eight active disposal sites in Jamaica (Table 6-1). While outdated, the National Solid Waste Policy of 2000 notes there are no sanitary landfills in Jamaica and the sites have a number of environmental concerns, including[15]:

- Leaching of toxic and hazardous substances into the ground and surface water bodies at the disposal sites because they are unlined
- Transmission of infections to sorters and livestock that rummage through waste which often includes medical and hazardous wastes
- Uncontrolled burning as a result of spontaneous combustion from wastes with low flash points and/or buildup of methane
- Foul odors, vermin and flies resulting from uncovered waste

Research indicates little, if any, progress has been made since 2000 to address these issues.

Table 6-1: Active Disposal Sites in Jamaica

Name	Disposal Site	Size (ha)
Riverton	St. Catherine	43.50
Church Corner	St. Thomas	1.21
Martin's Hill	Manchester	7.82
Myersville	St. Elizabeth	3.7
Retirement	St. James	10.96
Tobolski	St. Ann	4.94
Hadden	St. Ann	3.88
Doctors Wood	Portland	n/a

Source: Planning Institute of Jamaica. 2007[23]

As noted in Section 2, lighting upgrades will be performed in up to 50 buildings. This will result in large volumes of fluorescent lightbulbs and the associated ballasts containing mercury that will need disposal. Thermostats containing mercury may also be replaced and need disposal.

There are no regulations or guidelines in Jamaica for disposal of mercury, and NEPA indicates all wastes containing mercury are currently sent to the Riverton City dump[24]. As noted above, no waste facility in Jamaica is lined, and none are adequate for disposal of mercury or other hazardous materials.

While fluorescent bulbs could be re-used locally, they will eventually need to be sent to a landfill which would result in uncontained mercury entering the environment. Further, Jamaica is a signatory of the Minamata Convention and is required to control disposal of mercury.

Mitigation measures are required to ensure no mercury enters the soil, groundwater and/or surface waters.

6.1.2 Air Conditioning Units that Contain Refrigerants

It is envisioned that inefficient air conditioning units will be replaced as part of the program. It is unknown what type of refrigerants are used in the old units, but it is likely that they could be Freon ® or other chlorinated hydrocarbon substances that deplete the ozone and are controlled under the Montreal Protocol. Mitigation measures are required to ensure no refrigerants are vented to the atmosphere.

[23] Planning Institute of Jamaica. 2007. Management of Hazardous and Solid Wastes in Jamaica. Accessed from the Ministry of Finance and Planning website: http://pioj.gov.jm/portals/0/sustainable_development/management_of_wastes.pdf

[24] Correspondence with NEPA.

6.1.3 Asbestos Containing Materials

While the EE upgrades are largely focused on replacement of windows, lighting and other activities that are unlikely to disturb asbestos, some of the buildings are >100 years old and, particularly the hospitals, could contain asbestos. If asbestos is present and needs to be abated, additional mitigation is required. This is largely a human health risk, but it is significant from an environmental perspective also.

6.2 Capacity of Facilities to Accept Non-hazardous Solid Wastes

As noted in Section 6.1, waste facilities in Jamaica do not meet good international industry practice guidance[25]. In addition to the poor practices described above, local waste facilities likely [23]:

- Allow third party access to site unrestricted
- Do not have a clear system for segregation and storage
- Allow large quantities of waste to be piled in the open with no compaction or other treatment
- Have poor housekeeping
- Do not manage stormwater runoff
- Have little to no inspection or safety/environmental mitigation

In 2006 it is estimated that Jamaica produced approximately 1,463,900 cubic tonnes of solid waste from residential, commercial and institutional sources. [23] Relative to the whole of Jamaica, non-hazardous waste volumes to be generated by this program will be negligible. Despite this, however, additional mitigation measures are required to minimize impacts of non-hazardous solid waste disposal.

6.3 Risks to Workers from Occupational, Health and Safety Hazards

The program may involve numerous hazards that pose risks to worker health and safety, including:

- Working at heights
- Heavy lifting
- Use of machinery and power tools
- Exposure to natural elements (i.e. heat)
- Slips, trips and falls
- Exposure to asbestos containing materials

While many of these are standard to the construction industry, and are readily managed by standard controls (i.e. use of personal protective equipment) it is unclear if such practices are common in Jamaica. Further, most of the buildings to be renovated have not had asbestos surveys, and the types of activities to be conducted at each building is not defined, so it is unclear if EE upgrades may involve disturbance and/or removal of asbestos containing materials.

[25] Including the World Bank EHS Guidelines for Waste Management, see: http://www.ifc.org/wps/wcm/connect/6e4e348048865839b4cef66a6515bb18/1-6%2BWaste%2BManagement.pdf?MOD=AJPERES

While replacement of windows and air conditioning units are unlikely to involve asbestos, installation of solar panels into roofing tiles and activities involving boilers have a higher likelihood.

Uncontrolled disturbance of potentially friable asbestos would pose significant risks to worker (both construction workers as well as others using the buildings) health and safety and mitigation would be required to address this concern.

6.4 Risks to Facility Upgrades from Natural Hazards

There are a number of natural hazards present in Jamaica that could damage EE upgrades, and climate change could increase the risk of many of these hazards.

A 2014 probabilistic hazard and risk assessment study conducted on behalf of IDB for Montego Bay, Jamaica identified the following hazards[26]:

- Pluvial inundation (flooding from rivers)
- Coastal inundation (sea level rise and storm surge)
- Wind
- Seismicity
- Landslides

While the audit of four sampling buildings to be upgraded suggest facilities to be upgraded are in good to excellent condition, risks from natural hazards exist, as described below, and mitigation measures are required.

6.4.1 Pluvial Inundation: Flooding from Rivers

Pluvial flooding is flooding of rivers, streams, or channels. Pluvial flooding is characterized by:

- Temporary inundation caused by precipitation
- Stormwater accumulation in the lowest elevations
- Inundation conditions exacerbated by impermeable surfaces and drainage problems (natural/soil or anthropogenic)
- Short periods of inundation

Areas most affected are those located adjacent to or near rivers (within historic floodplains). The 2014 IDB Probabilistic Hazard and Risk Assessment found that flood extent and water depth did not change significantly due to climate change over 25, 50 and 100 year return periods. Therefore, risk of pluvial inundation damaging EMEP works is limited if the building has no history of pluvial inundation.

6.4.2 Coastal Inundation: Sea Level Rise and Storm Surge

Coastal inundation can be caused by storm surge and/or sea level rise.

Storm surge is characterized by:

- Temporary coastal inundation
- Damage to coastal properties and resources (i.e. aquifers)
- Worsened coastal erosion, loss of beach front and damage to coastal infrastructure

[26] IDB. 2014. Urban Development and Climate Change: Probabilistic Hazard and Risk Assessment.

Sea level rise is characterized by:

- Slow, but permanent sea level rise
- Degradation of shoreline structures and supporting infrastructure as a result of increased coastal flooding

The 2014 IDB Probabilistic Hazard and Risk Assessment found sea level in Jamaica is expected to rise by between .16 - .30 m by 2095. Sea level rise is generally related to climate change. Storm surge is most often associated with storms, and whereas the frequency of storms is expected to decrease, the intensity is expected to increase. However, in spatial terms (as in the case of pluvial inundation), storm surge impacts is expected to remain the same. Therefore, risk of coastal inundation damaging EMEP works is limited if the building has no history of pluvial inundation.

6.4.3 Wind

Strong winds, mostly associated with tropical depressions and storms, or hurricanes, can cause significant damage to structures. It is unclear what level of exposure buildings to be renovated by the EMEP will face, but is expected highest wind speeds will occur on windward facing areas (i.e. north and east) near the coast.

The 2014 IDB Probabilistic Hazard and Risk Assessment found the effects of climate change on wind patterns is unclear. With more intense storm events, wind speeds will also be more intense, but the number of storms is expected to decrease so the risk of damage from wind could be considered similar to the current conditions.

Nevertheless, damage to EMEP building infrastructure from wind could result, particularly impacting external features (i.e. solar PV cells and windows).

6.4.4 Seismicity

As described in Section 3, Jamaica is seismically active with over 200 earthquakes per year. Generally, earthquakes in Jamaica are less than 4.0 magnitude which are considered fairly minor, although large earthquakes that have caused significant damage to buildings have been reported. Seismic activity can result in significant damage to buildings and infrastructure, either from direct or secondary impacts (i.e. fire).

While seismic activity occurs independent of climate change, and thus is not expected to increase, earthquakes could damage EMEP works.

6.4.5 Landslides

Jamaica, and Kingston in particular, is subject to routine landslides resulting from a combination of geology, seismicity and precipitation.[27] Landslides cover approximately 4.77% of Kingston's mountainous terrain and the frequency is increasing with urbanization and development of geologically active slopes. Increased storm intensity from climate change may trigger additional landslides, however given the location of buildings to be updated is unknown, it is unclear what level of risk landslides may cause on the project.

[27] UWI. 1999. Landslides in Jamaica: Natural Hazards and Disasters. Accessed from the UWO website: http://www.mona.uwi.edu/uds/Land_Jam.html

6.5 Reduction of Greenhouse Gas Emissions

The specific objectives and expected results of this project are:

1) Reduced electricity consumption within government facilities
2) Decreased fuel consumption through improved traffic control management;
3) Reduced GHG emissions
4) Increased capacity to promote and supervise electricity planning in Jamaica.

The program will reduce electricity and fuel use significantly, thus the project will result in a significant reduction of GHGs.

Building upgrades may have additional indirect benefits, including improved patient, student and worker well-being from better air conditioning and lighting. These indirect benefits are likely positive, but of low significance.

6.6 Reduction in Traffic Congestion

Preliminary models show that the fuel efficiency component could increase average car speeds in corridors of Kingston from the current 22 km/h to 28 km/h, and this would imply reducing the traffic fuel consumption in those corridors by 40%. This reduction in traffic congestion would have many indirect benefits on human well-being, including lowering GHG, improving air quality in Kingston, increase fuel efficiency and lower fuel costs, and reduce stress caused by traffic.

A cost benefit analysis will be conducted for the project, and is expected to show significant benefits in traffic reduction.

7 Environmental and Social Management System

7.1 Environmental, Social, Health and Safety, and Labor Management

This Section describes the Environmental and Social Management System (ESMS) for the project. Ultimately, it is the responsibility for the PEU to manage ESHS and labor concerns. However, the work will be completed by contractors and they will have functional responsibility for managing ESHS and labor impacts and risks.

Specific actions that will be performed for this project include implementation of:

- Environmental and Social Management Plan (ESMP)
- Waste Management Plan
- Health and Safety Plan
- Training and Awareness
- Monitoring and Evaluation
- Grievance Management

Each of these are described below.

7.2 Environmental and Social Management Plan (ESMP)

Four key negative impacts / risks were identified for the program, including:

1) Potential contamination of soil and groundwater from improper hazardous waste management
2) Capacity of facilities to accept non-hazardous solid wastes
3) Risks to workers from occupational, health and safety hazards
4) Risks to facility upgrades from natural disaster

Mitigation measures for each, along with responsibility, schedule, monitoring, training / resources, and reporting requirements are provided in Table 7-1.

Investment Grade Audits are being performed to inform decision making and maximize positive benefits. Detailed selection of EE and EM activities and careful site selection are currently under consideration. These positive benefits are not discussed in the ESMP.

Table 7-1: ESMP

Impact / Risk	Mitigation Measure	Responsibility	Schedule	Monitoring	Training / Resources	Reporting
Potential contamination of soil and groundwater from improper hazardous waste management, including 1) Fluorescent light bulbs and thermostats that contain mercury 2) Air conditioning units that contain refrigerants 3) Asbestos containing materials	Collect and safely store all fluorescent light bulbs, thermostats, and other waste that may contain mercury.	Building contractor (s)	During construction	Weekly site visits by PEU	Ensure PEU staff conducting monitoring understands what sources of mercury are present	Complete full inventory of number of bulbs to be replaced prior to construction
	At the end of the program, export all mercury containing materials to an approved waste facility.	PEU	At end of program	Weekly site visits of storage site(s)	Ensure PEU staff are aware of the export and permitting process 3rd party waste exporter	Permit to export waste from NEPA Waste manifests and facility Invoices upon export
	Send all air conditioning units to the MoF collection facility. If possible, re-use in other facilities. If units need to be disposed of, hire trained technician to remove refrigerant prior to disposal.	MoF	During construction	Track final use/disposal of each air conditioning unit	External air conditioning specialist services, as needed	Complete full inventory of number air conditioning to be replaced, number re-used and number disposed Invoices from 3rd party air conditioning specialist services
	Once building specific EE measures have been defined, hire a certified specialist to screen activities that may disturb asbestos. If there are any high risk activities (i.e. replacement of boiler or pipe insulation), conduct asbestos survey of applicable building components. If asbestos is found, hire certified specialist to remove or manage the asbestos to a certified facility.	PEU	Prior to construction	Asbestos screening reports Asbestos survey reports (if any)	Ensure PEU staff are aware of the risks of asbestos External asbestos specialist	Waste manifests and facility invoices
	Track new Hazardous Waste Management Policy and E-waste regulations currently being promulgated by MEGJC and,	PEU	Prior to and during construction	Check the MEGJC website weekly for the new policy and regulation	Update PEU staff and contractors on new requirements, as applicable	Update ESMP and WMP if needed to meet requirements of

Impact / Risk	Mitigation Measure	Responsibility	Schedule	Monitoring	Training / Resources	Reporting
	once available, review and revise practices as needed					new policy and regulations
Capacity of facilities to accept non-hazardous solid wastes	Implement a Waste Management Plan.	PEU	During construction	Weekly site visits	Ensure PEU staff are aware the Waste Management Plan requirements Provide training to contractors on requirements of Waste Management Plan	Waste Manifests Chain of custody forms Receipts of waste disposal
Risks to workers and other building occupants from occupational, health and safety hazards	Contractors must submit Health and Safety Plans that include: • Identification of health and safety hazards • Measures to minimize hazards to workers • Risk categorization • Relevant procedures, training and other controls and risk reduction measures (e.g. personal protective equipment, training, management programs, etc.) to protect workers and the public.	PEU	During construction	Weekly site visits	Ensure PEU staff are aware HASP content requirements Communicate HASP requirements to contractors in advance of construction	Contractor progress reports Records of incidents and near misses
	Implement simple grievance mechanism to accept and address concerns of workers, building occupants and the public.	PEU	During construction	Daily review of grievance log and pending actions	Ensure PEU staff are aware of basic function and expectations of grievance management Communicate grievance process to contractors, workers and public.	Grievance log and records of remedy

Impact / Risk	Mitigation Measure	Responsibility	Schedule	Monitoring	Training / Resources	Reporting
	Track new Occupational Health and Safety Act currently being promulgated by Ministry of Labour and Social Security	PEU	Prior to and during construction	Check the Ministry of Labour and Social Security website weekly for the new Act Review contractor HASPs to ensure they comply with new requirements	Update PEU staff and contractors on new requirements, as applicable	Updated HASPs, upon promulgation of new Act
Risks to facility upgrades from natural hazards	Apply the International Building Code (IBC) for RE and EE construction, particularly to retrofit for low elevation flooding and high winds.	PEU	Prior to construction	Final inspection of construction works	Independent technical advisor	Final inspection report
	Develop Emergency Response Plan to prepare for extreme weather events.	PEU	Prior to construction	Conduct at least one unannounced drill at each facility	Ensure PEU staff and other individuals involved in emergency response are trained on the Emergency Response Plan, especially on their roles and responsibilities	Summary of emergency response drills

7.3 Waste Management Plan

Developing and consistently applying an EMEP-specific Waste Management Plan will ensure that all wastes from the program are properly managed in accordance with applicable laws and regulations and relevant international standards. Having a Waste Management Plan in place will help prevent accidental release of wastes by presenting safe handling, storage and disposal methods for each waste generated during program activities.

The EA team has prepared a Waste Management Plan for this project – it is included in Appendix C. The Waste Management Plan includes:

- Description of the types of wastes that will be generated
- Waste minimization opportunities
- Waste management methods
- Recordkeeping practices, including manifest and waste tracking forms

7.4 Health and Safety Plan

To ensure worker health and safety, the selected contractor(s) must submit a Health and Safety Plan (HASP) to the PEU for review prior to starting work.

The HASP should include:

- Identification of health and safety hazards
- Measures to minimize hazards to workers
- Risk categorization
- Relevant procedures, training and other controls and risk reduction measures (e.g. personal protective equipment, training, management programs, etc.) to protect workers and the public.

The HASP should be kept at each construction site for reference. The implementation of the HASP will mitigate or minimize health and safety impacts by ensuring that workers understand hazards specific to the program and how they can prevent incidents from occurring.

7.5 Training and Awareness

Successful implementation of the ESMP requires knowledge and understanding of the key issues by the PEU and often the contractor. If the PEU staff responsible for meeting requirements of the ESMP does not have a good understanding of these concerns, training is required. The PEU will also need to clearly articulate the issues defined in the ESMP to contractors and confirm PEU expectations and contractor roles and responsibilities.

Areas for training and awareness identified in the ESMP include:

- Ensure PEU staff conducting monitoring understands what sources of mercury are present
- Ensure PEU staff are aware of the waste export and permitting process
- Ensure PEU staff are aware of the risks of asbestos
- Ensure PEU staff are aware the Waste Management Plan requirements
- Provide training to contractors on requirements of Waste Management Plan
- Ensure PEU staff are aware HASP content requirements
- Communicate HASP requirements to contractors in advance of construction

- Ensure PEU staff are aware of basic function and expectations of grievance management
- Communicate grievance process to contractors, workers and public.
- Ensure PEU staff and other individuals involved in emergency response are trained on the Emergency Response Plan, especially on their roles and responsibilities

7.6 Monitoring and Evaluation

The PEU has ultimate responsibility for ensuring program compliance with the ESMS and applicable regulations. The PEU must dedicate personnel to review contractor performance against ESMS requirements. Weekly site visits should be conducted and contractors should submit routine progress reports with ESHS related information. Progress reports should contain records of any incidents, including near misses, as well as waste manifests and chain of custody forms as describe in the WMP.

7.7 Grievance Management

While EMEP activities are consistent with normal minor construction and building repairs; noise, traffic and other nuisances may result. A fit for purpose grievance redress process should be implemented to allow concerns to be identified and addressed. This mechanism should also apply for worker concerns. The PEU should design a simple process and ensure contractors, building management and the public are aware of how to submit complaints, and the process for resolution and closure.

8 Conclusions and Recommendations

The program has been classified as low-medium risk Category "B", likely to have only "local and short-term negative environmental and associated social impacts for which effective mitigation measures are readily available". Key impacts/risks (summarized in Table 8-1) are related to:

- Disposal of wastes (hazardous and non-hazardous)
- Occupational health and safety
- Risks to facility upgrades from natural hazards

Table 8-1: Summary of Impacts and Proposed Mitigation Measures

Impact / Risk	Mitigation Measure
Potential contamination of soil and groundwater from improper hazardous waste management, including 1) Fluorescent light bulbs and thermostats that contain mercury 2) Air conditioning units that contain refrigerants 3) Asbestos containing materials	Collect and safely store all fluorescent light bulbs, thermostats, and other waste that may contain mercury.
	At the end of the program, export all mercury containing materials to an approved waste facility.
	Send all air conditioning units to the MoF collection facility. If possible, re-use in other facilities. If units need to be disposed of, hire trained technician to remove refrigerant prior to disposal.
	Once building specific EE measures have been defined, hire a certified specialist to screen activities that may disturb asbestos. If there are any high risk activities (i.e. replacement of boiler or pipe insulation), conduct asbestos survey of applicable building components. If asbestos is found, hire certified specialist to remove or manage the asbestos to a certified facility.
	Track new Hazardous Waste Management Policy and E-waste regulations currently being promulgated by MEGJC and, once available, review and revise practices as needed
Capacity of facilities to accept non-hazardous solid wastes	Implement a Waste Management Plan.
Risks to workers and other building occupants from occupational, health and safety hazards	Contractors must submit Health and Safety Plans that include: • Identification of health and safety hazards • Measures to minimize hazards to workers • Risk categorization • Relevant procedures, training and other controls and risk reduction measures (e.g. personal protective equipment, training, management programs, etc.) to protect workers and the public.
	Implement simple grievance mechanism to accept and address concerns of workers, building occupants and the public.
	Track new Occupational Health and Safety Act currently being promulgated by Ministry of Labour and Social Security
Risks to facility upgrades from natural hazards	Apply the International Building Code (IBC) for RE and EE construction, particularly to retrofit for low elevation flooding and high winds.
	Develop Emergency Response Plan to prepare for extreme weather events.

To manage these impacts/risks, a fit-for purpose Environmental and Social Management System is provided, including Environmental and Social Management Plan (ESMP) and Waste Management Plan (WMP). In addition, the contractor and PEU will need to develop additional plans (i.e. Health and Safety Plan and Emergency Response Plan).

Appendix A: Environmental Audit and Consultation Mission Report

Environmental Audit and Consultation Mission Report: Environmental Analysis of Jamaica Energy Management and Efficiency Program (Project Number JA-L1056)

Introduction

Inter-American Development Bank (IDB) engaged Acorn International to conduct Environmental Analysis (EA) of the proposed Jamaica Energy Management and Efficiency Program (EMEP, or the program), Project Number JA-L1056. As part of our scope of work, John Black or Acorn International led a site visit to Jamaica July 25-29 to lead stakeholder consultation and conduct audits of four representative public buildings.

This Environmental Audit and Consultation Mission Report provides a summary of consultation and audits. Findings of the audits will be described in more detail in the EA Report.

Key meetings included:
1. Ministry of Economic Growth and Job Creation
2. Petroleum Corporation of Jamaica
3. Ministry of Finance
4. National Environmental Protection Agency
5. National Works Authority
6. Audit 1: Kingston Public Hospital / Victoria Jubilee Hospital
7. Audit 2: Cornwall Regional Hospital, Mount Salem, Montego Bay
8. Audit 3: HEART Trust NTA – Ebony Park Academy
9. Audit 4: May Pen Revenue (Tax) Center

Another meeting was planned, with the National Solid Waste Management Authority (NSWMA), but it was postponed at their request. We are trying to organize a conference call to replace that meeting.

Summary of the meetings and audits are provided below.

1. Ministry of Economic Growth and Job Creation (MEGCJ)

Address:
16A Halfway Tree Road, Kingston 5

Attendees:
Clifford Mahlung, Project Manager, Climate Change Division, MEGCJ;
Anaitee Mills, IDB; Wayne Williams, IDB Consultant; John Black, Acorn International (Collectively: "IDB").

Acorn INTERNATIONAL

Discussion:
MEGCJ described Jamaica's on-going intent to honor its commitments (not a binding target) to lowering its GHG footprint by 10 percent. Evidently, with changes already made, they have achieved the 10% target and will review the target in 2018, to achieve a 20% reduction by the year 2025.

IDB described the current EMEP, which today replaces an earlier energy efficiency program (EEP) that was cancelled by the Jamaica Government, after operating from 2007 through 2015. In the former EEP 2010 baseline, building envelope issues (missing window glass, leaky door and window seals, etc.) were not addressed.

The current Program has three main components:

Component 1 (US$24.6 million) will finance EE and EC measures in government facilities, concentrated in the health and education sectors. Activities include:

i. Investment-grade audits
ii. Purchase, installation, maintenance and operation of appropriate EE and EC technologies and measures within selected government facilities.
iii. Technical expertise and support for the Project Execution Unit (PEU), including training in EE maintenance (highlighted by gender) that would be extended to facilities teams in each building
iv. Set up of an instrument to manage the financial savings accruing from the reduction in energy consumption within government facilities

Component 2 (US$3.7 million) will finance fuel efficiency in the transport sector. Activities include:

i. Purchase and installation of equipment to facilitate the implementation of an Urban Traffic Management System (UTMS) in Kingston, such as fiber optic cables, traffic lights, cameras, sensors, planning software, communication technology maintenance equipment and training support
ii. Technical study to assess how the public transport sector, which is a fairly heavy user of oil and heavy fuel, can obtain EE from diversifying their fuel sources.

Component 3 (US$1.8 million) will finance institutional strengthening for energy planning. This component will build on previous studies commissioned by the IDB regarding institutional weaknesses and gaps in systems and technical capacity for wider energy planning. Activities include:

i. Development of information systems
ii. Training and technical support for energy planning in Jamaica with a particular focus on planning and supervision of EE and RE.

IDB described the design and implementation role of the Petroleum Corporation of Jamaica (PCJ), a wholly-owned subsidiary or branch of the national Ministry of Science and Energy Technology (MSET). IDB indicated that the earlier EEP had audited six facilities, but the Program would entail more detailed Investment Grade Audits that would feed into engineering designs for the selected facilities. IDB indicated that the current Program is budgeted at US $30M, with $15M being provided by IDB, and $15M being provided by the Japan International Cooperation Agency (JICA). An additional $10M is being sought from the EU, either to supplement the above, or to replace, in part, the contributions being made by IDB and JICA.

As part of IDB's contribution, an Environmental and Social Assessment (ESA) is to be performed on four representative facilities. These four are: Kingston Public/Victoria Jubilee Hospitals (KPH/VJH) in Kingston; Cornwall Hospital, in Montego By; HEART Trust NTA – Ebony Park Academy, in Ebony Park; and May Pen Revenue Center, in May Pen. IDB described the inputs required for the ESAs, including the age and usage of the facility; construction existing/current condition; utilities; business operations performed; chemicals and fuels used, their management and storage; history and/or evidence of contamination on the site; adjacent facilities and their operations; and the like. In addition to the ESAs, IDB indicated that Acorn International would also be preparing a Waste Management Plan (WMP) for use throughout the Program, to ensure that waste materials generated during the Program would be properly managed. The topic of Waste Management was not detailed in the earlier EEP.

2. Petroleum Corporation of Jamaica (PCJ)

Address:
36 Trafalgar Street, Kingston 10

Attendees:
Dr. Peter Ruddock, Renewable Energy and Energy Efficiency Department (REEED) Manager, PCJ; Wayne Williams and John Black (collectively "IDB")

Discussion:
PCJ has been designated as the execution entity for the design and implementation of the Program. Since 1978, PCJ has been involved with energy security for the country, operates the PetGen refinery, and until recently, operated a network of retail gas stations (PetCom) across the country. However, that business was recently sold off. In addition to its involvement with fossil fuels, PCJ is also charged with developing renewable energy sources and energy efficiency. PCJ is aware of the Program, which was briefly described by IDB, mentioning the purpose of Acorn International's role in performing the ESAs for the four "sample" sites mentioned above. As the executing agency of the Program, PCJ indicated that they would have Ms Jannelle James as their representative present during the visits to the four sites.

3. Ministry of Finance (MOF)

Address:
30 National Heroes Circle, Kingston 4

Attendees:
Ms. Sacha Lawrence-rose, Acting director, Asset Management Unit (MOF);
Wayne Williams and John Black (collectively "IDB")

Discussion:
MOF is well aware of the Program, and Acorn International's role in preparing ESAs and a WMP. However, MOF was pleased to see that solar electric power generation has been added into this Program, that was absent from the previous EEP.

MOF's role is in transparently disposing of, or re-assigning, the old air conditioning equipment released by the Program, and being replaced by new higher efficiency units. MOF was particularly interested in the procedure in which units to be removed from a facility would be inventoried while still in place, so that they could track them through the eventual re-assignment or eventual sale by auction, managed by MOF. MOF provided a status list of the a/c units that have already been re-

assigned, sold or disposed of from 12 governmental entities. The discussion asked about the fate of the Freon ® contained in the units being retired, and what happens to waste oils generated during the Program. These questions will be answered in the WMP to be prepared. MOF was interested in the selection procedure that resulted in the 35 facilities now on the list. For the lighting component of the Program, MOF noted that there have been concerns raised about the use of street lights using LED bulbs that emit a blue light that some people have trouble with. (These bulbs could be problematic for people either at night or in spaces that do not have natural daylight) (AMA, June 14, 2016 Annual Meeting, Chicago). MOF expressed a desire to be more highly integrated into the Program than they had been in the earlier EEP.

4. National Environmental Protection Agency (NEPA)

Address:
10 & 11 Caledonia Avenue, Kingston 5

Attendees: Peter Knight, CEO (and many others from NEPA), Wayne Williams and John Black (collectively "IDB").

Discussion:
IDB indicated that there are uncertainties regarding the classification of the waste materials that could be generated during the Program, and requested some clarifications. NEPA reminded IDB that they had responded to questions previously posed by IDB, and distributed copies of their previous responses. Nevertheless, IDB pressed to get at some "understanding" regarding the potential fate of the wastes, as follows (keeping the order used in NEPA's 15 June 2016 responses):

1. Used oil (engine oil in particular) – NEPA reiterated that while there are no clearly mandated procedures for handling used oil, there are companies in Jamaica that do collect and re-process it.
2. Air conditioning units – again, NEPA reiterated that while there are no clearly mandated procedures for decommissioning used a/c units, there are companies in Jamaica that do that. NEPA reminded IDB that the refrigerants, e.g. Freon ®, or R-22, are to be captured to the extent possible (trained technicians can do that). The captured used refrigerant can be stored (indefinitely it would seem) without a permit, or they could be exported to a country that could either use them or properly dispose of them. Export would likely require notification to NEPA, who might issue a permit authorizing the export.
3. Hazardous waste - again, NEPA reiterated that while there are no formalized procedures for handling hazardous waste, or permitted sites for the disposal or treatment of hazardous waste. Hazardous wastes could be exported, pursuant to the User's Guide for Transboundary Movement of Hazardous Waste. Export would likely require notification to NEPA, who might issue a permit authorizing the export. Issuance of an export permit by NEPA could take more than six months, however.
4. Mercury - again, NEPA reiterated that mercury, small quantities, e.g. domestic thermometers or thermostats, are currently disposed of in municipal landfills, but that if the Program were to generate a truck-load of mercury-containing equipment, landfills might not accept it. Again, export was given as an option for the disposal of mercury, subject to the Minamata Convention. Export would likely require notification to NEPA, who might issue a permit authorizing the export. Issuance of an export permit by NEPA could be a lengthy process, as noted above for hazardous waste.

5. e-wastes – NEPA again reminded IDB that MEGCJ has legislation addressing e-waste, that is scheduled to be made public by the end of August 2016. We should consult that guide in due course.
6. (Not specifically in NEPA's previous responses) Asbestos containing materials (ACM) – NEPA mentioned that while there are no formalized procedures for the disposal of ACM, it is currently being collected, bagged and placed in metal containers, to ensure its isolation, before being landfilled. The preferred landfill is known as Riverton.
7. (Not specifically in NEPA's previous responses) Polychlorinated biphenyls (PCBs) – IDB indicated that PCBs had been used in electrical power transformers, but were being phased out. NEPA indicated that spent PCBs may become hazardous waste, and could be addressed as such. IDB noted that in many cases, transformers remained the property of the power company that installed them, in this case - Jamaica Public Service (JPS). NEPA indicated that JPS has procedures for draining and replacing PCBs with a less hazardous dielectric fluid. IDB should find out what those procedures are. When asked what JPS did with the PCBs, NEPA replied that they probably exported them. IDB might look into that possibility also, if any PCB-containing transformers encountered in the Program are government-owner, as distinct from JPS-owned.

NEPA also mentioned that where there are no Jamaica regulations governing any of the above, IDB was at liberty to propose to follow the regulations of a country that has such regulations.

5. National Works Authority (NWA)

Address:
140 Maxfield Avenue, Kingston

Attendees:
Michael (Mike) Saunderson, Intelligent Transportation System Specialist, for NWA; and
John Black, for IDB

Discussion:
NWA described the scope of the traffic management upgrades. It included the installation of inter-connected traffic lights and sensors along various routes, particularly in Kingston, as well as camera systems located on existing poles, at strategic locations. The inter-connection of the traffic lights, cameras and sensors is to be made by means of fiber-optic cables, and a central control system, located in NWA's office building. Installation of the fiber-optic cables is being performed in conjunction with telephone companies Digicel and Flow; in both instances, the telephone companies are allowing access to their rights-of-way in exchange for the availability of some ducting.

The ducting consists of flexible plastic tubing, bundled into a plastic sheathing. The duct is installed in either a two-inch wide trench in the sidewalk, or in a four-inch wide trench in the street. Trenching is performed by specialized trenching machines to a depth of up to 18 inches.

Installation activity is being performed at night and on Sundays, to minimize the adverse impact to traffic – vehicles and pedestrians, as well as to the construction crews. The program is underway, with production of approximately 600m per shift. Once the trench has been dug and the ducting installed, the trench is backfilled with excavated material, and topped with granular fill, over which the traffic may cross for compaction. When considered complete, the duct trench is topped with asphalt.

NWA showed the control room already in operation in their building, and provided a brief tour around parts of the city to show where some of the installations have been completed, and some that were partially completed on the previous shift. The visible profile of the finished trenches is very low. Control boxes and equipment manholes are installed at appropriate locations. Again, the visible profile of the associated structures is very low, and likely largely unnoticed by the general population.

Audit 1: Kingston Public Hospital (KPH) / Victoria Jubilee Hospital (VJH)

Address:
North Street, Kingston

Attendees:
Mrs. Maxine Allen, KPH/VJH Hospital Administrator, and Raul Morgan, Services Manager, both of KPH (collectively "KPH); Jannelle James, Program Engineer, IDB; Wayne Williams and John Black (collectively "IDB")

Discussion:
IDB described the overall objectives of the Program, and the data requirements for the ESA planned for this facility. However, given the complexity of the facility – two hospitals, multiple buildings of different ages and constructions, lack of clear history of the site, and the time constraint of the visit, IDB proposed to run through the checklist, then visit selected potentially critical locations on the site. These were: the main boiler house; the stand-by electric generating plant; and the underground water cistern (tank). Accordingly, the checklist was completed and the above mentioned facilities were visited briefly. Numerous pictures were taken of the exterior of the entire site – looking at both the facilities on-site as well as neighboring ones.

Audit 2: Cornwall Regional Hospital

Address:
Mount Salem, Montego Bay

Attendees:
Joseph Ramsay, Operations Manager, Cyril Bailey, Electro/mechanical Supervisor, and Lerose Perry, Program Manager, and former Operations Manager, all of CRH; John Black, Acorn International, on behalf of IDB. (PCJ's representative did not attend the visit).

Discussion:
IDB informed CRH of the purpose of the visit, being part of the Program; CRH seemed to be well aware of the Program, so little time was spent in discussing it further. Most of the time spent during the visit was in filling out the checklist that Acorn Intl had prepared. Following that, a brief tour was made, focusing on the potentially most environmentally significant aspects of the site – fuel storage, generators and boilers. CRH indicated that they would provide by email information missing from the checklist.

Audit 3: HEART Trust NTA – Ebony Park Academy

Address:
Ebony Park, Clarendon

Attendees:
Robert Green, Director/Principal, Hughcal Spence, maintenance operative, both of the Ebony Park Academy ("EPA"); John Black, Acorn International, on behalf of IDB, and Kevin Gallimore, PCJ's representative.

Discussion:
IDB informed EPA of the purpose of the visit, being part of the Program; EPA seemed to be well aware of the Program, so little time was spent in discussing it further. Most of the time spent during the visit was in filling out the checklist that Acorn International had prepared. Following that, a brief tour was made, focusing on the aspects most likely related to the Program, and to the potentially most environmentally significant aspects of the site – fuel storage, generators and boilers. It should be noted that EPA covers some 500 acres in total, with 300 of them in their farm; the remaining 200 acres are occupied by the administrative building, the classrooms, laboratories, dorms and staff housing.

Audit 4: May Pen Revenue (Tax) Center

Address:
7 Windsor Avenue, May Pen

Attendees:
Ms. Chevanese Risden, Property Manager, MPRC; John Black, Acorn International, on behalf of IDB, Kevin Gallimore, PCJ's representative, and Wayne Williams, of IDB.

Discussion:
IDB informed MPRC of the purpose of the visit, being part of the Program; EPA seemed to be well aware of the Program, since the facility received a major up-graded air conditioning unit in March. Most of the time spent during the visit was in filling out the checklist that Acorn Intl had prepared. Following that, a tour was made around both the inside and outside of the single building that occupies the site. Notwithstanding the new a/c unit, air conditioning in the facility is far from satisfactory (i.e. in parts of the building where old a/c units are still in use, or non-existing, the temperature remains higher than desired).

Appendix B: Photographs of Site Visit

Photographs of Kingston Public Hospital

a) General View

b) Boilers

c) Boiler room floor (oil spill)

d) Back-up Generator

e) Back-up Generator

f) Leaking transformer

g) Roofs, windows and local coolers

h) Main water pumps

Photographs from Cornwall Regional Hospital

a) General view

b) Basement

c) Out of service boiler

d) Boiler room and spill

e) Windows, back-up generator and fuel tank

f) New addition (below), louver winders (above)

g) Medical waste bags (improper storage)

Photographs of Ebony Park Academy

a) Boiler

b) General view (incl. coolers and open windows)

c) Classroom / lab, (corrugated roofing, and open windows)

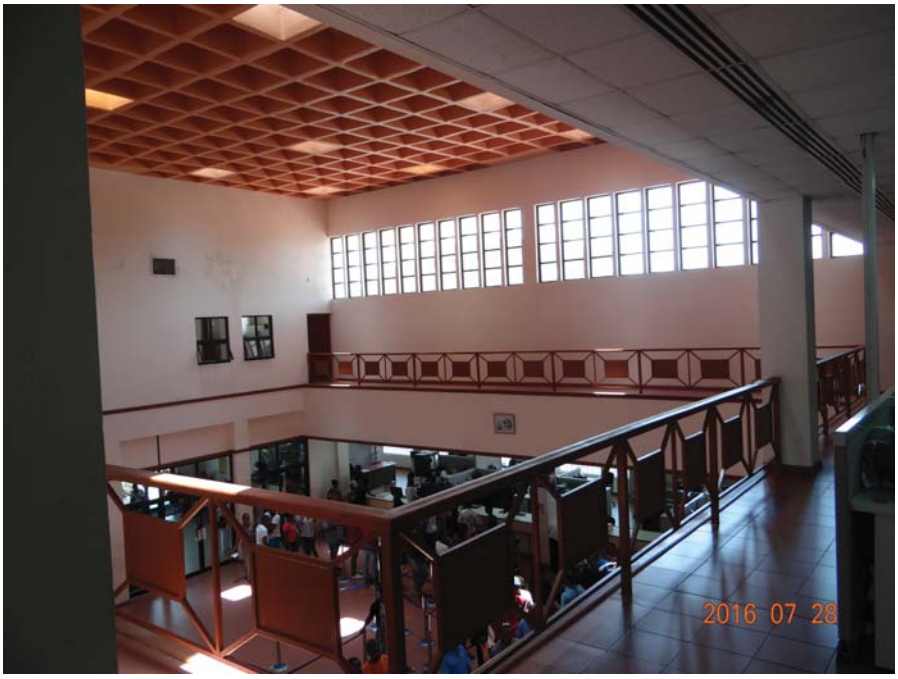
d) Storage tank for back-up generator

e) Pole-mounted transformers, one leaking

f) Back-up generator

Photographs of May Pen Revenue Centre

a) Back-up generator



b) Customer service atrium

c) A/C vents

d) Main entrance

e) General view

f) Local coolers

g) New main A/C units

h) Storage tank for back-up generator (no secondary containment, leaking)

Appendix C: Waste Management Plan

Environmental Analysis for Jamaica Energy Management and Efficiency Program (Project Number JA-L1056)

Waste Management Plan

August 2016

Contents

Appendices

Waste Management Plan

This Waste Management Plan (WMP) has been prepared for the Energy Management and Efficiency Program (EMEP, the Program) being undertaken in Jamaica. It has been prepared in part to satisfy the requirements of the Inter-American Development Bank (IDB), which is financing the Program.

Prior to, or during the implementation of the Energy Management and Efficiency Program (the Program), legislation that currently does not regulate any of the waste materials discussed herein might be promulgated by NEPA or another relevant governmental agency in Jamaica. Should that occur, this WMP should be revised to accord with the requirements of such new legislation.

1 Generalities

1.1 Background

The EMEP, to be partially funded by the IDB ,plans to provide (1) energy efficiency upgrades to more than 35 government-owned facilities around the country, (2) upgrades to the lighting systems in approximately 50 government-owned facilities, and (3) up-grade the traffic management system, in Kingston in particular. In the course of making these improvements, certain waste materials are expected to be generated.

For the energy efficiency component (1), the wastes likely to be generated include, or may include:

- Old air conditioning units (both centralized systems and individual room-size units
- Refrigerants
- Window and door frames and glass
- Doors
- Construction debris (including roofing materials, concrete, brick, plaster, wood, etc.)
- Ceiling tiles
- Thermostats (that may contain mercury)
- E-waste (old electronic equipment.

Normally, electrical power transformers, either pole-mounted or standing on a pad, that service a facility are the property of the electric power company. It is not anticipated that transformers would be included as “waste” materials in this Program, and are not discussed further.

For the lighting component (2), the waste stream could include: old lighting fixtures; ceiling board and tile; framing materials; wiring, harnesses and switches.

For the traffic management component (3), the wastes to be generated could include:

- Excavated street and sidewalk construction materials
- Old control equipment (the cabinet and their contents)
- Wiring
- Excess plastic ducting materials
- Old man-hole boxes
- Excess fiber-optic cabling

- Excess street repair materials (fill materials, asphalt and concrete).

This WMP is designed to show how these waste materials may be properly handled, from the time they are generated until their final disposition. It is understood that the schedule for performing the necessary upgrades will take approximately four years, commencing sometime in 2017 at the earliest, and potentially later.

The National Environment & Planning Agency (NEPA) informed IDB that as of 15 June 2016 (Appendix A) there were no environmental regulations in place in Jamaica governing the management and disposal of used (engine) oil, decommissioning of air conditioning units, hazardous waste, mercury and e-waste. However, NEPA did indicate that the Ministry for Economic Growth and Job Creation (MEGJC) was completing legislation for the handling of e-wastes that were expected to be ready for public use by the end of August 2016. During a meeting held with NEPA in Kingston on 28 July 2016, NEPA advised that there are currently no regulations governing the management of asbestos.

1.2 Regulatory Environment

Absent any Jamaica-specific regulations for the wastes noted above, that could be generated during this Program, as noted by NEPA at the 28 July 2016 meeting, NEPA suggested that this WMP should propose Program specific standards of waste management that could be applied to this Program. Accordingly, where no current regulations in Jamaica have been identified, wastes should be managed as described herein.

1.3 Objectives

The over-arching objectives of this WMP are to:

a. Ensure that waste materials generated during this Program are managed so as to minimize adverse impacts to public health;
b. Promote the safety of those engaged in performing the work; and
c. Minimize adverse effects of the wastes on the environment.

These objectives are expected to be achieved by having clear instructions or recommendations on how the different waste materials shall be handled, by the use of appropriate personnel protective equipment (PPE) being worn by those performing the work, and by adhering to relevant standards for the treatment and/or disposal of the waste materials, as described below.

As with all construction-related Programs, the area being worked on should be isolated from the general public (non-Program people) by appropriately placed barriers and signage warning of the activities being performed. This could be achieved using colored barrier tape, rope or fencing, as appropriate.

1.4 Waste Classification

The Project Execution Unit (PEU) will work with the Contractor to classify waste both at the generation point before and during Program activities. Accurate classification of waste is critical for safe storage, transportation, and treatment/disposal planning.

Wastes are first classified as solid or liquid, and can further be classified in the following categories:

- Hazardous or non-hazardous
- Refuse (garbage)
- Other waste
- Medical
- Special waste (e.g., Asbestos)
- Unknown waste

All unknown wastes will be treated as hazardous until proven otherwise. The following steps should be implemented to identify and classify an unknown waste:

1. Assume waste is hazardous and label as “unidentified waste” until it can be identified correctly.
2. Quarantine in the site waste storage area until it is identified. Initial steps to identify the waste should include considering the material’s original use, from what activity it generated, and consulting Safety Data Sheet (SDS) for the materials. If after these steps the waste is not identified, a sample will be taken. All equipment and Personal Protective Equipment (PPE) contaminated with the waste should be stored in a quarantined area as well.
3. Sampling of unidentified waste will only be completed by qualified and approved technicians, ensuring that all necessary safety precautions are taken and the correct equipment utilized. All samples should be labeled appropriately.

1.5 Waste Inventory

Following the classification of waste, the Contractor will revise the initial potential waste inventory, with input from technical personnel, detailing all hazardous and non-hazardous waste.

The waste Inventory will be used to keep track of wastes generated. It is also a good tool to use when planning storage, disposal options, and frequency of disposal. Information in this log could include:

- Waste stream and its source
- Description and classification of waste stream (e.g., solid, liquid, hazardous)
- Quantities of waste generated
- Handling and storage requirements and arrangements (e.g., use of PPE)
- Final treatment/disposal method and contractors used
- Date of transfer

Having a robust waste inventory and related measures enables more efficient transfer of information between PEU and Contractor for effective reduction/minimization of waste or safe disposal. This log should be updated and sent to PEU on a monthly basis (or whenever a change occurs), with temporary storage waste areas inspected weekly. Only personnel who have been trained in the use of the waste tracking log will update the waste management records.

PEU will designate specific people to review all waste logs in their area of responsibility at least monthly. Review will involve matching waste types listed on the Waste Generation Log and Waste Manifests, and deleting unused waste categories, as necessary.

1.6 Waste Handling/Collecting

Prior to generating waste materials, all potential waste streams will have pre-determined:

- Storage means (e.g., metal drums, plastic bag) and designated label
- Location for collection and storage on site
- Treatment/disposal plan, including final destination

All personnel responsible for waste generation and management will have been adequately trained the aforementioned waste management aspects. It is critical that the method of handling, particularly hazardous waste, is specific and understood for each waste type. To ensure this occurs, the Safety Data Sheets (SDS) will be available and will provide additional information, including waste description, handling instructions, required PPE, and storage location.

Excluding solid, non-hazardous wastes, mixing of wastes shall be avoided. Additionally, it is not recommended that containers which previously held hazardous materials be rinsed to further mitigate the risk of cross-contamination. In the event such a container is rinsed, the generated liquid will be tested and classified as a waste and handled accordingly (as it may have become hazardous).

Handling of hazardous goods and associated wastes requires special attention. Additional measures shall be taken to prevent accidental spillage. Packaging from hazardous goods shall also be handled, labeled, stored, and transported following the same requirements as hazardous wastes.

1.7 Labelling

It is the Contractor's responsibility to ensure that waste is labelled correctly at its place of work, until tracking forms or manifests have been completed.

Prior to their use, all waste receptacles (e.g., drums, bins, skips, poly bags) will be clearly labeled to inform which waste stream it is appropriate for (e.g., hazardous liquids). Any medical wastes generated by the Program shall be stored in red containers (rigid for sharps, and bags for non-sharps, and bags shall be stored in rigid-walled and lidded bins). Any labels leftover on receptacles from previous use will be removed or covered completely to avoid confusion.

The PEU will ensure that all used waste receptacles are clearly identifiable and appropriately labelled. All waste containers shall be labeled with the following information:

- Name or waste
- Date (when full)
- Potential risks attributed to the waste;
- Safety advice to ensure all internal and external personnel are aware of potential risks and therefore handle waste in a safe manner.

Additionally, labels will explain appropriate means to dispose of the waste (e.g., reuse, recycle, treat, discharge, etc.), including what to do with the waste container after the waste is emptied

(e.g., reuse, dispose as hazardous waste). Labels must be complete, legible, and permanent. It is preferable to have duplicate labels on more than one side of large containers to ensure that at least one label is visible at all times.

Color coding may be used to ensure quick and easy recognition of each receptacle, and should be explained to all Contractor personnel involved in waste management, prior to the start of generation of wastes.

1.8 Waste Segregation and Storage

Prior to segregation and storage, some generated wastes may be processed in order to reduce the amount of space required to store it, as well as for hygienic purposes. Processing activities could include (among others):

- Grinding
- Compacting
- Filtering

Waste streams generated at all sites should be segregated into specific hazardous, non-hazardous, and unidentified waste areas. To achieve a successful waste segregation program, waste will be segregated where they are generated; segregate wood and metal into separate containers.

All hazardous wastes will be strictly segregated, and solid and liquid wastes shall not be mixed.

Storage requirements differ depending on material and waste elements (e.g., hazardous versus non-hazardous, liquid versus solid, etc.). Table 1-1 presents general storage requirements for waste categories. Appendix 8 provides suggested segregation and storage expectations by waste stream.

Table 1-1: Waste Categories and Storage Requirements

Waste Category	Storage Requirements
Recyclable Wastes	No special requirements; store as needed in a designated area.
Hazardous Solids (Solids and Liquids)	Store in designated, secure, and clearly marked areas. Follow appropriate storage requirements depending on waste generation rate, accumulation amount, and duration. Ensure proper receptacle, space, and labelling.
Non-hazardous (Solids and Liquids)	Store in designated, secure, and clearly marked areas. Ensure liquid is contained in closed receptacles with appropriate mitigation measures (e.g., secondary containment) in place. Solids should not be stored anywhere where they could present risk of accidental disposal or harm to personnel.
Non-hazardous Burnable Solids	Store as needed prior to incineration at an approved facility.
Waste Lubricant Products (hazardous)	Store in an area with secondary containment, away from drains and open grating.

Various mitigation measures, including sheltering and fencing may be implemented in waste storage areas to limit environmental and health and safety risks. Waste receptacles will remain closed at all times when not in use, with bungs and lids securely fastened. Due to the dangerous nature of some of the hazardous materials and wastes, storage areas will be well ventilated.

Additional requirements for hazardous waste storage include:

- Segregation should be by hazard class, including flammable, oxidizer, pyrophoric, reactive, reducer, acid, base, and toxic
- Waste containers shall be located in places where the bins can be easily located, are safe for use, and protected from direct sunlight or rain
- All hazardous waste and special waste must be segregated to prevent incompatible mixtures. Consult SDS, if available
- Hazardous waste containers must be stored in secondary containment to adequately contain all of the contents of the containers within the containment area
- Special waste must be stored in pre-determined containers and in some cases stored in a special location

All waste storage areas will be clearly marked. A “Hazardous Waste Accumulation Area” will be designated where all hazardous wastes will be stored. Periodic sanitary checks and cleaning should be conducted to prevent and/or neutralize pathogen agents. Hazardous Waste Accumulation Areas should be equipped with specialized PPE and spill kits (if hazardous liquids present). At a minimum, PPE and the spill kit will include an apron, rubber or nitrile gloves, goggles, and a respirator with canisters for different chemicals. Non-hazardous waste will not be stored in the Hazardous Waste Accumulation Areas to avoid cross-contamination.

Much of the waste generated will be non-hazardous building material wastes, packing materials, excess cabling and the like. However, properly labeled waste receptacles will be available to adequately segregate and store hazardous materials that might be generated from specific activities, mercury-containing materials, electronic and electronic equipment waste (EEE waste), fluorescent light tubes (compact fluorescent and others), and potentially, asbestos-containing materials. These wastes will be collected by workers/crews trained in their handling.

The Contractor will make every effort to store waste for as little time as possible before transferring it for recycling, storage, treatment, or disposal at the designated destination(s). However, to mitigate risk, selected waste containers and/or areas will be able to store waste without damage for the maximum allowable amount of time prior to being transferred to a waste treatment/recovery or disposal facility.

2 Non-hazardous Wastes

All of the activities planned for this Program may be considered to be “dry”; accordingly, the non-hazardous wastes generated and described below are solid wastes.

2.1 Building and Construction Debris

During dismantling of old air conditioning, or other equipment involved in the Program, it might be expected that dust could be generated. If so, and especially in work inside a hospital, area

that could be impacted by dust should be screened-off using flexible plastic or other sheeting. The sheeting should be retained in place until the possible generation of dust has ceased.

It is possible that part of a ceiling or a wall might require to be removed in order to extract the old equipment, and subsequently in order to install new equipment. This could generate old ceiling or other tiles, brick, concrete material, wood (window frames, or other), metal (brackets, window frames, sheeting, other), wiring, none of which might have any future useful value.

In the Program's Traffic Management component, trenches up to four inches wide and up to 18 inches deep will be cut into either the roadways or the adjacent sidewalks or verges. Upon completion of the installation of the fiber-optic cable ducting, the trenches will be back-filled with excavated material, topped by granular material and then either concrete or asphalt, depending on the surface traversed by the trench. Any excess excavated or other backfill material that cannot be placed in the trench should be collected.

The debris should be collected and placed in appropriately sized bins, dumpsters or skips for shipping to designated landfills, in suitable trucks. Wherever possible, excavated road material should be sent to any concrete or asphalt mixing plant that might be interested in using or willing to use the material for its aggregate, as a preferred alternative to disposing of material in a landfill. Transport to the shipping trucks may be done either manually (hand carrying) or using intermediate transport, such as a barrow. During loading of the shipping trucks, care should be taken to ensure that all the material is placed into the cargo box, and that the load capacity of the truck is not exceeded.

If dust is likely to be released during transit to the landfill, the cargo box of the truck should be covered with a tarp or other suitable sheeting material to minimize any dust releases.

[If any of the above material is deemed to have some useful value, it should be segregated from that having no further use, to be disposed of according to Ministry of Finance, or other protocols].

Goal: All unusable building debris shall be disposed of in suitable commercially-operated landfill facilities in Jamaica.

2.2 Packaging Materials

New equipment to be installed is likely to be delivered to the site where it will be installed in some kind of packaging. This could be cardboard boxes, plastic or paper wrapping, wood, plastic or metal pallets or full enclosures.

Care should be taken when unpacking or unwrapping the new equipment to prevent injury to those performing the work, damage to the equipment, or injury to anyone not involved with the Program.

All of the packing material that is deemed to have no further value should be handled and disposed of as for building and construction debris (2.1 above). Any material considered to have further use in some other manner should be segregated from the waste material, and should be disposed of as described in 2.1 above.

Goal: All unusable packaging materials shall be disposed of in suitable commercially-operated landfill facilities in Jamaica.

2.3 Used Oil

It is possible that during the Program used engine oil could be encountered in, for example, a back-up generator engine. In the US, used oil is not regarded as hazardous (40 CFR 279.10), unless it is mixed with hazardous waste, in which case it all becomes hazardous waste (40 CFR 279.10(a), or it contains more than 1,000 ppm of total halogens, or contains chlorinated paraffins, or is contaminated with CFCs originating from air conditioning units (40 CFR 279.10(b), or if it contains PCBs. The presumption (by US EPA) is that used engine oil will be re-cycled.

NEPA has indicated (Appendix A) that Jamaica currently has no clear procedures for handling used oils, but they have permitted a number of persons to collect and store used oils.

Re-cycling of used oils could include separation (to remove water); filtration (by centrifuge, or other means), to remove particulates; or re-refining. Used oil may also be used for energy recovery, by using it as a fuel in an approved furnace or incinerator, e.g. in a cement kiln.

The used oil should be drained from the engine through the drain plug, and be collected in suitably-sized containers made of metal or plastic, fitted with threaded stoppers or plugs, and be clearly labeled as containing Used Oil.

***Goal*:** All used engine oil encountered in the course of this Program shall be recovered and re-cycled, or used as fuel in appropriate facilities, and not discharged to the ground.

3 Hazardous wastes

As noted in Section 2 above, Jamaica noes not presently have any regulations governing the handling, treatment or disposal of hazardous wastes. The guidance provided in the following sections of this WMP are based on standards in effect in the United States, either Federal or State level. Citations as to the sources used are provided as appropriate.

3.1 Liquid Hazardous Wastes

Three types of liquid materials that could become hazardous wastes have been identified in this Program – refrigerants (that are only liquid while contained), mercury – contained in some switches and thermostats, and polychlorinated biphenyls (PCBs) – contained in some electrical power transformers.

3.1.1 Refrigerants

Refrigerants, in particular chlorinated fluorocarbons (CFC) are contained under pressure in air conditioning units. Air conditioning refrigerants like Freon ® are powerful ozone depleting substances (ODS) and should not be vented to the atmosphere. In the US, venting refrigerant to the atmosphere is illegal (40 CFR 82, Subpart F: see Appendix B). When exchanging an old air conditioning unit for a new one, the refrigerant should be evacuated from the old unit and be saved. This activity is usually performed by certified air conditioning technicians, using equipment that is supposed to recover a minimum percentage of the refrigerant (at least 80

percent when the compressor is not in operation, or at least 90 percent if the compressor is in operation: Appendix B).

The recovered refrigerant could be destroyed, reclaimed for resale or stored to prevent its emission to the air (see Appendix C: US EPA – Construction and Demolition: How to properly dispose of refrigeration and air-conditioning equipment).

Destruction of the refrigerant is likely not currently possible in Jamaica, and the material would likely need to be exported to, for example, the USA; a permit to export the material should be requested from NEPA. Issuance of the permit could require several months.

Reputable contractors in Jamaica could store the recovered refrigerant for future use or resale.

Goal: At least 80% of the refrigerant currently contained in equipment scheduled to be replaced by new equipment shall be recovered and not vented to the atmosphere.

3.1.2 Mercury

Elemental (liquid) mercury may be found in certain thermostats, switches, pressure gauges, flame sensors, lighting fixtures, high intensity light bulbs, mercury and sodium light bulbs, and metal halide light bulbs, etc., that could be encountered in this Program. In light bulbs, the mercury might exist as a vapor.

When no longer wanted, the mercury is regarded as a hazardous waste, for which Jamaica currently has no guidelines for its disposal (Appendix A: NEPA, 15 June 2016). It would be similarly classified as hazardous waste in the US, where different states may have different requirements for its disposal. In Delaware, for example, it will be regarded as a hazardous waste under Delaware's Regulations Governing Hazardous Waste (DRGHW), but it could be managed as a Universal Waste, a category that includes batteries, mercury-containing equipment, obsolete agricultural pesticides and fluorescent / high intensity discharge lamps, under Part 273 of DRGHW (Appendix D)

1. Handling mercury: "If mercury escapes into the environment, evacuate children and pregnant women. Remove all jewelry, especially gold. Handle the mercury carefully. Wear rubber gloves and scoop it onto a sheet of paper or suck it up with an eyedropper. Place the mercury in a medicine vial or similar airtight container. The scoop, paper or eyedropper should also be bagged and disposed properly according to guidance provided by environmental officials or your local health department. Ventilate the room to the outside and close off the rest of the home. Use fans for a minimum of one hour to speed the ventilation" (Louisiana Department of Environmental Quality – LDEQ).
2. Managing spills: The following information is from the US PA website: www.epa.gov/mercury/what-do-if-you-spill-more-mercury-amount-thermometer:

   A. Spills of More than the Amount in a Thermometer, but Less Than or Similar to Two Tablespoons (One Pound)

   Cleanup Instructions:

   1. Have everyone (other than the designated handlers) leave the area; don't let anyone walk through the mercury on their way out.
   2. Open all windows and doors to the outside, to well ventilate the area

3. Turn down the temperature.
4. Shut all doors to other parts of the building, and leave the area.
5. Do not vacuum. Call your local health department as soon as possible. If it is after-hours, call your local fire department".

B. Spills of One Pound or More (i.e., if it Looks like Two Tablespoons or More)

If "any time one pound or more of mercury is released to the environment, (in the US) it is mandatory to call the National Response Center (NRC). Note that because mercury is heavy, only two tablespoons of mercury weigh about one pound". Jamaica might not have such a requirement at this time (August 2016), but perhaps could have sometime during the performance of the Program.

C. What NEVER to do after a mercury spill

1. Never use a vacuum cleaner to clean up mercury. The vacuum will put mercury into the air and increase exposure.
2. Never use a broom to clean up mercury. It will break the mercury into smaller droplets and spread them.
3. Never pour mercury down a drain. It may lodge in the plumbing and cause future problems during plumbing repairs. If discharged, it can cause pollution of the septic tank or sewage treatment plant.
4. Never walk around if your shoes might be contaminated with mercury.

As a Universal Waste coming from a small quantity generator (SQG) – that all of the facilities in the Program would be expected to be – up to 2,200 pounds of mercury may be generated in any on month, and may be stored for up to 180 days on-site (Delaware DRGHW Part 273 – Universal Waste Rule – Appendix D). A small quantity handler may accumulate up to 11,000 pounds in a year. Elemental mercury is likely to require to be exported to a licensed transportation, storage and disposal facility (known as a TSDF in the US; a permit to export the material should be requested from NEPA. Issuance of the permit could require several months.

Mercury shall not be released to land or water as noted in Article 9.4 of the Minamata Convention of 2013, signed by Jamaica, but not yet ratified.

Mercury-containing light bulbs (MCLB) - Some States in the US (e.g. California, Maine, Massachusetts, others) expressly prohibit the disposal of MCLBs into landfills since the mercury can be released when the bulb gets broken. Instead, they prefer the bulbs be re-cycled. In the absence of any facility in Jamaica that can re-cycle MCLBs, the preference would be for spent MCLBs to be exported, unbroken to a re-cycling facility outside the country. In the US "Lighting manufacturers, through their trade association he National Electrical Manufacturers Association (NEMA), developed lamprecycle.org to provide a one-stop source of information about recycling lamps (the term used in the lighting industry to refer to all types of light bulbs)" (www.lamprecycle.org).

The website http://www.lamprecycle.org/commercial-lighting-lamp-recyclers/ (also presented as Appendix E) gives a list of commercial lighting lamp recyclers, some of whom might receive spent MCLBs exported from Jamaica.

A permit to export mercury-containing equipment should be requested from NEPA. The export of mercury or mercury-containing materials shall be performed in accordance with Article 3.6 of the Minamata Convention of 2013, and the Basel Convention on the Control of Transboundary

Movements of Hazardous Wastes and their Disposal, to which Jamaica became a signatory in 2003. Note that under the Basel convention, Jamaica does not permit the export of hazardous waste solely for its disposal. Therefore hazardous waste exported should be for treatment.

***Goal*:** All liquid mercury contained in equipment scheduled to be replaced by new equipment shall be recovered and shall not be disposed of in a landfill, but shall be exported for proper management at a facility licensed to handle mercury. Mercury-containing light bulbs shall be sent to be re-cycled at an approved facility designated to receive such materials.

3.1.3 PCBs

Electrical power transformers contain a dielectric fluid that is used to transfer heat generated inside a transformer while in use to the cooling fins on the outside of the casing. It was discovered that a class of over 200 polychlorinated biphenyls – "PCBs" - was very effective in this role: they worked very well and were very stable. However, it was later discovered that PCBs can cause serious health effects, and in 1977 their manufacture in the US ceased. They may have continued to have been or be manufactured in other countries since then, however.

Electrical power transformers are often owned by the power company that supplies electricity – in Jamaica, that is the Jamaica Public Service Company (JPS). While JPS has instituted a program to steadily check for and, if necessary, replace the PCB-containing dielectric fluid in its transformers, there remains the possibility that not all transformers have had their PCB dielectric fluid replaced. It is customary for transformers that have been inspected and tested to have the maximum concentration of PCBs remaining in them to be stenciled on the casing or indicated on a plate attached to the casing. Typically, that number will be either 50 or 100 parts per million (ppm).

A transformer that has not had its dielectric fluid checked for PCBs probably will not have such a number stenciled on the casing, or will not have a plate indicating its maximum PCB concentration. All such transformers as part of the performance of this Program should be tested to determine the concentration of PCBs (if any) in the dielectric fluid. Any transformer found to contain more than 100 ppm of PCBs in its dielectric fluid shall have the fluid drained and replaced by a fluid containing not more than 100 ppm PCBs. That activity is likely to only be performed by JPS currently.

When either in operation or when being moved from one place to another, electrical transformers normally do not leak their dielectric fluid. Any power transformer that is seen in the performance of this Program to be leaking, and which does not have any sign indicating that it has a maximum concentration of PCBs of 100 ppm or less, should be reported immediately to JPS, for them to handle.

***Goal*:** All transformers involved in the performance of the Program shall contain no more than 100 ppm of PCBs in their dielectric fluids, and no PCBs shall be released to the environment.

3.2 Solid Hazardous Wastes

While it is not expected that many activities to be performed as part of the Program are likely to generate solid hazardous wastes, it is possible that some equipment that is to be replaced could do so.

3.2.1 Mercury Compounds

This equipment includes lighting equipment that may have mercury compounds in it. This equipment should be handled by technicians certified to handle such materials. The mercury-containing components should be separated from the non-mercury-containing parts, collected and sent to a facility designated to handle such materials, either in Jamaica, if such facilities exist, or overseas if they do not. The non-mercury-containing components could be collected for potential re-use, sale or disposal as non-hazardous waste in a suitable landfill.

Goal: All equipment containing mercury-containing compounds shall be disposed of or treated at a facility designated to handle that type of equipment.

3.2.2 Asbestos-containing Materials (ACM)

In 1989, the US EPA issued a ban of the manufacture, importation, processing or commercial distribution of most ACM. However, in 1991, the ban was overturned.

Under the Toxic Substances Control Act (TSCA), however, some ACM: corrugated paper, roll board, commercial paper, specialty paper and flooring felt remains banned. Under the Clean Air Act (CAA) certain pre-molded or wet-applied pipe or block insulation, and spray-on insulation containing more than 1% ACM is banned.

The continued use of ACM in Jamaica is highly likely, especially in older facilities, including KPH/VJH and Mandeville Hospital, both being well over 100 years old. It does not appear that any systematic ACM surveys of the buildings included in the Program have been performed.

It is recommended that limited asbestos surveys be performed by appropriately qualified contractors in the areas where the work is to be performed, and where there is any reasonable possibility of encountering ACM, before the work commences, and that appropriate measures be taken to manage ACM during the course of the work.

Should the removal of pre-formed block, wet-applied or spray-on insulation, or suspended ceiling tiles be required during the performance of the Program, special care should be taken during this activity. The material should be collected, taking great care to not generate dust which could contain asbestos, and be placed in double (two thicknesses of material) heavy duty plastic bags, clearly labelled to indicate their contents as being potential asbestos-containing material. The bags should be taken to a recognized landfill, such as Riverton, for burial.

***Goal*:** All insulation or ceiling tile material suspected to contain potentially friable ACM generated during the Program shall be collected without generating dust, be properly bagged and disposed of at recognized landfills in Jamaica.

Appendix H presents an example of a form that could be used as a Manifest for tracking hazardous wastes.

4 E-waste

E-waste is broadly defined as communications devices and information technology (IT) products and their internal and external batteries. This would include things like computers, laptops, monitors, cell phones, pads, servers, controllers, TVs and the like. Some of this type of material could be generated during the performance of the Program.

According to a presentation titled “Electronics Stewardship in the United States of America” made by US EPA on 14 July 2014 at the Institute of Electronics, Microelectronics and Nanotechnology (IEMN) meeting, approximately 29% of e-waste in the US was sent to be re-cycled in 2012, meaning that approximately 71% was not re-cycled, but was disposed of otherwise. While there are facilities to manage e-waste in the US, much is sent to companies in Asia, where usable components are recovered. Much e-waste is disposed of in landfills.

Until such time as Jamaica develops either a policy regarding or legislation to govern e-waste management, e-waste generated by the program may be disposed of in commercial landfills in Jamaica. Note that the Ministry of Economic Generation and Job Creation (MEGJC) is in the process of developing such legislation, and it might be available to the public by the end of August 2016. When it is available, this section might need to be revised.

5 Personnel Protective Equipment (PPE)

“Guidelines for the Use of Personnel Protective Equipment”. Prepared by the Occupational Safety & Health Council (Appendix F) provides more information about the correct application of the various elements of PPE.

Much of the work to be done during the execution of the Program - removing old AC and lighting units, making adjustments in the buildings for new units, and potentially removing or installing solar voltaic and other equipment; excavating narrow trenches with trenching machines, laying fiber-optic ductwork and cables; installing junction boxes and controllers – may be performed while wearing “regular” work clothing. This would include:

- Long pants
- Long-sleeved shirts
- Hard-toed boots or shoes
- Work gloves

However, some activities, such as when moving heavy equipment, handling hazardous materials, working with low headroom, will require that additional PPE be provided to those performing the work, and that those personnel wear the provided PPE for the duration of the assignment that requires its use.

When overhead obstacles may be present, add:

- Hard-hat

When handling hazardous liquid materials, add:

- Face-shield or goggles

When handling mercury-containing materials, especially if liquid mercury is uncontained, in addition to the above:

- Provide adequate ventilation, by opening windows and having fans operating
  Handling ACM, particularly if there is any possibility of encountering friable ACM, should be performed in accordance with NEPA’s proposed asbestos management policy, summarized in Appendix G, which includes:
    - Ensuring that the area in which potentially friable asbestos is being removed is isolated from other parts of the building from occupants not involved with the work

- Reducing the possibility of drafts, by closing windows and doors
- Wetting the material to be removed to reduce the potential for dust generation
- Wearing dust masks
- Operating vacuum cleaners to capture dust
- Sealing areas known or suspected to contain friable asbestos by painting over it, and making the area to clearly indicate to others that ACM might be present.

Appendices

Environmental Safeguards for Removal and Disposal of Waste Materials

NEPA is cognizant of the IDB-funded *Energy Management and Efficiency Programme* and the relevant objectives. Once the programme is implemented, the Government Facilities would need to dispose of cooling, lighting and other equipment which will be retrofitted.

NEPA hereby provides guidance on the relevant policies, guidelines or legislation that would guide the decommissioning/disposal of the units, oils, refrigerants (hazardous material) and safe handling/export of hazardous materials.

1. NEPA has no clear procedures for the handling of **Used Oils**. The Agency however have permitted a number of persons to collect and store used oils. The list of entities that provide this service is attached at Appendix 1.

2. NEPA does not have guidelines for **decommissioning of air conditioning units** as this is not part of the Agency's mandate. However, refrigeration technicians within the country can be procured to provide such service. The Technicians are usually trained in best practices and proper disposal techniques and would usually work for a firm that would be licensed to store or dispose of refrigerants. It should be noted though that NEPA also trains the technicians in using the correct refrigerants that are not harmful to the environment. Once the units are retrofitted the technicians would use environmentally friendly refrigerants.

3. The Ministry of Economic Growth & Job Creation (MEGJC) is currently finalizing a policy for Hazardous Waste management in the country. The country currently does not have any sites to take hazardous materials however is guided by the principles of the Basel Convention in the use, storage, handling and disposal of **hazardous waste**. NEPA however has trained officers within the Agency and other government entities as HAZMAT officers. These officers are trained in the removal and handling of hazardous materials and can be called on to safely removes those substances. NEPA has also developed *Asbestos Management Guidelines* (Appendix 2) for treatment and disposal of Asbestos and a *User's Guide for Transboundary Movement of Hazardous Wastes* (Appendix 3) to guide the export of hazardous wastes.

4. There are no guidelines for the disposal of **mercury**. Currently all wastes containing mercury are sent to the Riverton City dump. The country is however guided by the Minamata Convention in the handling of mercury and uses the hazardous waste transboundary guidelines to guide the export of mercury.

5. The MEGJC is currently completing legislation for the handling of **e-wastes**. That document is not yet completed but will be ready for public use by end on August 2016. The document will guide the government facilities in how to treat, store, handle and dispose of e-waste and to also mandate schemes such as "take-back" systems.

EPA United States Environmental Protection Agency

Refrigerant Recovery and Recycling Equipment Certification

Additional Information

- Technician certification requirements
- Additional information about servicing stationary refrigeration and air conditioning systems
- Information about service practice requirements

All refrigerant recovery and recycling equipment manufactured since 1993 must be tested to ensure it meets EPA requirements under Section 608 of the Clean Air Act.

For most recovery and recycling equipment, these requirements are detailed in Appendix B1 to 40 CFR 82, Subpart F and Appendix B2 to 40 CFR 82, Subpart F. These standards are based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) 740 test protocol. Small appliance recovery and recycling equipment may be tested under these requirements or the ones detailed in Appendix C to 40 CFR 82, Subpart F.

Recovery equipment standards vary depending on the size and type of air-conditioning or refrigeration appliance being serviced:

- Recovery and recycling equipment used with most air-conditioning and refrigeration equipment must meet the standards identified in Table 1.
- Small appliance recovery equipment must be able to recover either:
  - 90 percent of the refrigerant in the small appliance when the small appliance compressor is operating, or
  - 80 percent of the refrigerant in the small appliance when the compressor is not operating.

EPA-Approved Testing Organizations

EPA has approved both the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Exit and Underwriters Laboratories (UL) Exit to certify recycling and recovery equipment. Both organizations can provide information on certified equipment.

Certified equipment can be identified by a label that states: "This equipment has been certified by AHRI/UL to meet EPA's minimum requirements for recycling and/or recovery equipment intended for use with [appropriate category of appliance]."

Certification by Owners of Refrigerant Recovery and Recycling Equipment

EPA requires that persons servicing, disposing, or recycling air-conditioning and refrigeration equipment certify to the appropriate EPA Regional Office that they have acquired (built, bought, or leased) refrigerant recovery or recycling equipment and that they are complying with the applicable requirements.

A certification form must be signed by the owner of the equipment or another responsible officer and sent to the appropriate EPA Regional Office.

Owners do not have to send in a new form each time they add recycling or recovery equipment to their inventory.

Last updated on January 14, 2016

EPA
United States
Environmental Protection
Agency

Construction and Demolition

How to Properly Dispose of Refrigeration and Air-Conditioning Equipment

Whether you are on the job at a construction/demolition site or at a demolition scrapyard or recycling facility, you are likely to encounter refrigeration and air-conditioning (AC) equipment. Refrigeration/AC equipment has historically used refrigerants and/or insulating foam, such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), which deplete the stratospheric ozone layer and contribute to global climate change. Newer refrigeration/AC equipment is likely to contain hydrofluorocarbons (HFCs), which are used as ozone-friendly substitutes for CFCs and HCFCs but still contribute to climate change. The types of CFC, HCFC, and HFC refrigerants commonly used in refrigeration/AC equipment are shown in Box 1.

This factsheet outlines the requirements established by the U.S. Environmental Protection Agency (EPA) regarding refrigerants, as well as tips on best practices for handling refrigerants and foams, to ensure that emissions of ozone-depleting substances (ODS) and their substitutes are minimized during the disposal of refrigeration/AC equipment by companies in the demolition/recycling industry.

What is Required by Law?

Under Section 608 of the Clean Air Act (CAA), EPA has established regulations (40 CFR Part 82, Subparts A and F) that are relevant to the disposal of refrigeration/AC equipment. These regulations specify:

1. A prohibition on intentionally venting ODS refrigerants and ODS substitutes into the atmosphere while disposing of refrigeration/AC equipment;
2. Certification requirements for refrigerant recovery equipment, as well as refrigerant evacuation requirements, to maximize recovery of ODS during the disposal of refrigeration/AC equipment;
3. Certification requirements for technicians disposing of refrigeration/AC equipment, *excluding small appliances (see Box 4 on page 3)*;
4. Safe disposal requirements for small appliances to ensure removal of refrigerants from goods that enter the waste stream with the refrigerant charge intact;
5. Recordkeeping requirements for persons disposing of refrigeration/AC equipment to certify to EPA that they have acquired refrigerant recovery equipment and are complying with the rule; and
6. Procedural requirements for sending refrigerant to a destruction or reclamation facility.

Box 1. What Types of Refrigerants Are Typically Contained in Refrigeration/AC Equipment in the U.S.?

The refrigerants commonly found in refrigeration/AC equipment, as well as their approximate charge sizes, are listed in the table below. Actual equipment charge size varies based on equipment type and model. As shown, a household refrigerator typically contains 0.5 pounds of refrigerant, while a building chiller may contain over 1,000 pounds.

Typical Refrigerants and Charge Sizes Commonly Used in Refrigeration/AC Equipment

Equipment Type	Common Refrigerants	Charge Sizes (lb)
Chillers	CFC-11, CFC-12, HCFC-22, HCFC-123, HFC-134a, R-407C**	570 – 1,150
Cold Storage	CFC-12, R-502*, HCFC-22, R-404A	0.017 - 0.019/ft^2
Commercial Refrigeration	CFC-12, HCFC-22, R-404A, R-507A**	1,320 – 1,980
Dehumidifiers	HCFC-22, HFC-134a	0.4 - 0.5
Domestic Refrigerators & Freezers	CFC-12, HFC-134a	0.51
Ice Makers	CFC-12, HFC-134a	5.5 – 6.6
Industrial Refrigeration	CFC-11, CFC-12, HCFC-22, HCFC-123, HFC-134a, R-404A**	1,340 – 8,110
PTAC/PTHP	HCFC-22, R-410A**	1.3 – 1.5
Unitary AC	HCFC-22, R-410A	7.5 – 9.5
Window AC	HCFC-22, R-407C/410A	1.1 – 1.3

*Refrigerant blend containing HCFC-22 and CFC-115
** HFC blend

Box 2. Why Shouldn't I Just Vent Refrigerant?

1. It's illegal;
2. It's harmful to the environment and human health; and
3. You can earn money by selling recovered refrigerant to an EPA-certified refrigerant reclaimer.

How Do I Recover Refrigerant?

Section 608 of the CAA prohibits individuals from intentionally venting refrigerants into the atmosphere while disposing of refrigeration/AC equipment. "De minimis" quantities of refrigerant released in the course of making good faith attempts to recapture and recycle or safely dispose of refrigerant are not subject to this prohibition (§ 82.154[a][2]).

To implement the venting prohibition, Section 608 specifies evacuation level requirements (§ 82.156) and refrigerant recovery equipment requirements (§ 82.158) for both small appliances and other refrigeration/AC equipment.

Refrigerant Recovery Equipment Requirements

Persons involved in the disposal of refrigeration/AC equipment must certify to their EPA Regional Office that they have acquired (built, bought, or leased) and are properly using refrigerant recovery equipment certified by an EPA-approved equipment testing organization (see text box below). A sample form is available at www.epa.gov/Ozone/title6/608/recoveryform.pdf. This certification must be signed by the owner of the equipment or another responsible officer.

EPA-certified equipment meets the standards established in § 82.158 and is certified to be able to recover refrigerant from refrigeration/AC equipment according to the evacuation levels specified in § 82.156. These regulations specify evacuation levels for small appliances (§ 82.156[h]) and other equipment (§ 82.156[a]), dependent on the type, charge size, and date of manufacture of the equipment.

Box 3. EPA-Certified Recovery Equipment

EPA has approved two bodies to certify recycling and recovery equipment: the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) and Underwriters Laboratories (UL).

Lists of certified equipment may be obtained by contacting ARI at 703-524-8800 and UL at 708-272-8800 ext. 42371. Certified equipment can be identified by a label reading: *"This equipment has been certified by ARI/UL to meet EPA's minimum requirements for recycling and/ or recovery equipment intended for use with [appropriate category of appliance—e.g., HCFC appliances containing less than 200 pounds of refrigerant, all high-pressure appliances, etc.]."*

Technician Certification Requirements

Technician certification is not required for individuals removing refrigerant from small appliances when preparing them for disposal. However, EPA certification is required for technicians who perform disposal of all other types of refrigeration/AC equipment (§ 82.161). EPA has developed four types of certification, two of which are applicable to technicians that dispose of refrigeration/AC equipment:

- **Type II** – For technicians dealing with high- or very high-pressure refrigeration/AC equipment (e.g., industrial process and cold storage equipment),[1] except small appliances; and
- **Type III** – For technicians dealing with low-pressure refrigeration/AC equipment (e.g., chillers).

To become certified under the mandatory program, technicians must pass an EPA-approved test given by an EPA-approved certifying organization. These certification credentials do not expire.

If no in-house certified technicians are available to perform refrigerant recovery from refrigeration/AC equipment other than small appliances at time of disposal, a company with certified technicians can be hired.

How Do I Safely Dispose of Small Appliances?

Small appliances are subject to special safe disposal requirements (§ 82.156[f]). Specifically, the final person in the disposal chain (e.g., recycler or landfill operator) is responsible to perform the following:

1. Recover any remaining refrigerant from the small appliance in accordance with the evacuation requirements for small appliances (§ 82.156[h]); or
2. Notify the suppliers of the small appliance(s) that the refrigerant must be properly removed before delivery to the facility[2]; and verify[3] that the refrigerant has been evacuated from the appliance or shipment of appliances previously.

What Records Do I Need to Maintain?

Recordkeeping requirements have been established for persons disposing of small appliances and all other equipment (§ 82.166).

Small Appliances

Keep copies of signed statements collected in accordance with the Safe Disposal requirements on-site for at least three years.

All Other Equipment

Keep copies of technician certification at the technician's place of business.

What Should I Do with Refrigerant Once it Has Been Recovered?

Once refrigerant is recovered, it may be destroyed, reclaimed for resale, or stored safely to prevent emissions, as illustrated in Figure 1.

Destruction

If you choose to send recovered ODS refrigerant for destruction, the ODS shipment must be sent to a destruction facility which uses one of the following destruction technologies (§ 82.3): liquid injection incineration, reactor cracking, gaseous/fume oxidation, rotary kiln incineration, cement kiln, or radio frequency plasma.

In addition, the ODS shipment must be sent to a destruction facility that achieves a destruction efficiency (DE)[4] of 98%, as required under Title VI of the CAA; for ODS that are also Resource Conservation and Recovery Act (RCRA) hazardous wastes, the destruction facility must achieve a destruction and removal efficiency[5] (DRE) of 99.99%, as required by RCRA and Title V of the Clean Air Act.

Reclamation

If you send recovered ODS refrigerant for reclamation, the ODS refrigerant shipment must be sent to an EPA-certified refrigerant reclaimer. You can view a list at www.epa.gov/ozone/title6/608/reclamation/reclist.

Box 4. Definitions

Small Appliance

A small appliance is defined as any appliance that is fully manufactured, charged, and hermetically sealed in a factory with five pounds or less of a CFC or HCFC refrigerant, including the following:

- Refrigerators and freezers (designed for home, commercial, or consumer use);
- Medical or industrial research refrigeration equipment;
- Room air conditioners (including window air conditioners and packaged terminal air heat pumps);
- Under-the-counter ice makers;
- Vending machines; and
- Drinking water coolers.

All Other Equipment

In this fact sheet, "all other equipment" refers to all appliances except for small appliances, motor vehicle air conditioners (MVACs), and MVAC-like* appliances. Specifically, this equipment includes:

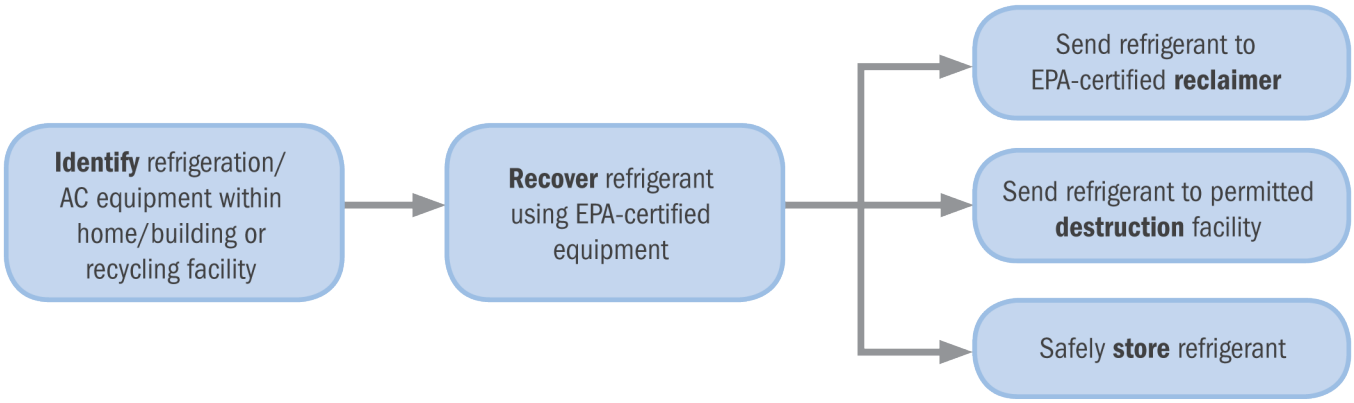
- Chillers;
- Industrial refrigeration equipment (not including research equipment);
- Commercial refrigeration equipment; and
- Cold storage equipment.

*An "MVAC-like appliance" has a refrigerant charge of 20 pounds or less and is used to cool the driver's or passenger's compartment of an off-road motor vehicle.

Box 5. What Happens to the Environment When Refrigerant or Blowing Agent is Released to the Atmosphere?

ODS refrigerant and blowing agents (CFCs and HCFCs) deplete the ozone layer and contribute to climate change. Ozone layer depletion allows more ultraviolet radiation, a human carcinogen, through our ozone layer, contributing to increased incidences of skin cancer, immune suppression, eye damage, and other skin problems in the general population. Climate change is associated with increased extreme weather events, rising sea levels, and thawing permafrost, among other major effects on the natural world. HFC blowing agents, which are used as substitutes for CFCs and HCFCs in newer equipment, do not deplete the ozone layer, but are potent greenhouse gases (GHGs).

Figure 1. Disposal Procedures for Refrigeration and Air-Conditioning Equipment



Going Beyond Requirements: Recovering ODS Foams

ODS blowing agents are used in insulating foam contained in commercial and domestic refrigerators and freezers, as well as in buildings (e.g., roofs, walls, floors, pipes, and storage tanks). Although not required by law, as a best practice, ODS foam can be recovered from refrigerators and freezers and buildings at time of demolition and sent for reclamation or destruction.

Foam Recovery from Buildings

Although there is limited experience to date in recovering and destroying foam insulation from buildings in the U.S., ODS foam recovery represents a significant opportunity for reducing emissions of ODS and GHGs. Technologies exist to recover ODS foam from buildings at time of demolition and either (a) send it for destruction (e.g., to a municipal solid waste incinerator or waste-to-energy boiler) or (b) send it for further processing to recover the blowing agent from the foam matrix and ultimately reclaim or destroy the concentrated blowing agent.[6] The ability to extract foam-containing elements from demolition waste depends largely on the type and original form of the foam and how it was applied. Steel-faced sandwich panels—used in wall and roof insulation and for cold storage—and polyurethane boardstock foam—used in wall, roof, and floor insulation—may represent the greatest opportunities for ODS foam recovery and destruction.

Box 6. Where Would I Find ODS Foam in a Building?

ODS foam is commonly used in building roofs, walls, floors, pipes, and storage tanks as insulation material. ODS blowing agents are likely to be found in polyurethane (PU) rigid sandwich panels, PU and polyisocyanurate (PIR) rigid boardstock, PU rigid spray foam, and extruded polystyrene (XPS) foam boards.

Foam Recovery from Refrigerators and Freezers

CFC, HCFC, and HFC-containing foam has generally been used to insulate refrigerant-containing appliances, such as household and commercial refrigerators and freezers. To avoid the harmful release of ODS and GHGs, insulating foam should be removed from all parts of refrigerators and freezers at time of equipment disposal. Foam can be recovered from refrigerators and freezers either manually or through a fully automated process. Several dedicated appliance recycling facilities offer these types of foam removal and processing services across the U.S. In addition, EPA's voluntary Responsible Appliance Disposal (RAD) Program, designed to promote these types of best practices, serves as a technical clearinghouse on the development and implementation of responsible appliance disposal programs. For more information on appliance foam removal and the RAD Program, visit www.epa.gov/ozone/parnerships/rad.

How Can I Report a Violation?

EPA performs random inspections, responding to tips and pursuing potential cases against violators. Under the CAA, EPA is authorized to assess fines of up to $37,500 per day for any violation of the regulations. Information on selected enforcement actions is available on EPA's website.

If you suspect or witness unlawful releases of refrigerant or other violations of the Clean Air Act regulations, you can file a report easily and anonymously by visiting EPA's Office of Enforcement and Compliance Assurance website at www.epa.gov/compliance/complaints/.

Where Can I Find More Information?

For more information concerning regulations related to stratospheric ozone protection visit:

www.epa.gov/ozone/strathome

---

[1] See § 82.152 for the definitions of high-, very high-, and low-pressure appliances.

[2] The form of this notification may be warning signs, letters to suppliers, or other equivalent means.

[3] Such verification consists of a signed statement from the person from whom the appliance(s) is obtained that all refrigerant had been recovered from the small appliance(s) in compliance with the evacuation requirements for small appliances, as well as the name and address of the person who recovered the refrigerant and the date the refrigerant was recovered, or a contract that refrigerant will be removed prior to delivery.

[4] DE is a measure of the comprehensiveness of destruction that includes emissions of undestroyed chemical from all points (e.g., stack gases, fly ash, scrubber, water, bottom ash).

[5] DRE is a % that represents the number of molecules of a compound removed or destroyed in an incinerator relative to the number of molecules entering the system (e.g., a DRE of 99.99% means that 9,999 molecules are destroyed for every 10,000 that enter).

[6] ODS sent for destruction must be sent to a destruction facility using an approved destruction technology, as listed on page 3.

EPA
United States Environmental Protection Agency

U.S. Environmental Protection Agency
Stratospheric Protection Division (6205J)
EPA-430-F-11-006
www.epa.gov
February 2011

Home

- DWHS Contact Info
- DNREC Newsroom
- DNREC Public Notices
- SHWMB Organization
- Waste Management FAQs
- Environmental Crimes Unit Survey
- DWHS Organization Chart

Services

- Env Release Notification
- Environmental Navigator
- Recycling Services
- SHWMB Forms/Applications
- SHWMB Related Links

Information

- Enforcement and Compliance Info
- Environmental Databases
- Freedom of Infomation Act Request
- Hazardous Waste
- Infectious Waste
- Landfills and Transfer Stations
- Publication and Reports
- Recycling
- Scrap Tires
- Solid and Hazardous Waste Rules, Regulations and Laws
- Solid Waste
- SWHMB Publications and Reports
- Waste Disposal How-To's
- Yard waste

Universal Waste Rule

Until recently several wastes, namely batteries, pesticides, mercury thermostats and mercury containing lamps were required to be managed as hazardous waste in full compliance with the Delaware Regulations Governing Hazardous Waste (DRGHW). With the adoption of the Universal Waste Rule (UWR) in Part 273 of the DRGHW, these wastes are afforded less stringent management standards that are dependent upon the amount of universal wastes managed. Please remember this fact sheet serves only as a guide and does not replace the requirements of the Delaware Regulations Governing Hazardous Waste.

1. What are universal wastes?

Universal wastes are items that are generated by large numbers of businesses in relatively small quantities. Currently, four hazardous wastes are identified as universal wastes. These universal wastes are batteries, mercury-containing equipment, obsolete agricultural pesticides and fluorescent/high intensity discharge lamps.

2. How does the management of hazardous waste under the UWR differ from managing the waste in accordance with the DRGHW requirements for hazardous waste generators?

As the stringency of the DRGHW differs between generator categories, so does the UWR. The UWR has two categories of universal waste handlers, small quantity and large quantity. Universal waste handlers have the ability to generate monthly, larger quantities of universal waste, and accumulate these wastes onsite for longer periods of time. For example, a small quantity generator of hazardous waste cannot generate greater than 2,200 pounds (1,000 kg) of hazardous waste in a calendar month and may not accumulate the hazardous waste onsite for more than 180 days. However, a small quantity handler of universal waste may accumulate less than 11,000 pounds (5,000 kg) of universal waste for periods up to one year.

3. What are the differences between the small quantity and large quantity handlers of universal waste?

A small quantity handler of universal waste may accumulate less than 11,000 pounds (5,000 kg) of total universal waste, (i.e., batteries, pesticides, mercury thermostats or mercury containing lamps) for periods up to one year.

A large quantity handler of universal waste is one who accumulates 11,000 pounds (5,000 kg) or more of total universal waste for periods up to one year.

4. In general, what must a small quantity handler of universal waste do to comply with the requirements of the DRGHW, Part 273.

Small quantity handlers must ensure that any universal wastes they are accumulating are managed in a closed container that prevents the release of the universal waste or waste components. Each container must be labeled with the type of universal waste it contains. The small quantity handler may accumulate its universal waste no longer than one year from the date the waste was generated, and must maintain records demonstrating the actual generation date. Additionally, the small quantity handler must ensure all employees handling a universal waste have been provided information on proper handling and emergency procedures appropriate to the types

to use a uniform hazardous waste manifest or keep records of universal waste shipments. However, it is highly recommended such records be maintained. Universal waste shipments may be transported by a contracted transporter or by the small quantity handler of universal waste. In either case, a Delaware Hazardous Waste Transporter Permit is not required.

5. What are the requirements for a large quantity handler of universal waste?

In general, the requirements for large quantity handlers are more stringent than those of small quantity handlers of universal waste. First, the large quantity handler must notify the Solid and Hazardous Waste Management Section and receive an EPA Identification Number. Much like the small quantity handler, the universal waste must be accumulated in a closed container labeled with what it contains. Large quantity handlers may not accumulate universal wastes for more than one year and must maintain records demonstrating the date of the universal waste generation. Employees managing universal waste must be trained as to proper waste handling and emergency procedures. Shipments of universal waste from a large quantity handler must be tracked on a manifest, bill of lading, or similar type of document which must be maintained for at least three (3) years.

6. Are there requirements for universal waste transporters?

While a Delaware Hazardous Waste Transporter permit is not required, there are certain regulatory requirements for universal waste transporters. Universal waste transporters may not dispose of, dilute, or treat universal waste, nor can transporters store universal waste shipments more than ten (10) days without becoming subject to more stringent handler requirements. Universal waste transporters must deliver the universal waste to either another universal waste transporter, or a permitted facility or a foreign destination. Transporters must ensure compliance with all applicable Department of Transportation regulations found in 49 CFR 171 through 180.

7. What are the requirements for a universal waste destination facility?

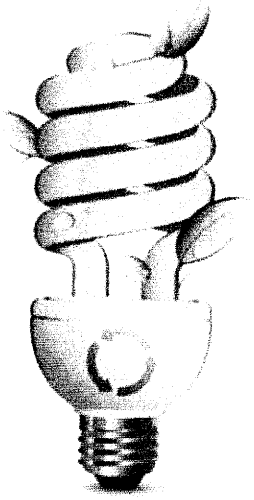
Universal waste destination facilities are, in actuality, permitted hazardous waste treatment, storage and disposal facilities (TSDFs). Therefore, these facilities must comply with the requirements for TSDFs found in the DRGHW.

If you have any questions, please contact the Solid and Hazardous Waste Management Section at (302) 739-9403.

Energy Efficient Lighting (http://www.lamprecycle.org/commercial-lighting-lamp-recyclers/energy-efficient-lighting/) | Recycling Regulations (http://www.lamprecycle.org/commercial-lighting-lamp-recyclers/recycling-regulations/) | Lamp Recyclers (http://www.lamprecycle.org/commercial-lighting-lamp-recyclers/) | Resources (http://www.lamprecycle.org/commercial-lighting-lamp-recyclers/resources/)

Commercial Lighting: Lamp Recyclers

NEMA maintains this list of companies in the United States and Canada that claim to recycle spent mercury-containing lamps or handle lamps so as to ensure they end up at a recycling facility. In the U.S., recycling companies must meet the definition of a "Destination Facility" and operate under a state permit or RCRA-equivalent authority to perform lamp recycling (per RCRA 40 CFR §273.6). Handlers are either generators or third party brokers that collect lamps and get them to recyclers.



INCLUSION ON THESE LISTS DOES NOT CONSTITUTE AN ENDORSEMENT OR RECOMMENDATION BY NEMA OF THE COMPANIES OR THEIR TECHNOLOGIES. NEMA RESERVES THE RIGHT IN ITS SOLE DISCRETION TO EXCLUDE COMPANIES FROM THIS LISTING. PERSONS CONTACTING THE LISTED COMPANIES SHOULD MAKE THEIR OWN INVESTIGATIONS AND DETERMINATIONS ABOUT THE COSTS AND APPROPRIATENESS OF THE ACTIVITIES OF THE LISTED COMPANIES.

The Association of Lighting and Mercury Recyclers (ALMR) is a national organization that represents lamp recyclers, Universal Waste Handlers, mercury and rare earth element reclamation companies, and related equipment manufacturers. ALMR member companies network with each other so that lamps can be collected and recycled from anywhere in the country. Additional information about lamp recycling can be found at www.almr.org . The International Association of Lighting Maintenance Companies (NALMCO, www.nalmco.org) represents lighting maintenance companies in the US, which may provide spent lamp management recycling services as part of their lighting maintenance operations.

link to http://www.almr.org/map.html (http://www.almr.org/map.html) for map of country with locations and contact information

ALMR Lamp Recyclers, Service Providers and Equipment Manufacturers

Air Cycle Corporation

Manufactures lamp crushing equipment for worldwide distribution; national service provider for recycling lamps, ballasts, batteries, and electronic products. Quantities above 500 lamps: The Bulb Eater and bulk pickup services.Quantities below 500 lamps: EasyPak mail-back container program. Lisle, IL

800-909-9709 (Toll-Free) Fax: 866-909-6725

Email: info@aircycle.com (mailto:info@aircycle.com), www.lamprecycling.com (http://www.lamprecycling.com/), www.aircycle.com (http://www.aircycle.com)

Balcan Engineering Ltd.

Worldwide distribution of lamp recycling and mercury recovery technology and equipment. Lamp recycling service in UK. Lincolnshire, United Kingdom

+44 1507 528500

www.cfl-lamprecycling.com (http://www.cfl-lamprecycling.com)

Bethlehem Apparatus Co. Inc.

National recycler of lamps and mercury-wastes. Recovers and refines mercury from products and waste, with worldwide distribution. Bethlehem and Hellertown, PA

610-838-7034

www.bethlehemapparatus.com (http://www.bethlehemapparatus.com)

DFP Mercury Corp.- and D.F. Goldsmith Chemical & Metal Corp

Refining and worldwide sale and distribution of precious metal products and mercury. Evanston, IL

847-869-7800

www.dfgoldsmith.com (http://www.dfgoldsmith.com/)

EcoLights Northwest/Total Reclaim

National service provider for recycling lamps, ballasts, batteries, and electronic products, mercury devices, and whole lighting fixtures, CRTs and electronic scrap. Pickup service and mail-in programs available. **Seattle, WA**

Quantities above 500 Lamps: (888) 214-2327. Quantities below 500 lamps: Mail back container program – (888) 214-2327

(888) 214-2327

www.ecolights.com (http://www.ecolights.com/)

Everlights

National recycling service provider for lamps, ballasts, batteries, electronics, mercury devices, and fixtures. Pickup service and mail-in programs available. Chicago, IL, Huntsville, AL

www.everlights.com (http://www.everlights.com/)

Fluorecycle Inc.

Regional recycling service and RCRA-Permitted Destination Facility in Midwest US for lamps and mercury recovery. Ingleside, IL

815-363-4411

www.fluorecycle.com (http://www.fluorecycle.com/)

Global Tungsten & Powders Corp.

International company engaged in manufacturing specialty powders, high temperature metallurgy and recovery of phosphors. Towanda, PA; Bruntal, Czech Republic

570-268-5000

www.globaltungsten.com (http://www.globaltungsten.com/)

Lighting Resources Inc.

National recycling service for lamps, ballasts, transformers, and electronic scrap. Ontario, CA; Greenwood, IN; Phoenix, AZ; Fort Worth, TX; Ocala, FL

800-572-9253

www.lightingresourcesinc.com (http://www.lightingresourcesinc.com/)

MRT System, International

Swedish manufacturer of systems for fluorescent lamp recycling and mercury recovery with worldwide distribution. Sweden, Bahrain, Brazil, China, France, Italy, Japan, Poland, Russia, South Korea, Spain, Taiwan, Thailand, USA & Canada

+46 455 30 28 70 | U.S. Sales 608-233-9022

www.mrtsystem.com (http://www.mrtsystem.com/)

NLR, Inc. (Next Level for Recycling)

National and regional lamp, e-waste, battery, ballast and mercury device recycling. Provides "BakPak" national pre-paid lamp recycling container program for lamps, cfls and ballasts. East Windsor CT.

888-657-5267 (Toll-Free) | Fax: 860-292-1114

Email: info@nlr-green.com (mailto:info@nlr-green.com), www.nlr-green.com (http://www.nlr-green.com), www.go-bak.com (http://www.go-bak.com)

Recycle Technologies, Inc.

Regional recycling service for lamps, ballasts, batteries, HVAC and electronic scrap. Minneapolis, MN; Milwaukee, WI

800-969-5166

www.recycletechnologies.com (http://www.recycletechnologies.com)

REEnewal Corporation

Recycling of products and wastes for the recovery and reuse of rare earth elements. San Jose, CA

408-800-7330

www.reenewalcorp.com (http://www.reenewalcorp.com)

Rhodia Inc.

Recovery of Rare Earth Elements from recycled lamps and production of precursors for lighting phosphors. Worldwide manufacturing of specialty chemicals for sustainable development, with 11 Global Business Units that partner with firms in the automotive, electronics, flavors and fragrances, health, personal and home care markets, consumer goods and industrial markets. Cranbury, NJ

609-860-4000

www.rhodia.us (http://www.rhodia.us)

Southeast Recycling Technologies, Inc.

Regional recycling services in Southeast US for lamps and electronic scrap. Johnson City, TN; Memphis, TN; Nashville, TN; Burlington, NC; Kennesaw, GA, Christiansburg, VA

800-592-3970

www.recyclebulbs.com (http://www.recyclebulbs.com)

Universal Recycling Technologies (URT), LLC.

866-522-7711, 800-755-4117, 608-754-0638

www.universalrecyclers.com (http://www.universalrecyclers.com)

Veolia Environmental Services

International recycling service for lamps, ballasts, mercury, and electronic scrap. Port Washington, WI; Phoenix, AZ; Tallahassee, FL; Stoughton, MA; Flanders, NJ; Sacramento, CA; Kent, WA; Albany, NY; Morrow, GA; collection throughout U.S. France (Limay, Castelnau-le-Lez, Geonesse) Norway (Trondheim)

800-556-5267

www.veoliaes.com (http://www.veoliaes.com)

WM LampTracker Inc.

Recycler of Lamps, Ballasts, Batteries, and Electronics. Nationwide coverage. Lake Ozark, MO, Minneapolis/St. Paul, MN; Phoenix, AZ; Lancaster, PA; Mira Loma, CA; Williamston, SC; Union Grove, WI

Quantities above 500 Lamps: 888-537-4874. Quantities below 500 lamps: Mail back container program- 800-664-1434
www.lamptracker.com (http://www.wmlamptracker.com)

Other Lamp Recyclers

A-Tec Recycling, Inc.

Des Moines, IA

800-551-4912
www.a-tec-recycling.com (http://www.a-tec-recycling.com)

AERC Recycling Solutions

Allentown, PA

1-610-797-7608
www.aercrecycling.com (http://www.aercrecycling.com)

American Lamp Recycling

Fishkill, NY

800-315-6262
www.americanlamprecycling.net (http://www.americanlamprecycling.net)

Cleanlites Recycling, Inc. aka USA Lamp and Ballast

Mason, MI

Spartenburg, SC

Cincinnati, OH

Lakeville, MN

800-778-6645
www.usalamp.com (http://www.usalamp.com)

Complete Recycling Solutions, LLC

Fall River, MA

866-277-9797
www.crsrecycle.com (http://www.crsrecycle.com)

Environmental Recycling

Bowling Green, OH

800-284-9107
www.envrecycle.com (http://www.envrecycle.com)

Green Lights Recycling, Inc.

Blaine, MN

800-208-8340
www.greenlightsrecycling.com (http://www.greenlightsrecycling.com)

Lamp Recyclers of Louisiana, Inc.

www.lei-inc.com (http://www.lei-inc.com)

Lamp Recyclers, Inc.

Green Bay, WI

920-592-1166
www.lamprecyclers.com (http://www.lamprecyclers.com)

Mercury Technologies of Minnesota

Pine City, MN

800-864-3821
www.mercurytechnologies-mn.com (http://www.mercurytechnologies-mn.com)

Fluorescent Bulb Recyclers in Canada

Aevitas (dba Fluorescent Lamp Recyclers Technologies, Inc)

Ayr, Ontario

1-800-324-9018;

519-740-3334
www.aevitas.ca/lamp_recycling.html (http://www.aevitas.ca/lamp_recycling.html)

Ontario Lamp Recyclers

Toronto, Ontario

T: 647-992-5267;

F: 866-280-5075
www.ontariolamp.com (http://www.ontariolamp.com)

Aevitas (dba Proeco Corporation)

Edmonton, Alberta

780-440-1825;

1-800-661-5792 (Toll-Free in Canada and US)
www.aevitas.ca/lamp_recycling.html (http://www.aevitas.ca/lamp_recycling.html)

Chem Tech Environmental subsidiary RLF Canada

Côteau-du-Lac,Québec

450-763-0066;

800-567-8027
www.recyclagedelampesfluorescentes.com (http://www.recyclagedelampesfluorescentes.com)

Guidelines for the Use of Personal Protective Equipment

職業安全健康局
Occupational Safety & Health Council

Contents

* This booklet is also available in Chinese version

Introduction

Personal protective equipment (PPE) is an important means of preventing work injuries. Ideally, the best approach is to maintain a safe work environment and eliminate any potential hazards. PPE should only be relied upon as a last line of defence in places where it is not practicable to control the hazards at source.

The use of PPE generally implies working in a potentially hazardous work environment and its use is a major means of injury prevention. Therefore, it is of prime importance to ensure that the equipment chosen is both reliable and effective, it is being properly used and maintained, and the user has undergone adequate training. The aim of this booklet is to raise the awareness of occupational safety and health practices and the proper use of PPE of people from all walks of life.

Key Points on the Proper Use of Personal Protective Equipment

(1) Proper selection

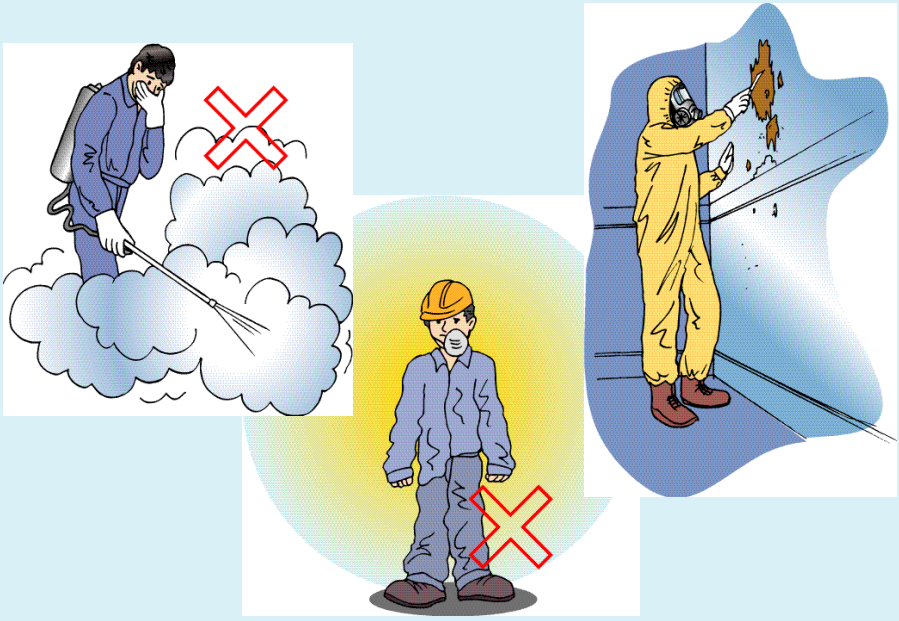
You must first understand the nature and degree of the potential hazards, and then select appropriate PPE that meets the relevant standards. Furthermore, some PPE (such as breathing apparatus) must properly fit the physique of the user before they can be effective. PPE must meet the demands of the work environment and should be as comfortable and easy to use as possible.

(2) Correct use

You must fully understand and abide by the correct usage methods of the PPE. Examples of incorrect use include different brands of filter being fitted to a respirator or the filters being cleaned with water.

(3) Correct maintenance

PPE should be cleaned and dried after use, properly stored and regularly inspected. If you discover any damage to the PPE, you should immediately report this to your supervisor so that it can be replaced.

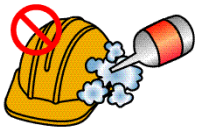


Safety Helmets

The "Construction Sites (Safety) Regulations" clearly state that no person shall enter a construction site without wearing a suitable safety helmet. In other places where there is the risk of falling objects, workers must also correctly wear safety helmets to avoid head injury.

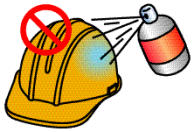
Safety helmets must:

Safety helmets require proper maintenance. You must not:



Clean them with organic solvents

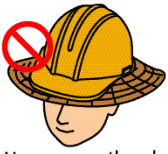
Drill holes in them



Paint or spray them

Use them when they are damaged

Throw or strike them



Wear any other hat under the safety helmet

Eye Protectors

Our eyes are highly susceptible to injury from external hazards that can lead to partial or complete blindness. The "Factories and Industrial Undertakings (Protection of Eyes) Regulations" state that proprietors must provide suitable eye protection to employees undertaking certain processes and to others affected by those processes.

Introduction to various kinds of eye protection equipment:

(1) Protective goggles

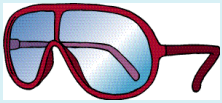
Suitable for protection from dust, particles, flying chips, chemical splattering and smoke.

(Goggles with direct vents are not suitable for protection from chemical splattering or smoke)

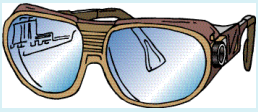
(Fitted with indirect vents)

(2) Safety glasses

Suitable for protection from particles, flying chips and the impact of fragments.



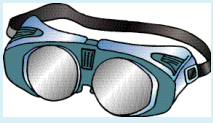
(Frontal protection)



(Fitted with side protection)

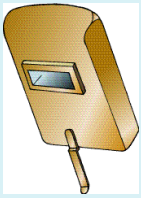
(3) Goggles for protection from glare, gas welding and smelting furnaces

Suitable for smelting furnace work (with an added face shield), glare, molten metal, strong light and gas welding etc.



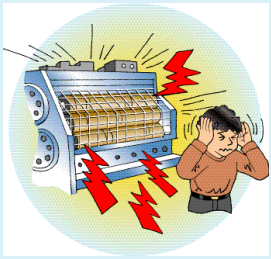
(4) Electric arc welding helmets and face shields

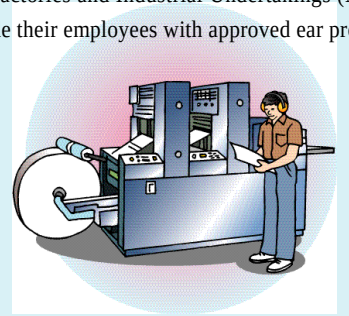
Suitable for protection from electric arc welding, electric sparks, strong UV-radiation (can be used together with safety goggles) etc.



Ear Protectors

Working under prolonged exposure to high levels of noise can lead to hearing loss. Intermittent exposure to high noise levels can lead to irritability, a reduced ability to concentrate, hearing damage and can even lead to accidents. Once hearing is damaged, it cannot be restored so we must protect our hearing. The "Factories and Industrial Undertakings (Noise at Work) Regulation" requires proprietors to provide their employees with approved ear protectors.



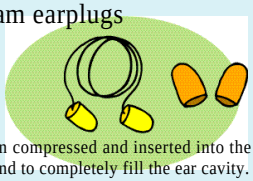


Different types of ear protectors:

(1) Cotton earplugs

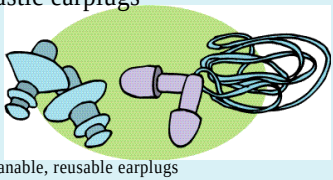
Disposable earplugs for short-term use - not suitable for high noise levels.

(3) Foam earplugs



When compressed and inserted into the ear cavity, they expand to completely fill the ear cavity.

(2) Elastic earplugs



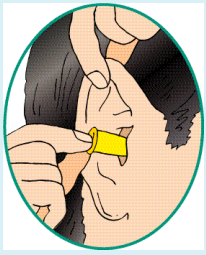
Cleanable, reusable earplugs

(4) Ear muffs

Ear muffs offer a high level of sound reduction and are suitable for high noise levels. They can be used in combination with a safety helmet

The correct use of earplugs

Pass your left hand behind your head and lift up the top of your right ear to open up the ear cavity. Insert the earplug into the ear cavity, pressing and turning lightly.



Respirators

The air quality of the work environment has a direct influence on the safety and health of employees. Ideal protective measures are to control any source of pollution and reduce the amount of pollutants entering the air supply. If circumstances do not allow such measures to be immediately taken, the best strategy is to ensure proper selection and use of appropriate respirators.

Common kinds of air pollution

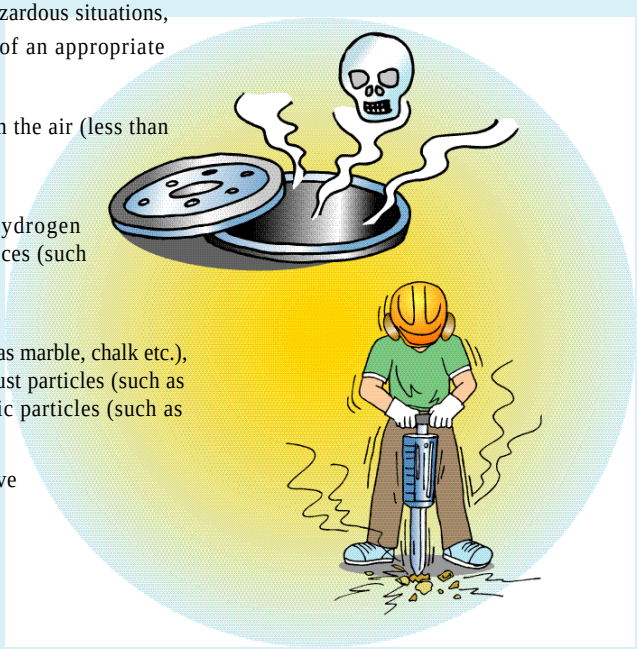
If you encounter the following hazardous situations, you may require the protection of an appropriate respirators:

(1) Inadequate oxygen supply in the air (less than 19% oxygen)

(2) Presence of toxic gases
Including gases (such as hydrogen sulfide) and volatile substances (such as benzene)

(3) Harmful particles
Including noxious dust (such as marble, chalk etc.), pneumoconiosis – causing dust particles (such as silica and asbestos) and toxic particles (such as lead dust and acid mist)

(4) Any combination of the above

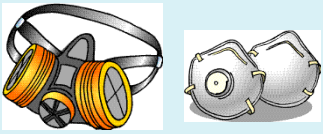


Respirators

Different types of respirators

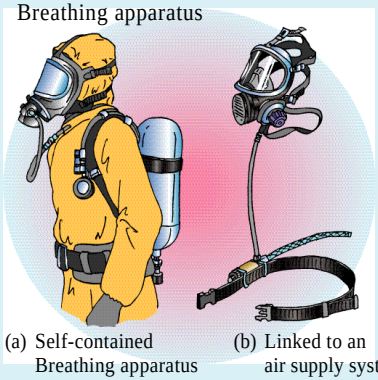
There are basically three kinds of respirators for protection from the above-mentioned hazards:

(1) Dust respirators
(Not suitable for oxygen deficient environments)



(2) Cartridge or canister
(Not suitable for oxygen deficient environments)

(3) Breathing apparatus



(a) Self-contained Breathing apparatus

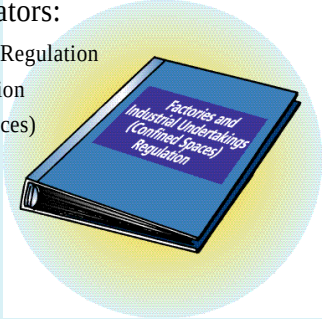
(b) Linked to an air supply system

Essential points to consider before using a respirator:

1. Selection of appropriate respirators according to the results of risk assessment, and provision of training and information in the proper use and care of the respirators.
2. Medical examinations should be carried out to screen which employees are suitable to carry out certain tasks that need wearing the respirators.
3. Inspection of the respirators should be carried out before work is commenced to ascertain whether there are any damages to the respirators and whether they are suitable for the existing work environment.
4. Checking whether the cartridge or canister works effectively.
5. Carrying out a proper fit test to ensure the respirator fits tightly against the face.

Regulations currently in effect regarding respirators:

1. Factories and Industrial Undertakings (Confined Spaces) Regulation
2. Factories and Industrial Undertakings (Asbestos) Regulation
3. Factories and Industrial Undertakings (Dangerous Substances) Regulations
4. Factories and Industrial Undertakings (Blasting By Abrasives) Special Regulations
5. Construction Sites (Safety) Regulations

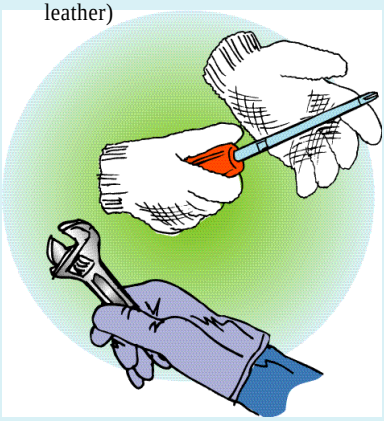


Protective Gloves

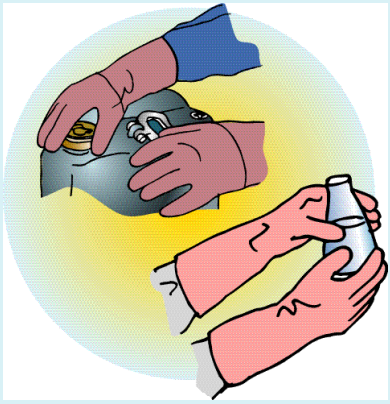
Using your hands is an almost indispensable part of any job and thus there is always the risk of getting your hands injured. You must therefore select appropriate hand protection. Furthermore, if your hands are likely to come into contact with harmful or corrosive chemicals resulting in rashes or skin inflammations, products such as protective ointments can be used to provide extra protection. The regulations also expressly state that proprietors shall provide sufficient supply of protective skin ointments to workers involved in electrolytic chromium processes.

Common protective gloves:

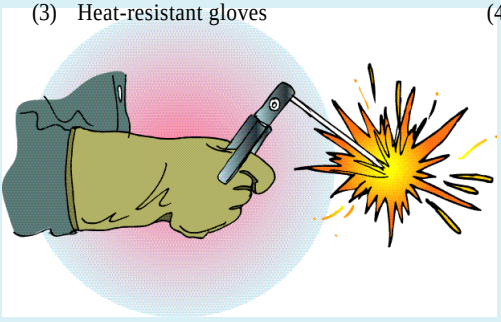
(1) Gloves for common tasks (cotton/ leather)



(2) Gloves for handling chemicals



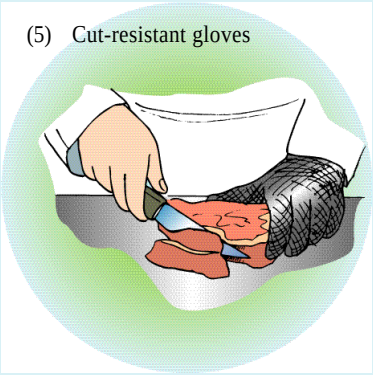
(3) Heat-resistant gloves



(4) Cold-resistant gloves

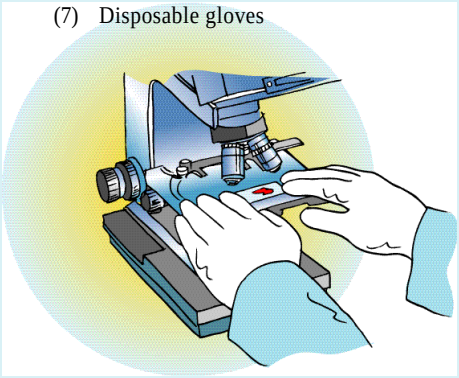
Protective Gloves

(5) Cut-resistant gloves

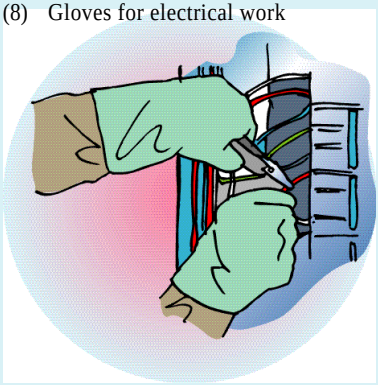


(6) Anti-shock gloves

(7) Disposable gloves



(8) Gloves for electrical work



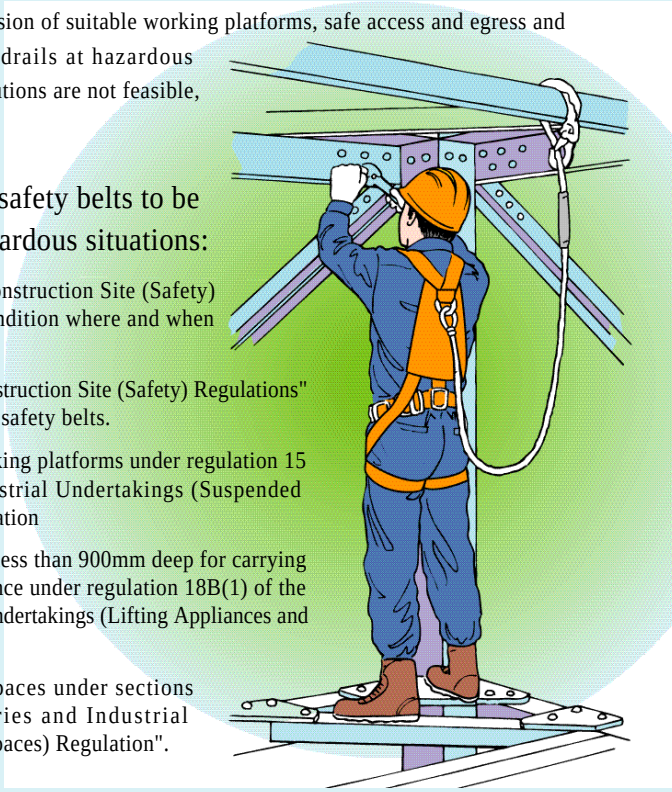
Protective gloves must have a good tactile sense, elasticity and dexterity. They must not be slippery and must be easy to put on and take off. They can be made of materials such as cotton, latex, nylon or leather. The appropriate kind of gloves should be selected according to the nature of the work. The only places gloves may not be used are situations where the gloves might get tangled up in moving parts of machinery such as drill spindles and revolving cutting tools.

Regulations currently in effect regarding protective gloves:

(1) Factories and Industrial Undertakings (Electrolytic Chromium Process) Regulations
(2) Factories and Industrial Undertakings (Dry Batteries) Regulations
(3) Factories and Industrial Undertakings (Dangerous Substances) Regulations

Safety Belts

For working at heights, the safety regulations require employers to adopt basic safety precautions including the provision of suitable working platforms, safe access and egress and the erection of suitable guardrails at hazardous locations. If these safety precautions are not feasible, safety belts must be used.



The regulations require safety belts to be use in the following hazardous situations:

(1) Regulation 38H of the "Construction Site (Safety) Regulations" states the condition where and when safety belts are used.

(2) Regulation 38I of the "Construction Site (Safety) Regulations" describes the duty to wear safety belts.

(3) The use of suspended working platforms under regulation 15 of the Factories and Industrial Undertakings (Suspended Working Platforms) Regulation

(4) The use of a receptacle of less than 900mm deep for carrying persons by a lifting appliance under regulation 18B(1) of the "Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations".

(5) Working in a confined spaces under sections 9 and 10 of the "Factories and Industrial Undertakings (Confined Spaces) Regulation".

Other examples of situations where safety belts are required:

(1) Working on container tops during cargo or container handling under regulation 10B of the Factories and Industrial Undertakings (Cargo & Container Handling) Regulations

(2) Working at a dangerous place which requires alternative protection under regulation 24(a) of the Factories and Industrial Undertakings Regulations.

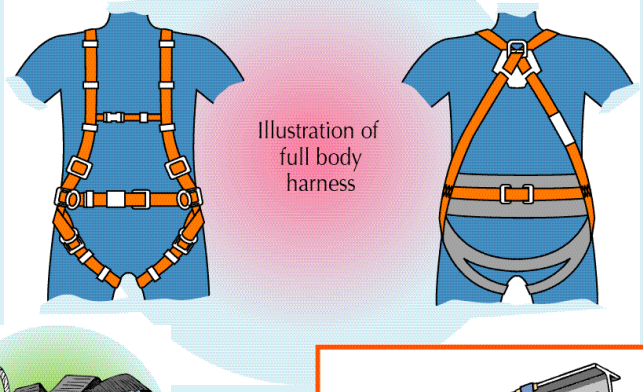
(3) Working at a dangerous place which requires alternative protection under section 6(1)(b) of the "Occupational Safety and Health Regulation".

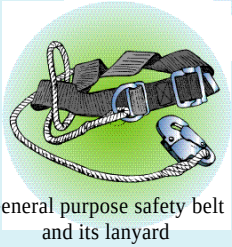
Safety Belts

Common types of safety belt:

(1) Full body harness is used to prevent falls.

(2) General purpose safety belt and its lanyard are used to restrict movement while working.

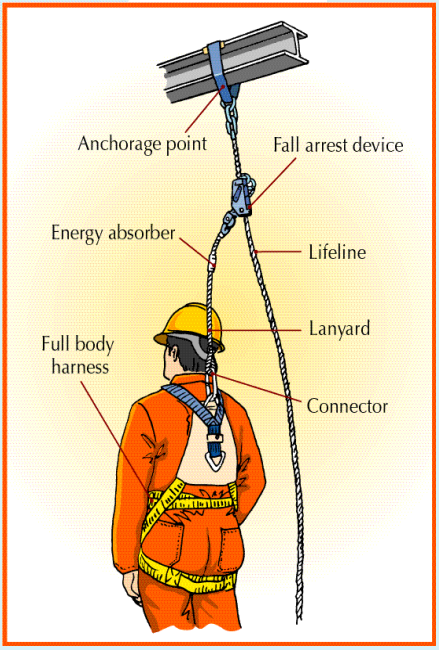




General purpose safety belt and its lanyard

Fall protection system for working at heights

In addition to a safety belt, the entire fall protection system for working at heights must also consider the area surrounding the worksite so as to, for example, prevent striking against nearby structures in the event of a fall. Environmental factors should also be taken into account so as to avoid high temperatures or smoke affecting the performance of each of the components of the system.



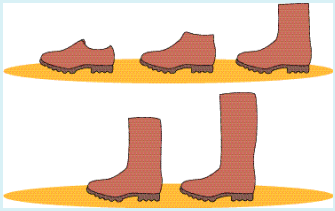
Fall protection system for working at heights

Safety Footwear

Accident statistics from the Labour Department reveal that there are many accidents annually caused by stepping on objects and slips. So how can we reduce the risk of foot injuries to employees? Wearing appropriate safety footwear is one of the easy and effective ways.

Selection of suitable safety footwear

Before making a selection, you must understand the major hazards causing direct or indirect foot injuries to employees.



(1) Being struck by hard, rolling or falling objects.

(2) Sharp objects piercing the sole or body of the shoe.

(3) Being scratched by sharp objects, resulting in epidermal laceration.

(4) Slipping on wet floors.

(5) Contact with chemicals, molten metals and hot or cold surfaces.

(6) If electrostatic discharge is inadequate, explosions may be triggered in environments containing flammable gases. Furthermore, the electrical conductivity of the feet can also affect the risk of electrical shock.

Use and maintenance of safety footwear

Safety footwear can only work effectively and protect the feet if they are properly used and looked after.

(1) You must not alter the structure of the safety footwear yourself.

(2) You must wear safety footwear of a suitable size.

(3) You must pay attention to personal hygiene and keep your feet and footwear clean and dry.

(4) Regularly clean your safety footwear. In addition, the soles of safety shoes must also be cleaned regularly to avoid the build-up of grime. This is because the grime on and texture of the sole of footwear can affect the electrical conductivity of the soles and may also reduce their anti-slip properties.

(5) Store your safety footwear in a shaded, dry and well-ventilated place.

Protective Clothing

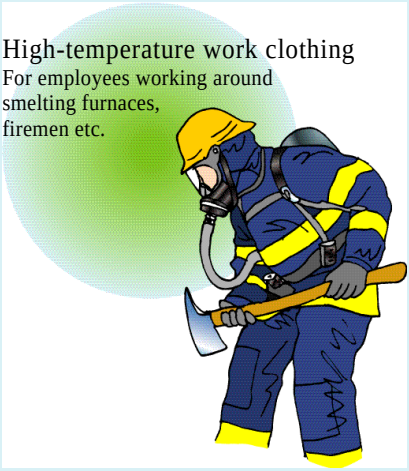
Protective clothing provides physical protection and can increase comfort levels while on the job.

The following kinds of protective clothing are available, affording protection from different hazards:

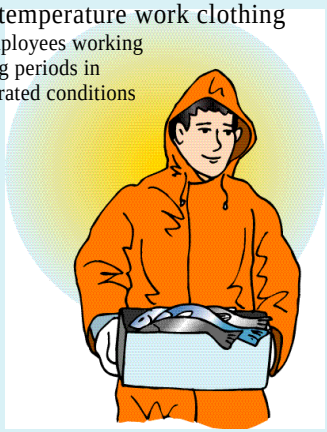
(1) General purpose protective clothing
Including raincoats

(2) Heat-resistant work clothing/aprons
Used for welding to prevent burns from sparks, fragments and flying molten metals

(3) High-temperature work clothing
For employees working around smelting furnaces, firemen etc.



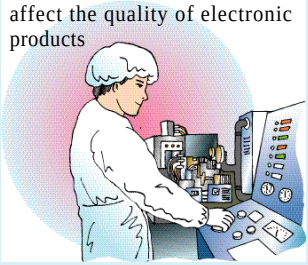
(4) Low-temperature work clothing
For employees working for long periods in refrigerated conditions



Protective Clothing

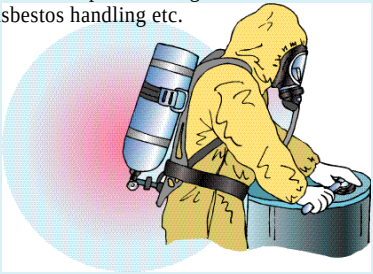
(5) Anti-electrostatic work clothing

Suitable for workplaces where flammable materials are handled or where static charges might affect the quality of electronic products



(6) Impermeable work clothing for protection against chemicals

Chemical spill handling and asbestos handling etc.

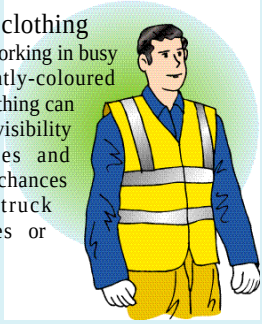


(7) Life jackets

Reduce the risk of drowning when an employee falls into water

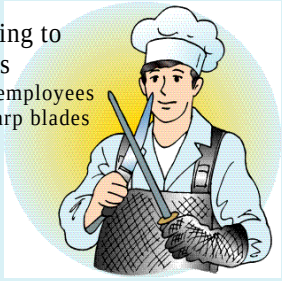
(8) Reflective clothing

Such as for working in busy traffic; brightly-coloured reflective clothing can increase the visibility of employees and reduce their chances of being struck by vehicles or machinery



(9) Work clothing to prevent cuts

Suitable for employees operating sharp blades and machines



Regulations related to protective work clothing:

Factories and Industrial Undertakings (Electrolytic Chromium Process) Regulations

Factories and Industrial Undertakings (Dry Batteries) Regulations

Factories and Industrial Undertakings (Dangerous Substances) Regulations

Factories and Industrial Undertakings (Asbestos) Regulation

職業安全健康局
OCCUPATIONAL SAFETY & HEALTH COUNCIL

香港北角馬寶道28號華匯中心19樓
19/F, China United Centre, 28 Marble Road,
North Point, Hong Kong
電話 Tel : 2739 9377　傳真 Fax : 2739 9779
電子郵件 E-mail : oshc@oshc.org.hk
職安熱線 Hotline : 2739 9000
職安資訊傳真服務 SafeFax : 2316 2576
網頁 Homepage : www.oshc.org.hk

攜手創職安
Partnership in Safety

Natural Resources Conservation Authority

Guidelines for the Management of Asbestos

Approved by the NRCA
24 February 2014

Note: These guidelines have been prepared by the National Environment and Planning Agency (NEPA) in good faith exercising all due care and attention, but no representation or warranty, expressed or implied, is made as to the relevance, accuracy, completeness or fitness of this document for any other purpose in respect of a particular user's circumstances. Users of this document should satisfy themselves about its application to their situation and, where necessary, seek expert advice.

Copies may be obtained from the website of the National Environment and Planning Agency http://www.nepa.gov.jm or the Documentation Centre, National Environment and Planning Agency, 11 Caledonia Avenue, Kingston 5, Jamaica W. I. Telephone: (876) 754 7540 Email: docentre@nepa.gov.jm.

The guidelines will be revised periodically following feedback from stakeholders using it, ensuring its ongoing relevance and reflecting advances in best practice as the result of regulator and industry experience. Comments are invited and should be sent via email to pubed@nepa.gov.jm.

National Environment and Planning Agency
10 Caledonia Avenue
Kingston 10
Jamaica W. I.
Telephone: (876) 754 7540
Fax: (876) 754 7595
Email: pubed@nepa.gov.jm

February 2014

Executive Summary

The NEPA Guidelines for the Management of Asbestos was developed to document the National Environment and Planning Agency's procedures and requirements for the abatement and removal of Asbestos Containing Materials. It is intended to support the Agency's environmental management, and applies to all parties responsible for premises that contain asbestos or are suspected to contain asbestos. The guidelines are also relevant to all contractors recognized by NEPA and approved to safely and professionally abate asbestos.

In summary, the document outlines the procedures and precautions to be taken for the management of asbestos. It indicates the Agency's notification requirements, gives minimum safety requirements, sampling requirements, quality control/quality assurance for taking and handling samples, reporting requirements and includes sections which discuss the procedures for testing and abating asbestos. The appendices contain supplemental information, as well as, form templates for reporting.

Table of Contents

Definitions

NOTE: *For clarity, some of the following definitions may have been abbreviated or simplified.*

TERM	***DEFINITION***
Asbestos containing materials (ACM)	products that are known to be built from material containing or contaminated by asbestos
Abatement Workplan	a detailed plan that lists all steps and precautions employed during an asbestos removal exercise
All practicable steps	taking all practicable steps having regard to: • the nature and severity of the harm that may be suffered if the result is not achieved; • the current state of knowledge about the likelihood of harm and severity if the result is not achieved; • the current state of knowledge about harm of that nature; • the current state of knowledge about the means available to achieve the result, and about the likely efficacy of each; and • availability and cost of each of those means.
Asbestos	a material that contains, or is composed of amosite, chrysotile, crocidolite, fibrous actinolite, anthophyllite, or fibrous tremolite.
Asbestos fibre	a particle of asbestos that: 1. is not less than 5 micrometres and not more than 100 micrometres in length; and 2. is less than 3 micrometres in width; and has a length to width ratio of not less than 3 to 1.
Asbestos contractor	the business, entity, organization, company, partnership, venture or group that holds the appropriate knowledge and experience of asbestos hazards, processes and safe removal procedures to competently undertake the risk assessment, management, training and supervision for the safe removal of asbestos-contaminated material as outlined in this document.
Asbestos	the safe removal of asbestos-contaminated material.

TERM	*DEFINITION*
removal/abatement	
Asbestos supervisor	a person who holds a current Certificate of Competency issued by a competent recognized institution and undertakes the onsite, direct management and supervision of the safe removal of asbestos-contaminated material.
(NEPA approved) Asbestos Contractor	an person or company which is recognized by NEPA to have the required knowledge and experience pertaining to restricted asbestos removal to undertake any removal or maintenance work safely.
Dust control equipment	equipment that, when used in satisfactory working order, suppresses the release of asbestos fibres into the air by any means, including the conveying of water or any other wetting agent to the asbestos containing material that would otherwise generate asbestos dust.
Emergency	An accidental situation involving the release or imminent release of dangerous goods or other substances that would result in serious adverse effects on the health/safety of persons or the environment. An emergency may be the result of man-made causes or natural occurrences such as, but not limited to process upsets, uncontrolled reactions, fire, explosions, threats, structural failures, tornadoes, earthquakes, floods and storms. Emergency also includes a situation when ACM needs to be removed immediately due to health risks from exposure to asbestos fibres.[1]
Employee	any person of any age employed by an employer to do any work for hire or reward.
Employer	a person who employs any person to do any work for hire or reward. *The term employer also includes a Principal and a Person in Control of a Place of Work.*
Encapsulant	a material used to enclose (something) in or as if in a capsule
Friable	asbestos that under ordinary conditions can be easily crumbled (i.e. ACM with the potential to release asbestos fibres)
Harm	illness, injury or both, including physical or mental harm caused by work-related stress.

[1] NRCA Guidelines for the Preparation of an Industry Emergency Response Plan

TERM	*DEFINITION*
Hazard	an activity, arrangement, circumstance, event, occurrence, phenomenon, process, situation or substance (whether arising or caused within or outside a place of work) that is an actual or potential cause or source of harm.
HEPA filters (High Efficiency Particulate Air Filter)	a type of air filter that can remove at least 99.97% of airborne particles 0.3 micrometres in diameter.
Insulant	insulating material, a material that reduces or prevents transmission of heat, sound or electricity.
Membrane filter method	a membrane filter using phase contrast microscopy for estimating airborne asbestos fibre concentrations.
Accredited laboratory	a laboratory that is currently accredited by local or international accreditation.
Notifiable work	any work involving the removal of asbestos contaminated/ containing waste. Notifiable work must be notified a minimum of three days prior to the commencement of an abatement activities.
Owners (property)	includes, where appropriate, lessees and managers or their agents.
Person who controls a place of work	a person who is: • the owner, lessee, sub-lessee, occupier or any person in possession of a place of work; or • the owner, lessee, sub-lessee or bailee, of any plant in the place. This can include all or any of the Client, Principal, Employer and Contractor
Place of work	a place (whether or not within or forming part of a building, structure, or vehicle) where any person works or may work, for gain or reward; and, in relation to an employee, includes a place under the control of the employer (not being domestic accommodation provided for the employee): • where the employee comes or may come to eat, rest or get

TERM	*DEFINITION*
	first-aid or pay; or • where the employee comes or may come as part of the employee's duties to report in or out, receive instructions or deliver goods or vehicles; or • through which the employee may or must pass to reach a place of work. To avoid doubt, a person is in a place of work whenever and wherever the person performs work including in a place that: • the person moves through; or • itself moves.
PPE	personal protective equipment.
Principal	a person who engages any person (otherwise than as an employee) to do any work for gain or reward.
Protective clothing	specifically designed protective clothing (including coveralls, gloves, underclothing and boots) that is to be used or is used in association with asbestos work that will limit the spread of asbestos contamination to the wearer, any other person or other environment.
Protective equipment	protective equipment that is to be used or is used in a place of work to prevent the spread of contamination from asbestos dust - for example, all appliances, tools and ventilation equipment.
Restricted asbestos work	work in one or more of the following categories: • Work involving asbestos, if the asbestos concerned is friable and is, or has been used in connection with thermal or acoustic insulation, or fire protection, in buildings, ships, structures or vehicles; • Work involving asbestos, if the asbestos concerned is friable and is, or has been used in connection with lagging around boilers, ducts, furnaces or pipes; • The demolition or maintenance of anything, including a building or part of a building containing friable asbestos;

TERM	*DEFINITION*
	• The encapsulation of material containing friable asbestos; • The use on asbestos cement or other bonded product containing asbestos of: o A power tool with any kind of cutting blade or abrasive device, except when use with dust control equipment; or o Any other equipment whose use may result in the release of asbestos dust except when it is used with dust control equipment Dry sanding of floor coverings containing asbestos.
Significant hazard	a hazard that is an actual or potential source of: • serious harm; or • harm the severity of whose effects on any person depend (entirely or among other things) on the extent or frequency of the person's exposure to the hazard; or • harm that does not usually occur, or usually is not easily detectable, until a significant time after exposure to the hazard.
Structure	a plant, building, wall, chimney, fence, bridge, dam, reservoir, wharf, jetty, earthworks, reclamation, floating structure and tunnel.
Vacuum cleaner	Industrial Vacuum Cleaners for particulates hazardous to health or environment (or equivalent standard) are acceptable for use with asbestos work.
Work involving asbestos	1. Work involving the cleaning, disposal, handling, processing, storage, use, or working of asbestos; or 2. Work involving the demolition or maintenance of anything, including a building or part of a building, containing asbestos; or 3. Cleaning work carried out as a consequence of, or in connection with, work specified in (1) or (2).

Acronyms

ACM	Asbestos Containing Materials
HEPA	High-efficiency particulate air
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
OSH	Occupational Safety and Health
PPE	Personal Protective Equipment
PVA	Polyvinly Acetate
RPDs	Respiratory Protection Devices
WES	Workplace Exposure Standards
RAP	Remediation Action Plan
VA	Vinyl-asbestos

1.0 Introduction

1.1 Purpose

To document the NRCA procedures and requirements for the safe handling and management of asbestos containing materials (ACM).

1.2 Scope

The guideline document applies to all parties responsible for premises containing ACM and to those asbestos contractors authorized to handle ACM in Jamaica.

2.0 Acceptable Workplace Exposure Limits/Standards

This section contains a list of workplace exposure standards for asbestos (exposure standards). These Guidelines require a person conducting a business or undertaking at a workplace to ensure, so far as is reasonably practicable, that exposure of a person at the workplace to airborne asbestos is eliminated or minimized. If it is not reasonably practicable to eliminate exposure to airborne asbestos at the workplace, the person must ensure that the exposure is minimized so far as is reasonably practicable. The person must ensure that the exposure standard for asbestos is not exceeded at the workplace.

Exposure standards do not represent a fine dividing line between a healthy and unhealthy work environment. Natural biological variation and the range of individual susceptibilities mean that a small number of people might experience adverse health effects below the exposure standard. *Exposure standard* represents the airborne concentration of a particular substance or mixture that must not be exceeded**.** It is important to note that there are no safe exposure limits to asbestos fibres and all practicable steps must be taken to ensure that exposure to asbestos is kept and maintained as low as possible and under no circumstances exceed the WES.

Table 1 Acceptable Asbestos Work Exposure Standards

Form of Asbestos	Work Exposure Standards
Chrysotile	An average concentration over any 4 hour period of 0.1 fibre per millilitre of air; and
Amosite, crocidolite, fibrous actinolite, fibrous anthophyllite, and fibrous tremolite	An average concentration over any 4 hour period of 0.1 fibres per millilitre of air

3.0 Planning and Preparation for the Safe Removal of Asbestos

If it is suspected that ACM is present on premises, the following procedure should be followed:

1. Using the services of an authorized asbestos abatement contractor, determine whether the suspected ACM is friable or non-friable. If it is friable, and based on the recommendations of the contractor the area must be immediately vacated and quarantined so as to avoid the risk of inhalation of asbestos fibres. Special attention must be paid to possible exposure to children as they are more susceptible to lung scaring from ACM exposure.

2. Recruit one of the authorized asbestos abatement contractors to safely determine if the material is ACM. Sample collection and testing MUST be conducted by trained specialists.

If the material is confirmed to contain asbestos (by laboratory analysis), the contractors must submit a notification and the relevant documents as stipulated by an existing NRCA Permit being held by said contractor.

3.1 Regulatory Requirements for Asbestos Abatement Professionals

Prior to the commencement of any ACM abatement activities, contractors should obtain an Environmental Permit from the NRCA for the storage, treatment and/or transportation of hazardous wastes. The relevant application forms and requirements may be sourced from the Applications eCentre on the NEPA website at http://www.nepa.gov.jm/ecentre/.

The requirements for the removal of asbestos-contaminated materials can differ greatly depending on the specific asbestos removal task. Many factors can affect the execution of the removal activities including the type, location, quantity and condition of the asbestos-contaminated materials to be removed as well as proximity to workers or passersby. Public safety is also a significant concern.

Asbestos removal work includes:

- the removal of asbestos-contaminated materials from buildings and structures including demolition/excavation sites;
- the removal of asbestos-contaminated materials from plant and equipment including friction products; and
- cleaning up asbestos dust and debris.

Whatever the circumstances, it is essential for an asbestos removal plan to be developed by the asbestos contractor and implemented whenever any ACM is to be removed. An asbestos removal plan includes:

- the location, type and condition of the asbestos to be removed (this can usually be gathered from the asbestos survey (if any));
- entity which will be removing the asbestos-contaminated materials;
- equipment to be used to remove the asbestos-contaminated materials;
- how it will be removed safely;
- any enclosures that will be constructed and method of construction (including site layout)
- decontamination procedures for personnel, facilities and equipment;
- clearance procedures once removed;
- dismantling of any enclosures/decontamination facilities.
- procedures for re-entry of occupied building

All practicable steps must be taken to ensure that workers and others in the areas are not exposed to asbestos fibres.

4.0 Safe Removal of Friable Asbestos

This section applies to the removal of, or work on:

- friable asbestos, including sprayed asbestos coatings used for thermal and acoustic insulation in buildings;
- decorative coatings in buildings;
- fire-damaged asbestos-contaminated materials, including sheeting/cladding material; and
- asbestos-based lagging on boilers and other industrial plant.

4.1 Planning and Programming Considerations

As the removal of friable asbestos by an asbestos contractor is done under contract or tender, the precise nature of the work to be done should be understood by both the contractor and client.

4.2 Information to be supplied by the Property Owner, Occupier or Agents (Client), including Principals and Persons in Control of a Place of Work

It is the responsibility of the owner to ensure an asbestos contractor carries out the removal of ACM. If in doubt, the owner or their agent should contact NEPA to obtain a list of NEPA approved Asbestos Abatement contractors before any ACM removal.

The owner or their agent should supply the asbestos contractor with precise details of the scope of the work to be done prior to commencement of any work. However, it is recognised that in some cases the full extent of Asbestos-contaminated materials present will not be known until after the removal is underway.

In the preparation of the job specification, the following considerations should be addressed:

Location:

a. indoors;
b. outdoors but protected;
c. outdoors exposed to weather;
d. enclosed in ducts or trenches below ground level;
e. difficult or unusual site conditions, which will influence the selection or application of removal methods, particularly in regard to transport, scaffolding or weather protection;
f. technical description of the material to be removed with details of the type of asbestos present and any special or unusual materials or circumstances; and
g. any issues that may affect the safety of workers or the public.

The extent of the removal work should be adequately detailed on drawings, preferably coloured, to indicate areas for removal. Otherwise, information of the following nature should be provided:

a. surface dimensions of flat or large curved areas, thickness of insulation, external diameters of pipes, length of each size pipe, and number and type of pipe fittings - e.g. flanged joints, valves, tees, expansion bends. Particular detail is to be provided if asbestos is to be removed from any part of the building's air-conditioning system;

b. details of any pipe-work sections that are steam or electrically heated and the arrangement of its insulation;

c. details of any section or materials to be left in place;

d. confirmation and details of residual heat that will remain in pipe-work, boilers, turbines or refinery equipment;

e. any unusual or specific hazards associated with the removal job;

f. temperature considerations - normal working temperature at the removal area;

g. conditions of substrate surfaces - special requirements, such as the removal (or otherwise) of protective paint or lacquer from pipe-work or for the application of paint or other protective coatings to the substrate from which the asbestos-contaminated materials have been removed;

h. types of fittings and supports and whether or not these may be removed or disposed of with the waste;

i. type of finish required or specification for re-insulation;

j. special service requirements - e.g. where there is any potential hazard from contact with live electrical equipment in use in the removal area, attention should be drawn to this fact;

k. site occupancy restrictions and conditions;

l. cleaning of adjacent areas (adjacent areas that are to be cleaned or are to be protected from airborne dust and are to be cleaned on completion);

m. safety practices to be followed under relevant legislation;

n. location of any relevant electrical cables; and

o. location of any relevant in-ground services.

Where electrical switch gear or panels are to be sealed, consideration should be given to the provision of supplementary ventilation to dispose of potential heat build-up and consequent fire risk.

4.3 Information to be supplied by the Asbestos Contractor

Restricted work involving asbestos **must** be notified to the NEPA. Please see **Appendix A** for the contents of the Asbestos Abatement Work Plan that must be submitted to the Agency prior to commencement of activities. Contractors must also provide proof of award of asbestos abatement contract.

4.3.1 Asbestos Abatement Work Plan

The asbestos contractor should develop a site-specific abatement plan before commencing any asbestos removal work. The purpose of each **Asbestos Abatement Work Plan** is to help ensure the removal is well planned and carried out in a safe manner. The asbestos removal control plan should include specifications and/or drawings addressing at least all of the items in **Appendix A** which are relevant to the particular removal job. Additional information should be included for each individual removal job as necessary and submitted to NEPA for approval.

The Abatement Plan should be finalised in consultation with the client and subsequently submitted to NEPA before abatement exercises begin. Consideration should be given to the removal of all asbestos from a building at one time. Piecemeal removal often leads to the contamination of other work areas thus placing other persons at risk. As the removal of asbestos may be dependent upon progress of other contractors at the site, details of planning schedules that will control the work and allow for effective removal without other personnel being present in the removal areas should be agreed upon. Conversely, the work of other contractors should be scheduled to preclude them working near to, or accidentally breaking into the asbestos removal area.

4.4 Planning for Emergencies

NOTE: *It is important to remember that ambulance services should not enter into any area where their staff may be put at risk, including an asbestos-contaminated workplace. Therefore, in the event that a worker may need to be stretchered out of the workplace, other procedures may need to be developed and practiced.*

Workers involved in ACM removal should be trained for emergency situations, particularly if they involve confined spaces or friable asbestos removal, where specialist skills may be required.

Emergency planning should include provisions for emergency and fire evacuation, including exit arrangements and emergency communications such as audible alarms. The alarms should be used for emergencies only.

Emergency exit arrangements need to be adequate for the risks involved. Barriers and signs or other warning devices can be used to communicate emergency arrangements.

A first aid kit and first aid officer should be readily available at all times and sufficient suitable fire extinguishers and hoses should be available at strategic locations. The locations of fire extinguishers and hoses should be displayed in written and/or graphic format.

4.5 General Training Requirements

Persons carrying out asbestos removal work should be trained so they can carry out this work safely and without risk to their own health and others. This training must reflect the specific type of asbestos work to be undertaken.

This training must include information in the site-specific asbestos removal work plan (refer to **Appendix A**), specifically:

- safe work procedures;
- correct decontamination procedures;
- emergency procedures; and
- correct wearing and general maintenance of all PPE and RPE.

Asbestos contractors must also provide the following information to all of their asbestos removal workers and to all applicants for employment as an asbestos removal worker:

- the health risks associated with exposure to asbestos; and
- the need for, and details of, health surveillance, including medical examinations, and these guidelines.

Asbestos contractors should keep a written record of all training provided to each of their asbestos removal workers and ensure that these records are readily accessible.

The asbestos contractors must ensure that the removal is continually supervised and that the operation is carried out in a safe and proper manner, in accordance with the precautions listed in these guidelines.

4.6 Supervisory Personnel

The asbestos contractor must ensure that persons supervising the removal of asbestos-contaminated materials defined as "restricted" must carry a Certificate of Competency in such work.

The asbestos contractor must ensure that supervisory personnel have a detailed knowledge of the precautions and procedures outlined in these guidelines. With this knowledge and at least two years' practical experience, they should assume the following responsibilities:

- implement the planned removal procedure;

- perform the pre-removal setting up;
- perform the actual removal and final cleaning operation;
- ensure that all necessary measures are taken to reduce the airborne concentration of asbestos dust to the lowest practicable level;
- ensure that asbestos fibres and asbestos-contaminated materials do not contaminate adjacent areas;
- arrange for, and assess results of air monitoring where appropriate;
- ensure that all workers under their supervision are adequately trained in the safe working practices outlined in these guidelines;
- ensure that the removal is continually supervised and that the operation is carried out in a safe and proper manner in accordance with the precautions listed in these guidelines;
- ensure that personal protective equipment (PPE) is used and maintained in good condition;
- ensure that the removal site is maintained in a clean condition and that waste is quickly and properly disposed of;
- ensure personal hygiene procedures are continually observed;
- maintain copies of all records;
- establish decontamination procedures

4.7 Non-Removal Persons Entering the Removal Enclosure

In some cases, non-removal persons may be required to enter the removal enclosure - for example, to undertake inspections or monitoring. In these instances, the asbestos contractor must ensure that these persons receive the appropriate training, supervision and PPE required ensuring their safety and health while in the removal area.

The information provided should be site-specific and include:

- general information about the removal works;
- the hazards and control methods implemented during the removal process;
- the types of asbestos-contaminated materials being removed, the health hazards from exposure and the controls to protect their health;
- the PPE required to work within the removal enclosure;

- site decontamination procedures;
- emergency procedures; and
- any other information required to ensure their health and safety.

If they provide and wish to use their own PPE, such as respirators, the asbestos contractor should check these to ensure that they are free from defects and suitable for the types of asbestos being encountered.

4.8 Site Preparation for the Removal of Friable Asbestos from Buildings and other Structures

There are two "asbestos removal boundaries" for asbestos removal work: the boundary of the **asbestos work area** and the boundary of the **asbestos removal site**. The asbestos work area is the immediate site in which removal work of ACM is taking place. The asbestos removal site is the region surrounding and adjacent to the asbestos work area.

The asbestos work area and the asbestos removal site should be clearly defined. The boundaries of the two should be determined by a competent person and should be based on a risk assessment. All interested parties must agree on the asbestos removal boundaries before any asbestos removal work may commence.

If a workplace and the type of asbestos removal work involved are both similar to those at a previously determined site, the same boundaries can be applied after a reassessment for each site.

In determining the asbestos removal boundaries, consideration needs to be given to the:

- use and suitability of various enclosures and asbestos removal methods; and
- impacts of the asbestos removal work, including potential exposures, in the surrounding region.

In all cases, the procedures adopted for the removal of friable asbestos must be designed to contain the asbestos and minimize airborne exposure. The steps required to be taken will vary from job to job but in all cases:

- access to the asbestos removal area must be restricted to those involved in the removal work;
- contamination of flooring furnishings with asbestos-containing dust must be avoided;

- the drift of airborne fibres must be restricted by ensuring that the removal area is effectively screened off from adjacent areas. This is usually achieved by extracting air from the removal area to ensure that it remains at negative pressure with respect to surrounding areas; and
- the precautions taken must be sufficient to ensure that any asbestos contamination in the air or surrounding areas is maintained below 0.01 fibres/ml (over a period of time outside the enclosure area) at all stages during and after the asbestos work.

The steps to be taken will be determined by the likelihood of asbestos fibre release and the size of the job in terms of time taken to complete it and the area involved.

In the following sections, the site preparation that is considered appropriate for three commonly performed removal tasks are discussed. These are:

1. the removal of fireproofing, thermal or acoustic insulation applied to structural steel or ceilings, or other similar major asbestos removal jobs;
2. the removal of decorative coating containing relatively low percentages of asbestos;
3. small-scale jobs such as the removal of minor amounts of asbestos pipe lagging.

4.9 Electrical and Lighting Installations

The risk of electrical injury, particularly when water is involved, must be addressed prior to removal of any asbestos-contaminated materials. The best control is de-energization (turning the power off) and removal of electrical installations from the asbestos work area. If electrical installations cannot be disconnected and removed, they must at the very least be de-energised. The de-energised installation must be tagged and locked out so it cannot be inadvertently re-energised. Any electrical cabling or equipment remaining in the asbestos removal area must be labelled and protected from mechanical damage or the ingress of water, and in accordance with local standards and regulations (wiring rules).

A licensed electrician must perform the safe removal and reinstallation of electrical cables and electrical equipment and ensure that any electrical cabling or equipment is safe prior to re-energization. If there are smoke, thermal or fire detectors in the asbestos work area, a competent person should remove the heads and isolate the circuits as required prior to the removal works commencing.

Upon completion of the asbestos removal work, a competent person should replace the heads, reactivate and test the system and prepare a certificate stating that the heads are operational and forward this to the person in control.

4.10 In-Ground Services

Care must be taken to identify and locate all in-ground services (such as water, gas or sewer pipes) in the asbestos work area or the asbestos removal site. If necessary, appropriate action must be taken to ensure that these services do not present a hazard to asbestos removal workers. Conversely, it must also be established that asbestos fibres do not contaminate any such services, possibly by disconnecting those services for the duration of the removal work.

4.11 Preparation of a Site for a Major Removal Programme[2]

Wherever practicable, enclosed "negative pressure" asbestos work areas should be established for any large-scale removal of friable asbestos-contaminated materials. Similar large enclosures can also be used for the removal of non-friable asbestos-contaminated materials if a risk assessment concludes that enclosure is an effective control for the risks involved.

The design and installation of the enclosure should take account of:

- the methods used to contain the asbestos work area;
- the provision and locations of decontamination and changing facilities;
- the precautions that must be implemented to prevent the spread of asbestos contamination outside the asbestos work area;
- air quality within the enclosure - for example, there must always be sufficient oxygen within the enclosure;
- the temperature within the enclosure (especially to avoid heat stress); and
- any other hazards in the enclosure. These hazards must be identified and control measures implemented before any asbestos removal work commences.

Work methods may also need to be adapted for the work environment within the enclosure.

[2] This section has been largely adopted and adapted in parts from WorkSafe New Zealand; newzealand.gov.nz. http://www.business.govt.nz/worksafe/information-guidance/all-guidance-items/new-zealand-guidelines-for-the-management-and-removal-of-asbestos-3rd-edition/safe-removal-of-friable-asbestos (Accessed January 2014)

Heavy duty plastic sheeting - minimum **200µm (microns)** - should be used for the enclosure. Recycled or reusable plastic must not be used. Every location where the asbestos work area connects to the outside environment or the rest of the building (such as windows, ducts, wall cavities, conduits and lift entrances) should be enclosed so that an airtight seal is maintained for the duration of the asbestos work. Vertical shafts should be properly sealed off to prevent the thermosyphon effect spreading asbestos fibre throughout the building.

Existing floor coverings should be removed where practicable. A double layer of plastic sheeting (suitably fixed by double-sided tape or adhesive to prevent movement between layers) should be used on the floor of the containment area and a turn-up should be used where the floor joins the side walls. The plastic sheeting should enclose all the walls, windows and doors. Wooden cleats may be used to anchor the plastic sheeting to the walls.

4.11.1 Airlocks

Airlocks should be provided at the entry points to the changing area. These airlocks should be constructed using double sets of overlapping plastic with suitable provisions for ensuring a seal.

4.11.2 Viewing Panels

Viewing panels are installed in enclosures to allow for inspection of removal operations and should be placed in appropriate locations.

4.11.3 Lighting Requirements

Adequate lighting needs to be provided within the enclosure, either naturally, using clear plastic or Perspex panels in the enclosure walls, or artificially, preferably from outside the enclosure and again using clear plastic or Perspex panels. Lights within an enclosure can increase the temperature within the enclosure.

4.11.4 Lift Shafts

Where asbestos is removed from an entire floor of a multi-story building, all passenger lifts should be prevented from stopping at the floor from which asbestos is being removed. Removal workers may gain access to the floor via the fire stairs or from a lift dedicated for this purpose. Where a lift is used for access, all exit doors to other floors should be sealed. It is important that emergency escape exits are available when blocking off such areas.

4.11.5 Furniture and Fixtures

All movable furniture, plant and fittings (such as curtains, desks, mats and false ceiling tiles) must be removed from the asbestos removal area. The immovable items should be fully wrapped and sealed in suitable plastic sheeting so that they are effectively isolated from the removal area. In regions of heavy traffic or high wear, additional masking or barricading may become necessary.

4.11.6 Masking and Preparation of Enclosure and Other Equipment

Where masking operations may liberate asbestos fibres, all persons in the removal area must wear respiratory protective devices approved for asbestos. This precaution is particularly applicable when removing existing barriers or partitions such as false ceiling tiles, or the erection of scaffolding.

4.11.7 Ceiling Spaces

Where asbestos materials may have fallen onto a false ceiling, the ceiling should be removed only under full removal conditions. Any utility or service line which penetrates into the ceiling space must be sealed.

Ceiling spaces may be sealed by constructing a plastic-lined frame within the ceiling space. This frame should be removed only after the completion of the final clearance inspection. Aside from specific asbestos extraction units, all ventilation and air-conditioning networks servicing the removal area should be closed down for the duration of the removal job. All vents should be thoroughly masked to prevent the ingress of asbestos fibre into the duct network. Upon completion and after final cleaning of the removal area, all mechanical ventilation filters for re-circulated air should be replaced.

Additional care must be taken to ensure that asbestos fibres cannot escape at points where pipes and conduits pass out of the removal area. Greater attention to masking and compliance testing should be given in these regions, particularly if service riser-shafts pass through the removal area.

If the asbestos work area is adjacent to areas occupied by unprotected persons, priority should be given to performing the removal work during periods when these areas are unoccupied or to a greater isolation of the removal area. In addition, hoarding should be constructed to form a barrier between the asbestos work area and the adjoining occupied areas. A plastic-lined

barrier should be erected within this hoarding. A buffer area should be reserved between the hoarding and occupied areas.

Any platforms and/or fixed scaffolding required for the safe removal of the asbestos-contaminated material should be erected during the early stages of the work. Where it is necessary to construct platforms and fixed scaffolding within the enclosed area, decontamination and visual inspection of these structures will be necessary at the end of the removal work.

4.11.8 Air Inlets

Air inlets are needed to help maintain a suitable volume of negative air pressure. If the Negative Air Units (NAUs) are turned off, air inlets should be filtered to prevent the escape of dirty air out of the inlets into the environment.

NOTE: *Air inlets into the enclosure will be required to balance the air flow because too much negative air pressure can cause the enclosure to implode or seals to fail.*

4.11.9 Extraction Units (Negative Air Units or NAUs)

To prevent the escape of airborne asbestos fibres from the removal area enclosure, an exhaust extraction fan should be installed in a position to create a negative air pressure of approximately 12 Pascals (water gauge) within the removal area. While accepting that the measurement of this pressure is not always possible, a good guide to the effectiveness of the system can be gauged from the inwards effect on the plastic tenting. If there is a visible bellowing inwards, there is good negative pressure. In this arrangement, the major and usually only route of air into the removal area would be through the decontamination unit. Where plastic tenting has not been used, the correct flow of air should be verified by using smoke testing.

The extraction units must be run continuously (i.e. 24 hours a day) until all asbestos removal and decontamination tasks have been completed and clearance given. Below is a basic formula for calculating the number of air handling units required based on the volume of the space to achieve a pre-determined number of air changes per hour:

Volume of air space (V) = (Width x Length x Height)

CFM Rating (cubic feet/minute) (R) = found on the air handling size unit

In this example the predetermined number of air changes = **4** and is over a **60** minute period:

V x 4 = 4V
R x 60 = 60R
4V / 60R = Number of Units Required

The calculated amount should be rounded to the nearest full number.

4.11.10 Extraction Unit Filtration

The air extracted by this system should pass through an appropriate High Efficiency Particulate Air (HEPA) filter to ensure removal of any asbestos fibres. Ideally, air extraction units should be situated so that access to the filters can be gained from the removal area. This expedites the otherwise difficult decontamination of these units and allows another unit to be brought into service in the event of a breakdown. Where it is not possible to change the filter within the removal area, a temporary enclosure should be constructed around the unit during the filter replacement.

Every employer must take all practicable steps to ensure that dust control equipment used in the course of the asbestos work is inspected for defects at least once every seven days by a person who has:

a. the relevant knowledge, experience, and skill to inspect dust control equipment for defects; and

b. either:

    i. a relevant qualification; or

    ii. a certificate issued by his employer as evidence that he is in possession of the required knowledge, experience, and skill.

The HEPA filter should comply with a minimum 99.97% efficiency requirement. A coarse pre-filter should be installed on the air intake side of the negative air unit to prolong the useful life of the high efficiency filter. Where practicable, the discharge point for this extraction unit should be to the outside air, distant from other working areas, air-conditioning inlets or breathing air compressors. Where this is not possible, testing of the exhaust air is to be carried out.

Procedures should be established for changing these HEPA filters so that areas outside the enclosure are not contaminated. The most satisfactory method for assessing the integrity of the HEPA filter and seal fittings is regular inspection in conjunction with a static pressure alarm to indicate any failure in the system.

When installing the asbestos removal area containment, extra consideration should be given to the alteration of the fire rating of the building and to the provision of the fire-fighting facilities, emergency exits and emergency lighting.

4.11.11 Signage

The asbestos removal site should be clearly defined to ensure that non-essential persons do not enter and to clearly delineate the removal site and warn persons that asbestos removal work is being carried out. Warning notices stating "ABESTOS HAZARD AREA - KEEP OUT" must be placed at entrances to the removal area. These signs, with lettering of 100mm in height, are to be placed so they are clearly visible. Other more general signs may be used elsewhere in the buildings to indicate that construction work is in progress (Figure 1).[3]

[3] https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9995 Section 1910.1001(j)(4) (Accessed 30 January 2014)

Figure 1: Examples of Signs to be placed in the vicinity of an Asbestos Removal Site[4]

All signs and barriers should remain in place until a clearance to re-occupy has been granted.

4.11.12 Compliance Testing of Removal Area Prior to Commencement of Work

When the asbestos contractor is satisfied that the enclosure is complete, and before any asbestos removal begins in an enclosure, a competent person should carry out a visual inspection to check the integrity of the structure. Smoke testing may also be used to detect leaks. Negative air exhaust units should not be used while the smoke test is being conducted. Only smoke-generating devices incorporating non oil-based, non-toxic smoke fluid should be used. Flares should not be used.

Attention should be given to the billowing inward of the plastic sheeting. At the beginning of each working period the inspection should be repeated and any defects rectified immediately. If any leaks or other deficiencies in the enclosure are found during the testing, work should not proceed until these have been rectified.

[4] http://www.keysignsuk.co.uk/safety-signs-uk.asp?ProductID=8508 (Accessed 31 July 2013)

If air monitoring or visual examinations of the enclosure and items of equipment indicate that asbestos dust might be escaping from the enclosure, asbestos removal work should be stopped until any defects have been rectified. Following any such incident and before work commences it is essential to:

- identify the source of the leak(s);
- prevent further release of fibres;
- re-test the enclosure;
- clean any contaminated areas;
- conduct a visual inspection; and
- conduct monitoring tests specific to the incident;
- where applicable and necessary, notify the Department.

A supply of expandable foam sealant, polyester insulation or equivalent should be maintained on the site to assist with sealing leaks.

4.11.13 Decontamination Facilities

The decontamination unit should be situated immediately adjacent to, and joined to, the enclosed asbestos removal area. Where it is not physically possible to locate the decontamination unit in this way, alternative procedures to minimize asbestos contamination should be implemented. See Section 7.14 (Remote Decontamination Units.)

The decontamination unit should be divided into three distinct areas:

1. a dirty decontamination area;
2. a clean decontamination area; and
3. a clean changing area.

These areas should be separated by suitable airlocks or buffer zones. Normally these airlocks have spring-loaded doors or two or more overlapping sheets of plastic sheeting positioned to define the boundary between each segment of the decontamination unit, while allowing personnel access and an air-flow towards the asbestos work area. To ensure there is sufficient airflow through the decontamination unit if doors are used, they should have large openings with a hinged flap operating as a one-way valve.

A typical layout is shown in Figure 2.

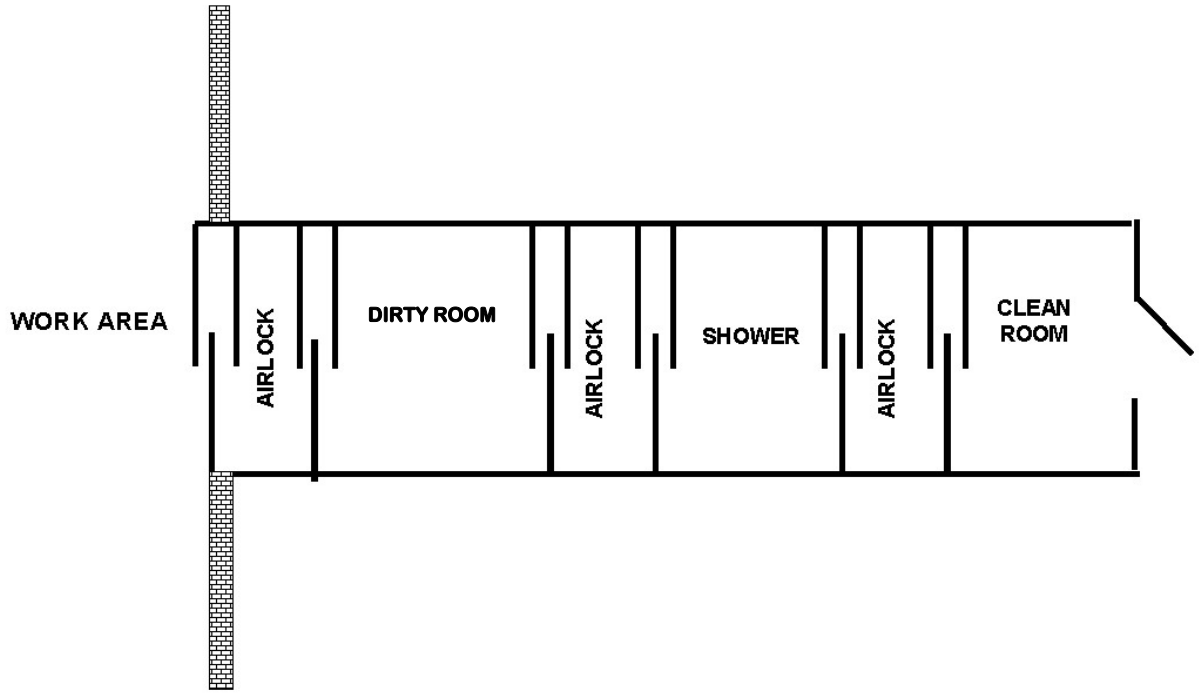


Figure 2: Typical Decontamination Facility[5]

The dirty decontamination area should provide for:

- vacuum cleaning or hosing down of contaminated clothing and footwear;
- the storage of contaminated clothing and footwear;
- labelled waste bags/bins for disposable protected clothing; and
- a shower area with an adequate supply of warm water.

The clean decontaminated area should provide for:

- the storage of individual respirators in containers or lockers;
- airflow towards the dirty decontamination area; and

[5] *Modified from*: Asbestos – Part 56 of Title of the Official Compilation of Codes, Rules and Regulations of the State of New York (Cited as 12 NYCRR Part 56). As amended, effective March 21, 2007. State of New York Department of Labour Safety and Health Subpart 56-9.

- a shower area with an adequate supply of warm water.

The clean changing area should provide for:

- the storage of clean clothing;
- separate storage of clean and dirty towels; and
- airflow towards the clean decontamination area.

All water from the decontamination facility should pass through a high efficiency particulate filter or other trap before it passes into sewer mains. The filter or trap must be capable of capturing particulates down to 5µm - refer to Section 7.22 (Waste Water Management) of these guidelines.

Workers must not smoke, eat or drink in any part of the decontamination unit.

4.11.14 Remote Decontamination Units

Remote decontamination units are not located next to the asbestos work area. They should only be used if a decontamination unit cannot be located immediately adjacent to the asbestos work area. When a remote decontamination unit is to be used, the asbestos contractor may need to implement additional procedures to minimize asbestos contamination including, for example, methods for the connection and disconnection of airline respirators.

The route of access from the asbestos work area to the decontamination unit should be suitably signposted and barricaded to restrict public access. An isolated changing area should be attached to the asbestos work area. Before workers enter this changing area, all obvious signs of asbestos dust should be removed from their protective clothing using an asbestos vacuum cleaner.

The isolated changing area is used to discard outer garments including coveralls and overshoes and to dress in fresh outer/protective clothing for the journey to the decontamination unit. Control monitoring must be conducted in the immediate vicinity of the access route and at other suitable locations outside the asbestos area to ensure that no contamination is being spread outside of the isolated changing area and asbestos work area. Respiratory protection should continue to be worn until the appropriate phase of the decontamination procedure within the remote decontamination unit.[6]

[6] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), 39

4.11.15 Procedure for Entering the Asbestos Work Area

The procedure for persons entering the asbestos work area should be as follows:

4.11.15.1 Clean Change Area

- Change into clean work clothes and put on clean protective clothing;
- Store any removed clothing in a dust-proof container;
- Pass through the airlock into the clean decontamination area;
- Adequate supplies of undergarments and socks (disposable or reusable) should be provided for all personnel entering the asbestos work area; and
- Adequate supplies of shorts and t-shirts should also be made available for all workers.

4.11.15.2 Clean Decontamination Area

- Put on respirator. Check that it is working properly and that there is a good facial seal; and
- move to the dirty decontamination area.

4.11.15.3 Dirty Decontamination Area

- Put on any additional protective equipment that has been stored in the dirty decontamination area, such as footwear; and
- if using air-supplied equipment, connect to the air supply;
- exit from the decontamination unit into the asbestos work area.

4.11.16 Procedure for Leaving the Asbestos Work Area

The decontamination procedure for persons leaving the asbestos work area should be as follows:

4.11.16.1 Asbestos Work Area

- Use an asbestos vacuum cleaner to remove any obvious signs of asbestos dust from protective clothing;
- remove footwear and leave inside the asbestos work area, adjacent to the decontamination unit (footwear should be stored upside down to minimize further contamination); and

- proceed into the dirty decontamination area.

4.11.16.2 Dirty Decontamination Area

- If shoes/boots have not already been removed, remove them and store them (upside down) within the dirty decontamination area;
- if using air supplied equipment, disconnect airline respirator;
- keep other respiratory equipment in operation;
- shower while wearing protective clothing and respirator;
- leaving the respirator on, remove protective clothing and place it in labelled waste bags/bins;
- remove wet underclothing such as t-shirts or shorts, while showering and place it in the storage unit provided within the dirty decontamination unit; and
- pass through the airlock into the clean decontamination area.

4.11.16.3 Clean Decontamination Area

- Commence shower and remove respirator;
- thoroughly wash hands, fingernails, face, head and respirator;
- store respirator in a suitable container within the clean decontamination area; and
- move to the clean change area.

4.11.16.4 Clean Change Area

- Change into clean clothing; and
- exit decontamination unit.

4.11.17 Person Outside the Enclosure

The asbestos contractor should ensure a worker is stationed outside the asbestos work area for the duration of the asbestos work to:

- liaise with outside management;
- communicate with personnel outside the enclosure; and
- instigate emergency/evacuation procedures if necessary.

Records of these activities should be kept on a daily basis.

4.11.18 Sealing the Enclosure and Decontamination Unit upon the Completion of the Asbestos Removal Work

After the removal work has been completed, all plant and equipment within the asbestos work area and the decontamination unit, including any remaining non-removable items, should be vacuumed and/or wet wiped to remove any residual dust. When decontamination is not possible, the items should be wrapped in plastic and sealed and only opened in another removal area. When emptying the asbestos vacuum cleaner, any asbestos contained should be disposed of as asbestos waste, including the containment bag and filters.

Once the asbestos supervisor is satisfied that the asbestos work area and decontamination unit are clean, all of the clean surfaces should be sprayed with PVA using airless spray equipment. Items of equipment that may be damaged by the application of the PVA can be screened with plastic sheeting. Any layer of plastic forming the inner surface of the enclosed work area or decontamination unit should also be sprayed with PVA.

The final layer of any plastic enclosing the asbestos work area and decontamination unit should not be taken down until a visual inspection has found no visible asbestos residue and clearance monitoring indicates airborne asbestos fibre levels are below 0.01/mL.[7] Settled dust sampling may also be considered as an indicator of cleanliness.

Plastic sheeting and any similar materials used for the enclosure must be treated as asbestos waste. This need not apply to scaffolding or other equipment used to add strength to the enclosure, but any such equipment should be vacuumed, damp-wiped and sprayed with PVA as part of the clean-up process. Ropes, warning signs and protective plastic isolating areas should not be removed until the asbestos work area and decontamination unit have had a satisfactory clearance inspection.

4.11.19 Mini-Enclosures for Small-Scale Asbestos Removal Work

Mini-enclosures are suitable for asbestos removal work in areas with restricted access, such as ceiling spaces, and for emergency asbestos removals. The mini-enclosure has to be large enough to allow movement inside the enclosure and contain all the equipment needed for the asbestos removal work. The frame of a mini-enclosure can be made from a variety of materials, but has to be strong enough to support the plastic sheeting that forms the enclosure.

[7] https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9995 Section 1910.1001(c)(1) (Accessed 30 January 2014)

Machinery that consumes oxygen or emits exhaust fumes must not be placed in a mini-enclosure. Heavy duty plastic sheeting, 200µm minimum thickness[8], should be used to make the enclosure. Recycled plastic must not be used. The tape used to connect the plastic to the frame must be strong enough to securely hold the plastic to the frame. A smoke tube should be used to check the sealing of the plastic sheeting.

A slit will have to be made in the plastic sheeting to allow entry. The slit can then be taped from inside the enclosure. A typical layout is show in Figure 3.

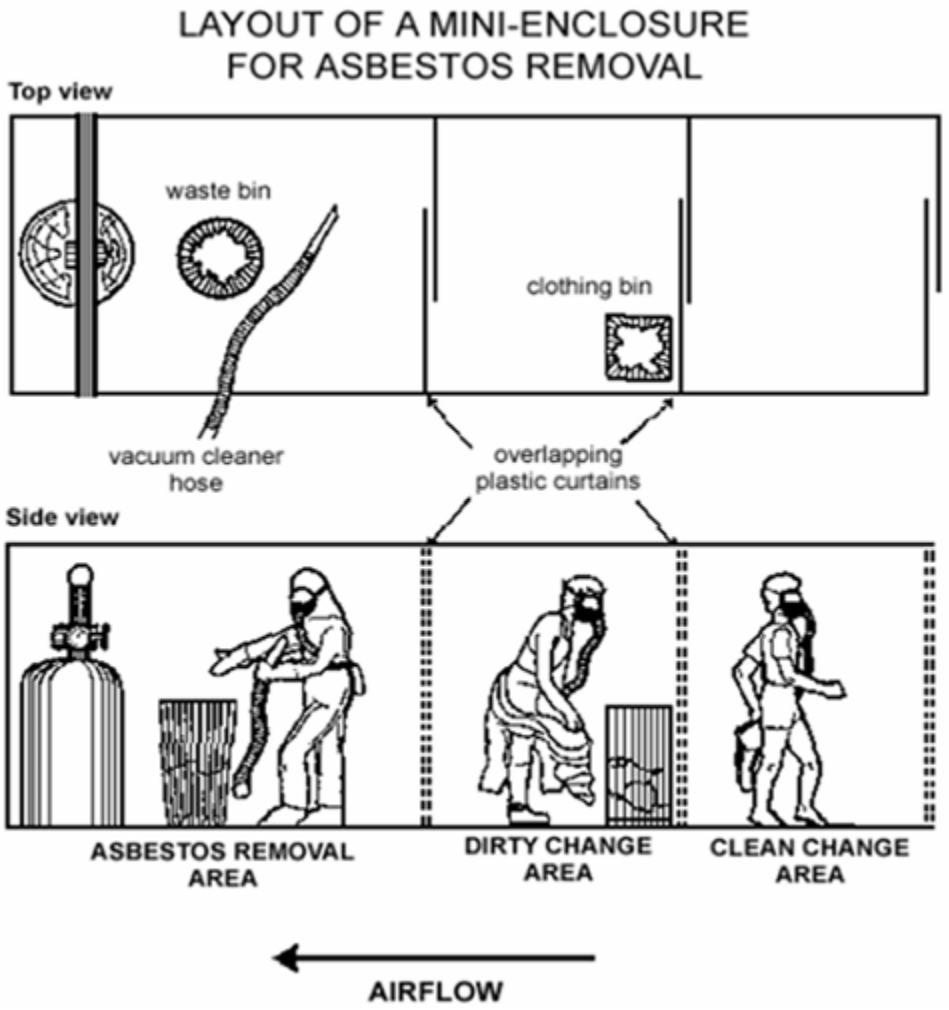


Figure 3: Layout of a mini-enclosure for small-scale asbestos removal

[8] https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9995 Section 1910.1001(c)(1) (Accessed 30 January 2014)

The hazards and work procedures that need to be considered for large enclosures also need to be taken into account for all mini-enclosures. Workers leaving the mini-enclosure must follow the personal decontamination procedures.

4.11.20 Dry Decontamination – Suitable for Small-Scale Non-Friable Asbestos Removal Work – Service and Maintenance

Personal decontamination must be undertaken each time removal workers leave the asbestos work area and on completion of asbestos service and maintenance work. Personal decontamination should be done within the asbestos work area where recontamination cannot occur. Asbestos-contaminated PPE should not be transported outside the asbestos work area except for disposal purposes.

The procedure for dry decontamination is:

- all visible asbestos dust/residue is removed from protective clothing using an asbestos vacuum cleaner and/or wet-wiping;
- the protective clothing is taken off (while still wearing a respirator) and placed in an asbestos waste bag;
- disposable protective clothing is preferred. If non-disposable clothing is used, such as wet weather gear, it should be completely wetted before double bagging, labelled and sent to a laundering facility capable of laundering asbestos-contaminated clothing. The laundering of contaminated protective clothing in workers' homes is strictly prohibited;
- clothing and footwear worn during the removal should be vacuumed using an asbestos vacuum cleaner and the footwear should also be wet-wiped;
- disposable respirators should then be discarded as asbestos waste;
- non-disposable respirators should be removed and thoroughly cleaned and
- after removing the respirator, workers should wash their face and hands, paying particular attention to their fingernails.

This form of personal decontamination may also be appropriate after the service and maintenance or removal of:

- an asbestos gasket;
- an asbestos (Zelemite) electrical switchboard;
- **small** amounts of asbestos sheeting or vinyl floor covering (typically less than one day's work for one person);
- minor amounts of asbestos debris;
- asbestos cement conduits and in-ground surface pits; or
- asbestos friction materials.

However, some of these forms of asbestos-contaminated materials could be friable making more extensive decontaminated procedures necessary. The measures adopted should always address the risks of each individual asbestos removal job.[9]

4.11.21 Vehicular/Machinery Decontamination

Vehicular decontamination units are required when asbestos removal works require the use of heavy machinery and/or trucking in the asbestos removal area - for example, large-scale removal of contaminated soil or of internal building asbestos-contaminated materials.

A risk assessment should be undertaken by the asbestos contractor to determine the extent or necessity of vehicular decontamination procedures. The vehicular decontamination unit should be located away from the personal decontamination unit and should be adjacent to the asbestos removal work area.

The decontamination unit may be purpose-built with suitable heavy duty timbers and plywood. The decontamination unit must be lined internally and externally with heavy duty plastic sheeting of 200µm thickness[10]. The sheeting must be checked regularly for damage and leaks and, if any are identified, it must be removed and replaced before usage continues. The unit must be watertight to prevent excess water run-off during wash-down procedures. Spring-loaded doors on either side of the unit should be used to ensure that an airlock is maintained as the vehicle/machine is passing through the unit.

During entry and exit procedures, only one set of doors should be open at one time, to prevent airborne fibres from escaping the enclosure. All materials used in the construction of the decontamination unit must be disposed of as asbestos waste once the unit is dismantled upon completion of removal works. Extraction fans should be installed to force the air back into the

[9] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), 41
[10] https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9995 Section 1910 (Accessed 30 January 2014)

asbestos work area. After each vehicle/machine has been thoroughly washed, the unit must be liberally doused with water to arrest any fibres remaining in the decontamination unit.

4.11.21.1 Procedures for Decontamination of Machinery

At all times when in the asbestos work area and the vehicular decontamination unit, the machine operator must:

- be fully kitted with appropriate PPE and RPE required for the asbestos removal work;
- ensure the machine is thoroughly washed down using water hose pressure when exiting the removal work area;
- take care to ensure the cab, tracks/tyres, undercarriage, boom and body are thoroughly doused with water to remove any residue of asbestos dust on the machine; and
- leave the machine in the decontamination unit.

Once the machine has been thoroughly washed and the decontamination unit has been washed down, another operator similarly kitted in clean PPE and RPE is to enter the decontamination unit from the clean side to extract the machine from the decontamination unit to the clean area.

NOTE: *No operator can exit from the asbestos working area through the vehicular decontamination unit*[11]*.*

4.11.21.2 Procedures for Decontamination of Vehicles

At all times when in the asbestos work area and the vehicular decontamination unit, the vehicle operator must:

- ensure that the vehicle's windows are wound up completely and securely;
- ensure that all air-conditioning inside the vehicle is turned off;
- ensure that they do not exit the vehicle while in the asbestos removal area;
- ensure that the vehicle is washed down thoroughly using water hose pressure; and
- take care to ensure the sides, tray, undercarriage, tyres and cab body are thoroughly doused down with water to remove all visible residue of asbestos dust on the vehicle.
-

[11] https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9995 Section 1910 (Accessed 30 January 2014)

4.11.22 Waste Water Management

The vehicular decontamination unit must be suitably constructed so that no water escapes its confines, except to where it is to be collected for filtration or disposal. The water from the decontamination process is to be collected in a "sump" and regularly disposed of as contaminated waste. Alternatively, a trap should be constructed with a HEPA filtration unit to extract and collect asbestos fibres from the water before it is collected as normal contaminated water from the vehicles or machinery. No unfiltered water is to be dumped in any catchments.

4.11.23 Decontamination of Waste Removed from Asbestos Work Area

Waste bags and wrapped items need to be decontaminated before leaving the enclosure. Asbestos-labelled bags need to be wetted down and not overfilled, to reduce the risk of splitting and tearing.

4.11.24 Glove Bag Removal Method[12]

Glove bags are single-use bags constructed from transparent, heavy duty plastic with built- in arms and access ports. Generally these glove bags are approximately one metre wide and 1.5 metres deep. Glove bags are designed to isolate small removal jobs from the general working environment. They provide a flexible, easily installed and quickly dismantled temporary enclosure for small asbestos removal jobs. The glove bag removal method is especially suited for the removal of asbestos lagging from individual valves, joints, piping etc.

A major advantage of all glove bags is that they contain all waste and contamination within the bag, eliminating the need for extensive PPE and decontamination. The only significant limitation on the use of glove bags is the volume of waste material they are able to contain. Care needs to be exercised to prevent overfilling of the bag with water or waste. See Figure 4 below.

[12] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), 45

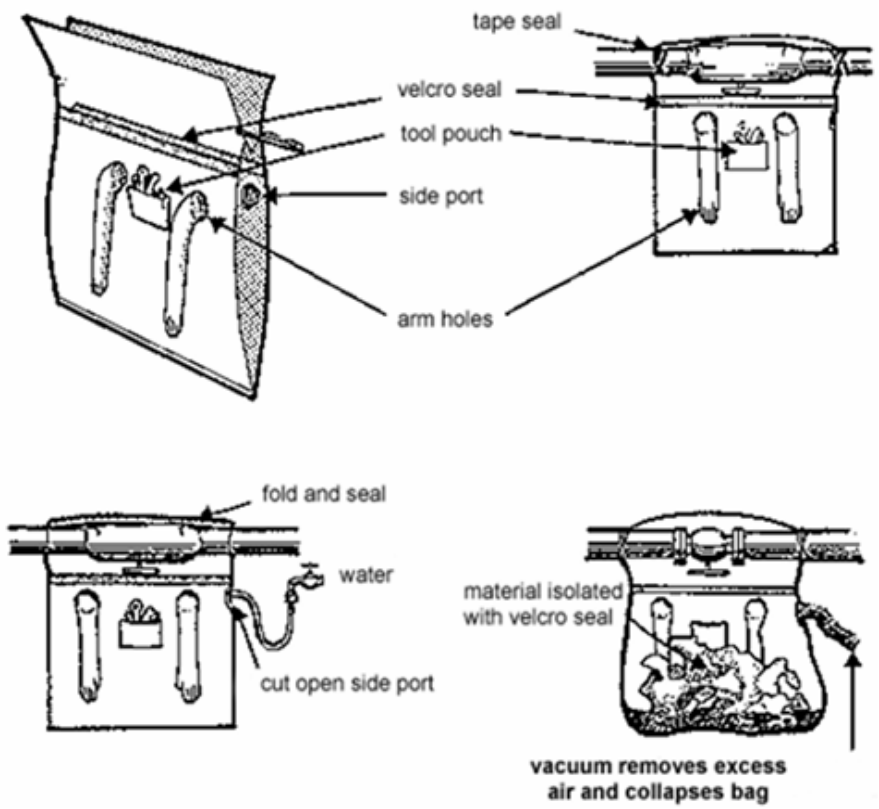


Figure 4: Use of glove bags[13]

1. Cutting and removal tools that will be used in the removal should be placed into the glove bag at the start of the job. When the removal is complete, tools should be either disposed of as asbestos waste or sealed for re-use in future removal jobs.
2. The glove bag should completely cover the pipe or object on which the asbestos removal work is to be performed. The lagging on either side of the bag must be sound enough to support the weight of the bag and its wet contents.
3. Cut the sides of the glove bag to fit the size of the object from which asbestos is to be removed. Attach the sides of the glove bag to the object by folding in the open edges together and securely sealing them with duct tape. Seal all openings in the glove bag with duct tape or an equivalent. The bottom and side seams of the glove bag should also be sealed with duct tape or an equivalent to prevent any leakage if there is a defect in a seam.

[13] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), 45

4. Thoroughly saturate the asbestos-contaminated materials with a wetting agent and then remove it from the pipe, beam or other surface. The wetting agent should be applied with an airless sprayer through a pre-cut port as provided in most glove bags, or through a small hole cut in the bag. Asbestos-contaminated materials that have fallen into the bag should be thoroughly saturated. Any canvas should be cut and peeled away from the asbestos-contaminated materials. If the asbestos-contaminated materials are dry, it should be re-sprayed with the wetting agent before it is removed.
5. Thoroughly clean the pipe or surface from which the asbestos has been removed with a wire brush and wet wipe it until no traces of the asbestos-contaminated materials can be seen. Wash down the upper section of the bag to remove any adhering asbestos-contaminated materials.
6. Seal any edges of the asbestos-contaminated materials that have been exposed by the removal or by any maintenance activity to ensure these edges do not release any airborne asbestos fibres after the glove bag is removed.
7. Once the asbestos-contaminated materials have been removed and sealed, insert a vacuum hose from an asbestos vacuum cleaner into the glove bag through the access port to remove any air in the bag that might contain airborne asbestos fibres. Once the bag has been evacuated, squeeze it tightly as close to the top as possible, twist it and seal it with tape, keeping the asbestos-contaminated materials safely in the bottom of the bag.
8. Remove the vacuum line from the bag and then remove the glove bag from the work place for proper disposal as asbestos waste.

4.11.25 Wrap and Cut Removal Method[14]

This method of removal produces the lowest levels of airborne asbestos fibres and is most appropriate for redundant plant and equipment. The plant or equipment to be removed should be double wrapped with minimum 200µm thick plastic and taped so that the ACM is totally sealed within the plastic. The wrapped plant and equipment can then be cut from the rest of the plant and equipment using mechanical shear or oxy-cutting tools. Only exposed metal should be cut and care should be taken to ensure the plastic wrapping is not punctured and/or melted.

If lagging has to be removed to allow pipe to be cut, the glove bag removal method should be used to expose the metal at the point to be cut and for a sufficient length on either side. The insulation should be thoroughly wetted, bagged and disposed of as asbestos waste. The pipe should then be cut at the centre of the exposed section.

[14] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), 46

4.11.25.1 Removal of Decorative Coatings (Textured Ceilings)[15]

Because of the relatively low asbestos content (range of 3-10%) and the nature of the product, it may not be necessary to adopt all the procedures set out in Sections 7.12 to 7.20 for major removal programmes. This is especially so if complete saturation with water is possible as this greatly reduces the release of asbestos fibres.

However, where contamination of the asbestos-contaminated materials covers a large area (typically greater than a standard three-bedroom residential dwelling) and where work exposure exceeds a maximum of 8 hours total work duration, then procedures as described in Sections 7.3 to 7.12 of these guidelines must be followed.

4.11.25.2 Procedures for Small-Scale Removal Work - Domestic Dwellings[16]

The minimum procedures that must be followed in instances of domestic dwellings are that the room(s) must be isolated from adjoining areas. This can be done by sealing doors and other openings with tape. It may not be necessary to totally enclose the removal area with polythene sheeting, provided the surfaces can be vacuumed with an asbestos vacuum cleaner and wet-wiped clean. The floor must be covered. All furniture, fittings and curtains must be removed. Negative air pressure should be maintained within the work area.

Procedures must be adopted to ensure that the asbestos-contaminated materials do not contaminate other areas. Work methods must be methodical and orderly, thereby reducing the release of airborne fibres and the spread of asbestos. Protective clothing should remain in the removal area and be disposed of as asbestos waste at the completion of the job.

4.11.26 Decontamination of Soil

4.11.26.1 General

Asbestos fibres or dust can be released from materials present on the site, including materials buried at insufficient depth, by weathering, erosion or disturbance by, for instance, vehicles or during construction activities. The tendency for asbestos fibres to be released is increased if the contaminated material consists of friable asbestos, such as pipe lagging, asbestos blankets, rope

[15] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), 46

[16] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), 46

or millboard. If the site is well drained and dry then the tendency for asbestos fibres to release is also increased.[17]

4.11.26.2 Excavation and Removal Offsite

This process is suitable for all types of asbestos contamination. The site should be appropriately secured or boarded off to prevent the unintentional entry by members of the public or other non-essential personnel. Appropriate warning signage should be erected at all entry points and are not to be removed until the work is completed.

The methods used for this decontamination should be based on a risk assessment. The use of professional site remediation advice and/or services should be considered as they can develop a RAP (Remediation Action Plan) for the asbestos contractor to work to.

The minimum suitable respiratory protection is a P2 half face-piece respirator with particulate filter. The type of decontamination facilities should be determined by a risk assessment by the asbestos contractor. During soil decontamination the topsoil should be dampened down to minimize the generation of dust and all visible pieces of asbestos-contaminated materials should be picked up individually so that the risk of asbestos fibre inhalation is effectively eliminated. The method of dampening should be such so as not to cause pooling or run-off of contaminated water.

If this is not practicable, the contaminated topsoil should be removed to a depth that has no visible contamination or asbestos debris. The contaminated soil must be disposed of as asbestos waste at a registered tip-site. The trailer used for removing the asbestos-contaminated materials from site to the registered tip-site must be lined in accordance with Section 9 of these guidelines.

All documentation should be maintained by the asbestos contractor and provided to the client. In addition, there should be:

- provision for PPE to prevent the spread of contamination to the wearer and others;
- provision for personnel decontamination;
- provision for vehicular and equipment decontamination;
- provision for personnel amenities outside the contaminated area;
- provisions for monitoring of the removal area to ensure no cross contamination. This may include air monitoring; and

[17] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), 46

- other requirements as outlined in these guidelines including an asbestos removal plan, safety plan and other documentation.

4.11.27 Site Remediation for Fire-Damaged Asbestos-Contaminated Materials

The remediation and clean up of fire-damaged asbestos containing products, including cement bonded products such as cladding material, is a restricted activity that requires the direct supervision and management by a person holding a C*ertificate of Competence for restricted work*.

The asbestos contractor must complete a site investigation to assess:

- the types of asbestos-contaminated materials damaged and the extent of damage and contamination (this may include an inspection of surrounding properties);
- the potential for contamination into drainage systems and the protection of these; and
- other risks/hazards that the asbestos removal personnel will be exposed as well.

Generally, fire damaged asbestos-contaminated materials attracts a lot of attention due to the high public health concern. The asbestos contractor may be required to deal with a variety of agencies including fire investigation, police, the Ministry of Health and the NEPA. Fire damaged asbestos-contaminated materials need to be kept wetted down, but not to the point of causing pooling. Any water used for the wetting down of fire damaged asbestos-contaminated materials will be contaminated and must be captured and treated as such.

The site should be appropriately secured or boarded off to prevent the unintentional entry by members of the public or other non-essential personnel. Appropriate warning signage should be erected at all entry points and are not to be removed until the work is completed.

The removal method adopted by the asbestos contractor should be one that minimizes the risk of further contamination. In addition, there should be:

- provision for PPE to prevent the spread of contamination to the wearer and others;
- provision for personnel decontamination;
- provision for vehicular and equipment decontamination;
- provision for personnel amenities outside the contaminated area;

- provision for monitoring of the removal area to ensure no cross contamination. This may include air monitoring; and
- other requirements as outlined in these guidelines, including an asbestos removal plan, safety plan and other documentation.

4.11.28 Removal Techniques for Buildings and Structures

The removal of asbestos-contaminated materials from buildings and other structures should be carried out by methods that will minimize the release of asbestos fibre into the atmosphere during and after the removal operation. The choice of method is determined by the nature of the asbestos materials, the quantity of insulant and its location.

Breaking through the finishing compound and cutting the reinforcing wire in lagging can liberate considerable quantities of dust. Care should be taken in the selection of tools and in keeping the insulation wet. Tools should allow cutting of the insulation into small sections while keeping asbestos fibre levels in the removal area to a minimum.

NOTE: *Power, telephone and fire alarms may lie beneath asbestos insulation. These cables must be clearly identified prior to the commencement of any cutting as severe damage and / or hazard to the worker could result.*

As the techniques used for the removal of sprayed thermal insulation from buildings are not dissimilar from those used for removal from steam pipes and boilers, the following removal methods may be adapted to the removal of asbestos from industrial plant and machinery.

4.11.28.1 Removal by Soaking or Total Saturation

The quantity of asbestos-containing insulation to be removed from pipes or ducts is often so extreme, or the material so thick, that the spray method (see following technique) will not suppress fibre release sufficiently. An alternative is to soak the insulation by the introduction of water through appropriate applicators.

The following steps are recommended for the soaking procedure[18]:

- Where the asbestos-contaminated materials are covered with cloth, mastic or other such materials, loose material dust should be removed by vacuum cleaning or by wiping with a damp cloth. Where cladding has to be removed before access is obtained to the asbestos-contaminated materials, the cladding should be removed

[18]Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), 49

carefully and surfaces vacuum-cleaned continually or, where practicable, sprayed with water.

- Holes or cuts should be made in the outer covering to enable water to be injected in such a manner and quantity to ensure that ACM is wetted but not washed out by the passage of water. It has been found that slow saturation from the metal interface outwards is quite successful. The addition of a wetting agent to the water will assist the saturation process.
- The quantity of water and the time to soak will be dependent on factors such as thickness of insulation, access and location of holes.
- The saturated asbestos-contaminated materials should be removed in sections and immediately placed in properly labelled containers and suitably sealed. During this process it may be necessary to carefully cut reinforcing wire or similar restraints.

The asbestos-contaminated materials should be properly soaked and small sections that dislodge should be properly disposed of.

4.11.28.2 Spray Method

Water is very effective in preventing release of asbestos fibre. This method should be used only where small quantities of asbestos-contaminated materials are to be removed and where the following conditions apply to the material:

- the asbestos-contaminated materials are not covered with other materials such as calico or metal cladding which require prior removal;
- there is no reinforcing wire or similar restrictions to removal;
- the asbestos-contaminated materials are not coated with paint or mastic;
- where rapid temperature drop due to excessive water could cause damage to heated metal components; and
- where live electrical conductors are present and where no damage to electrical equipment can arise from the entry of water.

The spray should be applied in such a manner as to ensure that the entire surface of ACM is wet but minimal run-off occurs. In many instances adding a wetting agent to the water will facilitate more rapid wetting of the insulation material. It is desirable for the asbestos-contaminated materials to be wetted through its full depth and maintained in a wet condition. A manually controlled, consistent low-pressure coarse spray, such as from an adjustable pistol grip garden hose, should be used for this purpose.

The design of the spraying equipment will be dependent on availability of water supply and access to the area to be sprayed. It is important that the spray should be copious, but not such that the water droplets generate dust from impact with the surface of the insulation. When using cutting equipment to remove asbestos, the water spray should be directed at the site of the cut and the wetted material removed as the cut progresses.

The wetted asbestos-contaminated materials should be removed in sections and immediately placed in suitably labelled containers and properly sealed. Any small sections that is dislodged should be collected and properly disposed of. Asbestos fibre release is significantly depressed although not entirely eliminated by this technique, so appropriate respiratory protection should be used.

4.11.28.3 Dry Removal

This method is considered the least desirable removal technique and must only be used where spray and soaking methods cannot be used - for example where there are live electrical conductors or where major electrical equipment could be permanently damaged or made dangerous by contact with water[19].

Notwithstanding the general guidance given earlier in these guidelines, the greater potential for the generation of the airborne asbestos dust in dry removal techniques demands that particular attention be given to work methods.

4.11.29 Protective Clothing and Equipment

When the use of respiratory devices and protective clothing is required, adequate rest breaks should be provided to take into account the physical strain caused by the use of such equipment.

Care should be taken in the selection of all tools and equipment for asbestos removal tasks. In addition to suitability for these tasks, all tools should prevent or minimize the generation and dispersion of airborne asbestos fibres as much as possible. The use of power tools in asbestos removal work should be avoided because of the possibility of internal contamination which commonly occurs with such devices. In general, manually operated hand tools are preferred[20].

At the end of removal work, all tools should be:

[19] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), 50

[20] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), 51

- decontaminated by fully dismantling and cleaning under controlled conditions; or
- placed in sealed containers (and used only for asbestos removal work); or
- disposed of as asbestos waste.

CAUTION

In general circumstances high speed abrasive power tools or pneumatic tools such as angle grinders, sanders, saws and high speed drills should not be used for asbestos removal - for example, when removing asbestos fibrolite sheeting.

4.11.29.1 Spray Equipment

A constant low pressure water supply is required for wetting down asbestos. This can be achieved with a mains-supplied garden hose fitted with a pistol grip. If no water supply is readily available, a portable pressurised vessel such as a pump up garden sprayer may be used.

4.11.29.2 Asbestos Vacuum Cleaners

Asbestos vacuum cleaners should only be used for collecting small pieces of asbestos dust and debris. Larger pieces should never be broken into smaller sizes so they can be vacuumed. Vacuum cleaners used on asbestos work should not be used for any other purpose and must be labelled "*For Asbestos Use Only*". Asbestos vacuum cleaners should not be used for vacuuming wet materials because this can damage the HEPA filter. Use the correct attachment to the asbestos vacuum cleaner for the type of surface you are cleaning.

Procedures should be established for the general maintenance of asbestos vacuum cleaners in a controlled environment. They should be cleaned externally with a wet cloth after each task, the hose and attachments stored in a labelled container or impervious bag and a cap should be placed over the opening to the asbestos vacuum cleaner when the attachments are removed[21].

PPE should be worn whenever an asbestos vacuum cleaner is opened to change the bag or filter or to perform other maintenance or decontamination. Emptying asbestos vacuum cleaners can be hazardous if the correct procedures are not followed. Asbestos vacuum cleaners should only be emptied by a competent person with the correct PPE in a controlled environment and in compliance with the manufacturer's instructions.

[21] Occupational Safety & Health Administration Regulations (Standards - 29 CFR) Standards Section 1910

Whenever possible, asbestos vacuum cleaners should not be hired as they can be difficult to fully decontaminate. If hiring is necessary, they should only be hired from organisations that provide vacuum cleaners specifically for work with asbestos.

When the work is complete the asbestos vacuum cleaner should be decontaminated with the bag and filter being removed in accordance with the manufacturer's instructions and disposed of as asbestos waste. The inside and outside of the vacuum should be wet-wiped and the asbestos vacuum cleaner should be re-sealed in the storage container provided.

4.11.29.2 Inspection of Equipment

All equipment used for the removal of asbestos-contaminated materials should be inspected before the commencement of the removal work, after any repairs and at least once every seven days when it is being used continually. A register should be maintained with details of these inspections, the state of the equipment and any repairs.[22]

4.11.30 Dismantling of Asbestos Removal Area

The asbestos removal job should only be considered to have been completed when the asbestos contractor has complied fully with the clearance criteria.

4.11.30.1 Clearance and Visual Inspection Procedures

On completion of the asbestos removal job, all tools and equipment not used for cleaning should be removed from the removal area so that efficient vacuuming of the inside of the removal area enclosure can be undertaken. When taking these tools and equipment from the removal area, appropriate decontamination procedures should be observed.

After clearance has been given, any sealing plastic used should then be dismantled, folded inwards and placed in appropriate disposal bags and sealed. The sealing plastic should not be re-used, but must be treated as asbestos waste. Safety barricades and warning signs must not be removed until the complete removal area has been thoroughly cleaned[23].

[22] Occupational Safety & Health Administration Regulations (Standards - 29 CFR) Standards Section 1910

[23] Occupational Safety & Health Administration Regulations (Standards - 29 CFR) Standards Section 1910

5.0 Handling of Non-Friable Asbestos

Non-friable asbestos products have been compounded using asbestos mixed with cement or other hard bonding materials. This section of the guidelines recommends precautions to be taken when working with non-friable asbestos products.

These products include, but are not limited to:

- flat or corrugated compressed asbestos cement sheeting;
- asbestos cement pipes for water, drainage and flue gases;
- roofing shingles;
- floor or wall coverings;
- asbestos gaskets;
- pump and valve packings;
- asbestos bonded into bituminous products; and
- flexible building boards such as villa board, hardiflex, flexiboard.

While new fibre cement products no longer contain asbestos (it was replaced by non-asbestos fibres such as cellulose in the 1980s), crocidolite (blue) and amosite (brown) asbestos were extensively used in many asbestos cement building products until the 1970s. Chrysotile (white) asbestos was used almost exclusively in fibre cement products during the 1970s and 1980s.

If these products are maintained in good order and are not worked on with abrasive cutting or grinding tools they are not likely to present a health risk. The employer must ensure that precautions are taken during structural alteration or demolition involving asbestos cement materials and the removal of all floor and wall coverings containing asbestos.

Work procedures must be designed to minimize the generation of dust. Action should be taken to avoid the spread of asbestos fibre. In particular, the following procedures should be adopted[24]:

[24] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition) Section 8

- abrasive cutting or sanding power tools should not be used on asbestos-contaminated materials as they may generate large amounts of dust containing asbestos;
- non-powered hand tools such as hand saws should be used;
- wet the material to further reduce the release of asbestos fibre when cutting;
- high pressure water jets/guns must not be used because of the potential to spread asbestos waste in the surrounding environment;
- work with asbestos-contaminated materials in well-ventilated areas and, where possible, in the open air;
- observe good work hygiene principles. These may involve using plastic drop sheets to collect off-cuts and coarse dust, or using appropriate vacuum cleaning equipment when necessary;
- suitable respiratory protection should be used when airborne asbestos fibre is likely to be present; and
- all off-cuts and collected dust should be disposed of as asbestos waste.

5.1 Removal of Asbestos Cement Pipes

5.1.1 General

In most cases, asbestos cement pipes are considered non-friable. However fibres can be released into the air and surrounding environment when the pipes are crushed, damaged, mishandled or in a badly weathered condition. To prevent the release of asbestos fibres, the contractor must not allow the pipe to be damaged, crushed or shattered in any way during removal. The contractor must not sand, chip, grind or use any power tools on the piping during its removal.

The asbestos cement (asbestos cement) piping can generally be removed in sections, split at the collar (or sleeve) and removed carefully by lifting out of the excavated shaft. The piping must be kept wet at all times and must not be blown with compressed air or a vacuum cleaner not rated to HEPA requirements.

NOTE: *When asbestos cement piping is damaged, the removal and remediation work is now defined as "Restricted" and will require the removal and decontamination of the surrounding soil in most cases.*

5.1.2 Enclosure

The need for an enclosure and a decontamination facility should be determined by a risk assessment. The decontamination facilities should be located inside the asbestos work area. Decontamination facilities, appropriate for the removal job, should be available throughout the entire removal process.

5.1.3 Personal Decontamination

PPE should be vacuumed and wet-wiped in conjunction with any other decontamination methods. Decontamination should be carried out in a designated area. Contaminated PPE should not be worn outside the asbestos work area under any circumstances.

5.2 Removal of Asbestos Cement Sheeting

5.2.1 General Conditions

ASBESTOS CEMENT products would normally be assessed as non-friable even though they can suffer significant weathering in outdoor environments. Provided these products are maintained in good order, they present a low health risk. However, if such a product is damaged (broken or damaged by water, fire etc) or has deteriorated to expose fibrous material, it will present a health risk and will require removal.

In some cases the product can be damaged to the point of becoming easily crumbled. Once it is at this stage it becomes friable asbestos and removal must be completed by a NEPA approved asbestos abatement contractor. Precautions should be observed during structural alterations or demolition involving these products. Hail, storm and fire-damaged asbestos cement products can pose a high risk of asbestos exposure and should be assessed to determine if they are friable. Under normal removal conditions the removal of asbestos cement products does not attract a recommendation for extraction ventilation.

The **minimum** suitable respiratory protection is a P2 half face-piece respirator with a particulate filter.

5.2.2 Enclosure

The need for an enclosure and a decontamination facility should be determined by a risk assessment. The decontamination facilities should be located inside the asbestos work area.

Decontamination facilities appropriate for the removal job should be available throughout the entire removal process.

5.2.3 Removal[25]

The asbestos contractor should ensure that the following precautions are observed when removing asbestos cement roofing, wall sheeting or other asbestos cement products from buildings or other structures:

- The work area should be kept clean, tidy and free from asbestos cement debris and cleaned up at least daily. All debris should be collected and disposed of as asbestos waste.
- Prior to the removal process, asbestos cement sheets should be finely sprayed with PVA using low-pressure spray equipment. The PVA must be dry before sheet removal begins, to eliminate a risk of a worker slipping or falling from a roof.
- Anchoring bolts/screws should be removed from the roofing sheets using an oxy-torch or other suitable device that will not significantly damage the sheet. All nails and bolts removed should be disposed of as asbestos waste.
- asbestos cement sheets should be removed with minimal breakage and should be lowered to the ground, **not dropped**. Unnecessary breaking of asbestos cement sheets must not be permitted.
- Cranes or elevated work platforms (EWPs) can be used to safely access and lower the asbestos cement sheets to the ground. Use of this equipment must comply with all relevant regulations, guidelines and codes of practice.
- The removed sheets should be stacked on two layers of plastic sheeting 200µm thick and not allowed to lie about where they may be further broken or crushed by machinery or site traffic.
- All asbestos-containing waste should be kept wet, wrapped in plastic sheeting 200µm thick or otherwise sealed and removed from the site as soon as possible using bins pre-lined with a minimum of two layers of 200µm sheeting.
- The asbestos-containing waste should be disposed of in a manner, and at a site, approved by the appropriate disposal authority - refer to Section 9 of these guidelines.
- Asbestos cement sheets must not be re-used or offered for sale.

[25] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition) Page 87

- Any asbestos cement residues remaining in the roof space, framework, exposed wall cavities or around the removal area should be cleaned up using an asbestos vacuum cleaner if necessary.
- Rough sawn timber cannot be effectively wet-wiped or vacuum-cleaned. If the timber is to remain in situ or be recycled, it should be sealed with PVA using low-pressure spray equipment.
- Staff should be relocated (where appropriate).
- As far as practicable there should be no spread of contamination beyond the work area.
- All windows and doors in the building should be closed or, in buildings where there is no ceiling, the area below or adjacent to the work should be roped off.
- Workers should wear disposable overalls.

5.2.4 Personal Decontamination

PPE should be vacuumed and wet-wiped, in conjunction with any other decontamination methods. Decontamination should be carried out in a designated area. Contaminated PPE should not be worn outside the asbestos work area under any circumstances.

5.3 Working on Brittle or Unstable Roofs[26]

Asbestos cement sheeting is liable to shatter without warning under a person's weight. For this reason, roofs that are sheathed in asbestos cement sheeting are known as "brittle roofs". In some cases the roof structure itself is unstable due to damaged timber framing.

The removal of asbestos cement sheeting from a roof should only be undertaken by persons with the knowledge, experience and resources necessary to allow them to work safely at heights. The asbestos contractor should conduct a risk assessment to determine appropriate requirements for the safe removal of asbestos sheeting from brittle or unstable roofs. Consideration should be given to:

- the necessity to have asbestos removal workers on the roof, exposed to the risk of a fall. Alternative methods that should be considered by the asbestos removalist include the use of crane/man cages or mobile scaffolding, or elevated work platforms where the removal work is done from the confines of the protective working platform;

[26] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition)

- the structural integrity of the building, if asbestos removal workers must work from the roof. Propping may be required and, if so, must be certified by a registered engineer;
- suitable gangways being installed if asbestos workers must work from the roof to prevent workers from walking directly on the asbestos sheeting. (All asbestos removal workers must wear suitable fall arrest harnessing if working above 6 metres); and
- identification and protection of all open voids, including clear sheeting, to prevent asbestos workers falling through.

NOTE: *Chicken wire installed under asbestos sheeting is not to be considered by the asbestos contractor as an appropriate means to prevent the asbestos worker from falling through the asbestos sheeting.*

5.3.1 Fall-Arrest Systems

The use of fall-arrest systems, the asbestos contractor must ensure that:

- they are not used when working below 6 metres;
- supervisory personnel are trained and certified to competently supervise such systems.
- asbestos removal workers are appropriately trained to use the fall-arrest system correctly and safely;
- anchoring points for harnesses/static line set up are capable of holding 15kN for a single person and 22kN for two persons;
- emergency procedures are defined in case of a fall-arrest; and
- appropriate checklists for equipment and training/induction of persons and equipment are readily available throughout the removal operations.

The system used for working on brittle or unstable roofs should allow for not only those directly involved in the work, but also other persons who could be affected.

5.3.2 Preparation and Enclosure

If the asbestos cement sheeting removal includes grinding and abrading, the wet-spray method should be used and the removal should be undertaken within an enclosure - refer to Section 5 of these guidelines for information on the use of enclosures.

The minimum respiratory protection for this operation is a P2 filter with a half face-piece respirator. If grinding or abrading is involved, the minimum recommended respiratory protection is a P3 full face-piece particulate respirator. Section 15 of these guidelines provides further information on the selection, use and maintenance of the appropriate RPE and PPE.

Decontamination facilities should be available throughout the entire removal process. A decontamination unit should be available when grinding or abrading is undertaken and otherwise as determined by a risk assessment by the asbestos contractor.

5.4 Removal of Vinyl Floor and Wall Coverings Containing Asbestos

In the 1960s and 1970s vinyl floor tiles and vinyl floors sheets were commonly reinforced with asbestos in a bonded matrix. A visual inspection cannot determine whether vinyl floor tiles contain asbestos. The material must be sample-tested. All fittings and fixtures on top of the vinyl floor should be removed before the vinyl is taken up. Vinyl-asbestos (VA) coverings (usually asbestos-backed floor coverings) may still be encountered. They do not usually present a risk in situ but sanding to prepare the surface for replacement or removal operations may create a hazard.

The contractor working with vinyl products that may contain asbestos should ensure that all practicable steps are taken to confirm whether or not asbestos is present. If there is any doubt about the product being asbestos-free, laboratory tests should be carried out. The product is more likely to contain asbestos if it was installed between 1968 and 1985. Where the VA coverings are found (or assumed) to contain asbestos, the provisions set out in these guidelines should be followed. Significant release of asbestos fibre can result when VA products are abraded by sanding. The work methods and control procedures used when working with VA products must be designed to limit workers' exposure to asbestos and the spread of asbestos into the surrounding environment.

In deciding the approach to be taken in replacing asbestos-backed vinyl products, the following options may be considered:

- leaving the product in place and fixing a new product over the top; or
- removing the product with a spade or other flat instrument; or
- sanding the surface to expose the substrate. This should only be done after all reasonable steps have been taken to remove the asbestos by scraping.

Fixing the new product over the VA covering creates the least risk at the time but, in reality, just defers the problem. The best option will usually involve removal of the covering with a method that minimizes release of dust containing asbestos fibre[27].

[27] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), Sec8

5.5 Sanding of Floors in Removing Vinyl Asbestos Products

Power sanding of floors must be kept to a minimum. In all cases the surface must be wetted to minimize the release of asbestos fibre. If floors are sanded dry, it is highly likely that asbestos fibre levels above the workplace exposure standard will be generated. Sanding equipment used to sand VA floors should not be used for other jobs.

While water is the safest liquid to use for wetting floors when sanding, some contractors prefer to use kerosene, on the basis that it does not clog the abrasive or stain the flooring. If a flammable liquid is used, extreme care must be taken to avoid ignition. The flammable liquid should have a flashpoint above 61^{0}C - the product's SDS (Safety Data Sheet) will advise of this.

The following procedures should be used for the wet sanding of floors[28]:

- The work area should be sealed or isolated from other parts of the building. This would normally involve the use of plastic sheeting or other suitable material for sealing off all doors and entrance ways.
- Cupboards and drawers should either be sealed or emptied prior to the commencement of work.
- The floor should be wetted by "mopping" with kerosene or water to assist in suppressing dust.
- All operators should wear single use overalls that must be treated as asbestos waste on completion of the job. Overalls may be used for several jobs but must be sealed in a plastic bag between jobs.
- All operators should use a half-face piece respirator with a class P2 filter suitable for asbestos dust or a combination P2 and organic vapour filter if using kerosene.
- Clean-up procedures should be carried out thoroughly by first vacuuming residues and dust from all surfaces followed by wet mopping. The vacuum cleaner should be fitted with a HEPA filter and the cleanings disposed of as asbestos waste.
- Where sanding has been carried out in service rooms such as kitchens, cupboards and drawers not previously sealed should be vacuumed and wiped down with wetted rags.
- All asbestos-contaminated waste (including rags that have been used for wet-wiping) must be disposed of in properly labelled and sealed bags.
- Equipment used to sand floors should be cleaned by vacuuming and wet-wiping before being removed from the job.

[28] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), Sec8

5.6 Removal of Asbestos-Backed and Millboard from beneath a Vinyl Floor[29]

5.6.1 Preparation and Enclosure

All fittings and fixtures on top of the vinyl floor should be removed before the vinyl is taken up.

The minimum respiratory protection for this operation is a P3 full face-piece powered air purifying particulate respirator. Since asbestos millboard is typically 100% asbestos and very friable, a full enclosure with negative air extraction units must be used for this type of removal. A decontamination unit must be available at all times - refer to Section 4 of these guidelines.

5.6.2 Removal

The asbestos millboard should be wetted down as the vinyl is peeled from the floor, preferably with the millboard attached. The vinyl can be cut into strips prior to its removal, to facilitate bagging or it can be rolled into one roll and securely wrapped with 250µm thick plastic sheeting, making sure it is totally sealed. If the vinyl sheeting cannot be removed without leaving some of the asbestos millboard on the floor surface, the remaining asbestos millboard should be wetted down and, when thoroughly soaked, scraped off the floor surface. Sufficient water should be used to dampen the millboard but not so much that run-off or pools of contaminated water will occur.

If a heat source is used to soften the adhesive beneath the vinyl tiles, care should be taken not to scorch or burn the tiles. Burning or scorching can result in the release of toxic decomposition products and generate a fire hazard. Alternative removal methods should only be used if they do not result in excessive fibre release from the asbestos millboard and do not result in any additional hazards.

5.7 Removal of Asbestos Gaskets and Rope from Plant and Equipment[30]

Gaskets reinforced with asbestos were once used extensively in plant and equipment exposed to high temperatures and/or pressures. These gaskets were typically used between the flanges of pipes.

[29] http://www.asbestosremovalsaustralia.com.au/asbestos_friable_vinyl_sheet_floor_covering.htm (Accessed 30 January 2014)
[30] http://www.hse.gov.uk/pubns/guidance/a25.pdf (Accessed 30 January 2014)

Asbestos rope was often used for lagging pipes and valves and for sealing hatches. It is likely that the asbestos-contaminated materials in gaskets and rope from plant and equipment will be friable.

5.7.1 Preparation

Ensure the plant or equipment is shut down and isolated. The minimum respiratory protection suitable for this operation is a P2 filter with a half face-piece respirator.

5.7.2 Removal

Dismantle the equipment carefully. Protect any other components with plastic sheeting. Thoroughly dampen the gasket or rope with water. Use a hand-scraper to slowly remove the gasket or rope. Continue to dampen as drier material is exposed. Collect the removed asbestos-contaminated materials in a container directly beneath the scraper.

All the asbestos gasket or rope should be removed.

5.8 Removal of Asbestos Switchboards and Meter Boards[31]

Historically, ACM was used in and around switchboards and meter boards to provide electrical insulation and to prevent fire spreading from the boards. Asbestos-contaminated materials were used in the front panels and also in materials that covered the inside and back of the switchboard boxes. Small electrical load centres (with a main switch and a few fuses) have also been known to have ACM backings.

A registered electrician must isolate the relevant switchboard or meter board before any work begins. When removing an asbestos switchboard or meter board any other asbestos-contaminated materials, such as fire-proofing on the switchboard box sides and base, should also be removed.

5.8.1 Preparation

Electricity must be disconnected from the switchboard or meter panel by a registered electrician. Once disconnection has been tested and confirmed the removal process can begin. All wiring on the back of the switchboard or meter board should be disconnected or isolated by a registered electrician. If this is not practical, the wiring should be suitably terminated and labelled to indicate that it is live and the wiring should be protected against

[31] http://www.deir.qld.gov.au/workplace/subjects/asbestos/electrical-installations/index.htm#.Uuq3cvuFY40 (Accessed 30 January 2014)

mechanical damage or otherwise rendered safe. The switchboard or meter panel and surrounding area should be cleaned before removal work begins.

The minimum suitable respiratory protection is a P2 half face-piece respirator with particulate filter - refer Section 8 of these guidelines for information on the selection, use and maintenance of appropriate RPE and PPE.

5.8.2 Removal

Lay out a 200µm thick plastic sheet to catch any debris that may fall. Remove the mounting screws from the board without damaging the board. Vacuum the front surface of the board using an asbestos vacuum cleaner. Tilt the board forward and disconnect the cabling from the board. Wrap the board in a double layer of heavy duty 250µm plastic sheeting - refer to Section 9 of these guidelines for waste disposal procedures.

5.8.3 Decontamination

- Vacuum the area where the board was located and the surrounding area.
- Wet-wipe the area with a rag to remove minor amounts of debris that may be attached to the wall or cabling. Dispose of this rag as asbestos waste.
- Vacuum the sheet of plastic laid out to catch any debris and dispose of it as asbestos waste.
-

5.9 Removal of Asbestos Mastics and Bitumen[32]

Mastics and bitumen are usually soft, so they were often reinforced with asbestos to give them strength while retaining their flexibility.

5.9.1 Preparation

The minimum respiratory protection suitable for this operation is a P2 filter with a half face-piece respirator. Section 15 of these guidelines provides further information on the selection, use and maintenance of appropriate RPE and PPE.

5.9.2 Removal

Because these asbestos-contaminated materials are flexible they need to be removed using scraping and chipping tools. The pieces removed should be kept as intact as possible.

[32] http://www.hse.gov.uk/asbestos/essentials/ (Accessed 30 January 2014)

If heating is used to soften the material to enable it to be peeled, it is important not to burn the material as this can release airborne asbestos fibres. Excessive heating is also likely to generate toxic fumes and gases and generate a fire hazard.

5.10 Removal and Cleaning of Ceiling Tiles[33]

False ceiling tiles or suspended ceilings sometimes need to be removed so that maintenance work can be performed. If asbestos-contaminated materials have been used on structural materials above false ceilings there could be contamination on the upper surface of the tiles.

5.10.1 Preparation

The minimum respiratory protection suitable for this operation is a P2 filter with a half face-piece respirator. If considerable amounts of asbestos dust or debris are likely to be involved, full face-piece air purifying positive pressure respirators should be worn. Section 8 of these guidelines provides information on the selection, use and maintenance of appropriate RPE and PPE.

5.10.2 Method

Any surface below the tiles that might be contaminated should be covered with 200µm plastic sheeting. The first tile should be lifted carefully to minimize the disturbance of any asbestos fibres. The top of each tile should be thoroughly vacuumed with an asbestos vacuum cleaner and wet-wiped, where possible prior to removing other tiles.

Where non-asbestos ceiling tiles are to be re-used, they should be covered with plastic as they are removed from the ceiling to prevent further dust settling on them. Asbestos ceiling tiles must not be re-used. Wrap the asbestos ceiling tiles in a double layer of heavy duty 200µm thick plastic sheeting - refer to Section 9 of these guidelines for waste disposal procedures. Ceiling tiles should not be placed in the ceiling until the areas of the ceiling space affected by the maintenance work have been cleaned.

6.0 Monitoring Asbestos in Air Levels and Clearance Procedures

The measurement of airborne fibre levels will be required to verify that asbestos exposure standards have not been exceeded and to check that practices set out in these guidelines have been met. The main objective of sampling should be to ensure that the potential for personal exposure has been minimized.

The type of monitoring that is applicable will depend on the exposure circumstances. A clear distinction should be made between sampling conducted as part of the quality control procedures on asbestos removal or encapsulation jobs and occupational sampling. Overall,

[33] http://www.hse.gov.uk/asbestos/essentials/ (Accessed 30 January 2014)

both are concerned with safeguarding the health of individuals but, in the case of quality control samplings, the immediate emphasis is placed on confirming that the task has been completed to a satisfactory standard.

7.0 After Abatement: Monitoring Asbestos in Air Levels and Clearance Procedures

7.1 Monitoring of Removal Work

The requirements for air sampling should be established before the removal process begins. It may be appropriate to conduct background monitoring to establish existing asbestos fibre levels. This is most likely to be useful where the contract is for the removal of only part of the asbestos present in the building or structure.

The ability of the enclosure to contain the asbestos generated in the removal process is perhaps best monitored by regular checks on the negative air pressure. A pragmatic method is to observe the inward bulge in the plastic sheeting. Air sampling may, especially in the initial stages of the removal work, provide more direct evidence that satisfactory containment is being achieved.

7.2 Control Levels for Monitored Airborne Asbestos Fibres

Control levels are airborne asbestos fibre concentrations which, if exceeded, indicate there is a need to review current control measures or take other action. These control levels are occupational hygiene best practice and are not health-based standards - i.e. they are below the concentrations set for asbestos.

The control levels shown in the following table should be used for determining the effectiveness of control measures:

Table 2: Control levels for monitored airborne asbestos fibres[34]

Control Level (airborne asbestos fibres/mL	Control/Action

[34] Occupational Health & Safety Administration Regulations (Standards - 29 CFR)

Table 2: Control levels for monitored airborne asbestos fibres[34]

Control Level (airborne asbestos fibres/mL	Control/Action
≥0.01	Continue with control measures
<0.01	Review control measures
≥0.02	Stop work and find the cause

7.3 Clearance and Visual Inspection Procedures

At the completion of the removal process, clearance must be gained prior to reoccupation.

This procedure is the responsibility of the principal. The principal should engage the services of an independent person or entity to conduct a visual inspection and carry out final clearance monitoring.

While the asbestos contractor undertaking the removal work may engage an agent to carry out monitoring while the work is progressing, final clearance for reoccupation must be conducted by an independent agent.

7.3.1 Visual Inspections

The visual inspections are conducted after the removal area has been meticulously cleaned. Normally inspections prior to clearance monitoring will be the responsibility of the principal, but this function may be delegated to an independent operator who has no financial or other interest in the job. If attention is given to the cleaning aspect of the removal process, it is unlikely that airborne asbestos contamination will be a problem.

Any asbestos remaining (including that which is not visible to the naked eye) will be removed rapidly in the normal cleaning process. In some circumstances sealant may be applied to work surfaces and plastic sheeting after the visual inspection and initial monitoring. Any dust present in the removal area must be treated as if it contains asbestos. If asbestos is not completely

stripped from an area because of access difficulties the area should be sealed and the location noted.

7.3.2 Clearance Monitoring

Following a satisfactory visual inspection, clearance monitoring will be required for all friable asbestos work and interior asbestos sheeting removal. The area must be dry, the negative air switched off and the inlet capped before sampling is started. As far as practicable, the decontamination unit must be isolated from the area being cleared.

Sampling pumps are to be suitably placed to collect representative samples. The sampling head should be positioned one to two metres from the floor and away from walls or other solid surfaces. Section 7 of these guidelines discusses the requirements for sampling equipment. If the area has been sprayed with PVA or other sealant, sampling should not commence for at least two hours to allow the sealant to dry properly.

7.3.3 Recommended Number of Samples

The recommended numbers of samples to be taken should be determined as follows:

Table 3: Recommended Number of Samples[35]

Enclosure area (m^2)	Enclosure volume (m^3)	Number of samples
<50	<10	1
50	150	2
200	600	4
500	1500	6
1000	3000	9

[35] Asbestos - New Zealand guidelines for the management and removal of asbestos (3rd Edition), Sec8

Table 3: Recommended Number of Samples[35]

Enclosure area (m^2)	Enclosure volume (m^3)	Number of samples
5000	15000	16
10000	30000	20

If the volume of the area to be cleared is less than 10 cubic metres, one sample is sufficient; otherwise at least two samples should be taken. Where the enclosure is less than three metres high, or where exposure is only likely to be at ground level, use the area for calculating the number of samples. In other cases the volume should be used as the basis for determining the number of samples. If there are large items in the enclosure, their volume may be subtracted from the total before estimating the number of samples to be taken.

The above criteria are to be used as a guide only in estimating the number of samples to be taken. For example, it may be necessary to take more samples where the area is subdivided.

7.3.4 Sampling Procedure

Sampling should be conducted over a period of 4 hours at a rate of 2 litres/minute to give a sample volume of 480 litres. At the start of the sampling period, activity should be undertaken to disturb any settled asbestos fibres. This can be achieved by fanning the air beside accessible surfaces where it is suspected asbestos may be present.

The flow rate should be recorded at the beginning and end of the sampling period using a calibrated flow meter. The sampling period should be as close as possible to 4 hours and recorded to the nearest minute.

7.3.5 Storage and Transport of Filters

Filters should not be treated with a fixative - this has been shown to be unnecessary and may damage the sample. Care should be taken to follow exactly the instructions specified by the analysing laboratory for the handling and transport of the exposed filters.

7.3.6 Interpretation of Results

For a clearance to be given, all results must be less than or equal to 0.01 fibres/ml unless:

- It can be established that the fibre present is unlikely to be asbestos (this will normally require confirmation by an alternative method such as Scanning Electronic Microscopy with Energy Dispersive X-ray Analysis).

7.3.7 Standardized Method of Determining the Concentration of Asbestos Fibres in Air Samples

The acceptable method of analysis for determining the concentration of asbestos fibres in air samples is the NIOSH Method which is described in detail in the NIOSH Manual of Analytical Methods. The NIOSH Method utilizes the phase contrast microscopy analysis (PCM) test method. For definitive analysis, it is crucial that the air samples are analyzed by a nationally and/or internationally accredited asbestos testing laboratory.

7.5 Occupational Sampling

The employer is responsible for ensuring that employees working with asbestos and all others who may come into contact with asbestos fibre generated from the removal process are protected. For persons working with asbestos WES are specified in Table 3 in these guidelines. These standards are only applicable where the work is directly connected with asbestos or an asbestos product.

Personal monitoring will generally be required using equipment that samples air from the worker's breathing zone. To obtain a sample that can be compared with the WES a sample over any continuous 4-hour period is to be taken.

The sampling strategy should be designed to achieve results that are indicative of typical exposures. The person conducting the sampling should be conversant with occupational hygiene monitoring procedures. In developing the sampling strategy relevant information on the processes in the workplace must be gained. In particular, information on the following should be sought:

1. the plant and equipment used for transporting and processing materials containing asbestos;
2. the exhaust ventilation and other dust control equipment;
3. the composition of the materials (the percentage and type of asbestos present in the material handled, for example);
4. process details; and
5. the tasks performed by individual employees.

7.5.1 Sampling Duration and Flow Rate

The WES for asbestos refers to 4-hour periods. A 4-hour sample at a sampling rate of one litre per minute is recommended but, depending on the level of dust present in the air, the sampling rate

may have to be reduced to avoid overloading the filter. The total sampling period should never be less than four hours and preferably cover the full work period with two 4-hour samples.

8.0 Respiratory and Personal Protection for Asbestos Workers

8.1 General

Employers and others involved in asbestos removal or abatement procedures must take all necessary control measures to protect against exposure to asbestos fibres. There are a legal requirements placed on employers to ensure that their employees and others in the vicinity are adequately protected from the effects of asbestos.

Good occupational hygiene practice requires that all practicable efforts are taken to prevent asbestos fibres from entering the air of the workplace. In circumstances where it is impracticable to prevent asbestos from entering the atmosphere, suitable respiratory protection should be worn.

Respirators should be issued to individuals for their exclusive use. A system of regular cleaning, inspection and maintenance should be provided for respirators on extended personal use and records of all respirator issues and uses should be established and maintained.

8.2 Respirator Programme

It is essential that all organisations required to use respirators in their work develop and run a comprehensive respiratory protection programme. There are seven elements to a successful programme:

- the administrative system;
- knowledge and assessment of the risks involved;
- control processes;
- correct selection of respiratory protection devices (RPDs);
- staff training;
- medical assessment; and
- inspection, maintenance and storage of RPDs.

8.2.1 Administrative System

Written standard operating instructions must be available. These should provide information on the company policy relating to the issue and use of RPDs. One person should be responsible for

the coordination and direction of this policy. Each RPD programme will vary according to the peculiarities of the work being carried out.

8.2.2 Knowledge and Assessment of Risks Involved

The degree of respiratory protection required for asbestos work is determined by:

- the nature of the work;
- the type of asbestos;
- the work methods; and
- potential for exposure to asbestos fibres.

It is essential that a full appraisal of the work using the above criteria is carried out to assess the likely risk factors and to identify the appropriate safety measures. It may be necessary to undertake environmental monitoring to assist with the assessment. This is a responsibility of the employer.

Air contaminated with asbestos fibres will be the major hazard to workers and the most appropriate control methods will need to be considered in the assessment process. Because the greatest risk is from the inhalation of asbestos fibres, stringent protection measures must be used. Therefore, all people likely to be exposed to asbestos must wear approved RPDs for the whole exposure period.

8.2.3 Correct Selection of Respiratory Protective Devices (RPDs)

The following issues must be addressed[36]:

Fit to the wearer

- If a proper fit cannot be achieved with one type, model or size of respirator, another which does fit must be provided.

Face seal

- The presence of facial hair (beard, stubble growth, or sideburns,) wearing spectacles, or facial characteristics may affect the face seal adversely. Positive pressure powered equipment with full-face-piece copes better with these matters than non-powered devices.

[36] Occupational Health & Safety Administration Regulations (Standards - 29 CFR) Sec1910

- Persons requiring the use of prescription spectacles may not be able to use full-face-piece respirators because of the loss of seal around the spectacle arms. If their spectacles cannot be modified so that they do not need the support of the ears, these people should not use full-face-piece respirators and should wear air supply hoods instead. It is important to be sure these hoods will provide a sufficient level of protection.

Freedom of movement

- The need for a worker to move freely about a job will influence the type of RPD. While air-line respirators offer higher protection the restrictions imposed by the air-line may be prohibitive.

Physical and thermal stress

- The wearing of RPDs can cause severe problems during asbestos removal because of the physical activity required. In addition, this type of work is often carried out in hot environments. The cooling effect of air-supplied respirators will make them more acceptable and condensation on the visor will not be a problem.

Other factors

- factors that may affect the selection of RPDs could include:
- the need to communicate;
- ease of cleaning; and
- availability of replacement parts.

Air supply hoods

Where airlines are used, the airline should incorporate a belt-mounted back-up filter. Where a failure of the air supply system occurs, workers should leave the work area using normal decontamination procedures. The use of a backup belt-mounted filter device allows for adequate respiratory protection during this process.

Battery powered full-face-piece air filtration respiratory protection devices

Battery powered full-face-piece respiratory protection devices are particularly suitable for friable asbestos work requiring freedom of movement around enclosed plant and equipment.

When battery powered units are used, particular care must be taken to ensure that back-up battery power packs are readily available in case of failure. These batteries must be changed regularly to maintain a consistent quality of airflow through the filters to the mask.

Systems of work should be established for the cleaning, maintenance and storage of respirators. Respirators should be maintained in clean and good working condition by the person designated by the supervisor of the removal job as responsible for the safe working condition of respiratory equipment. Examples of the different types of respirators are shown in Figure 5.

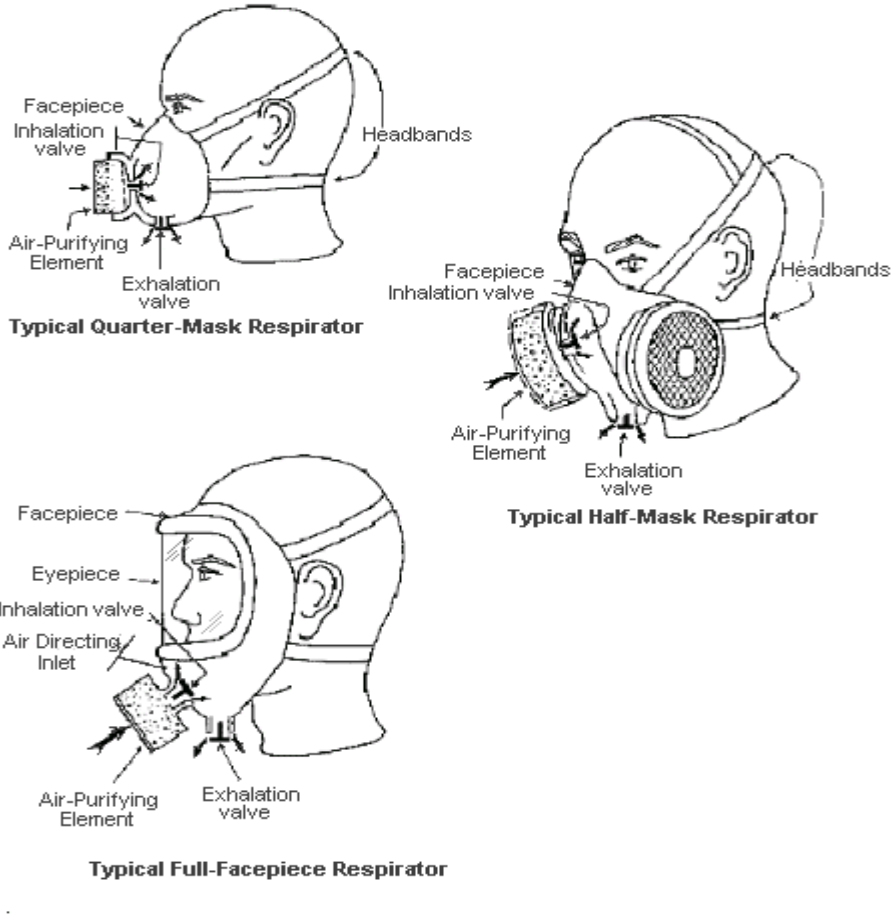


Figure 5: Types of respirators[37]

[37] http://www.business.govt.nz/worksafe/information-guidance/all-guidance-items/new-zealand-guidelines-for-the-management-and-removal-of-asbestos-3rd-edition/respiratory-and-personal-protection-for-asbestos-work (Accessed 30 January 2014)

8.2.4 Staff Training

The correct and proper use of RPDs must be taught to all users. No person is to use a respirator without first being given training in its correct use, operation, care and maintenance, emergency procedures, and cleaning and storage requirements.

8.2.5 Medical Assessment

Any type of respirator may place undue stress on some users. It is important that anyone required to routinely wear a respirator is given the opportunity to have a medical assessment to determine that they are able to wear it safely.

8.2.6 Inspection, Maintenance and Storage of RPDs[38]

Proper inspection, maintenance and repair of RPDs are essential parts of the respirator protection programme. Facepieces should be cleaned, dried and stored properly after each use. Regular checks of the diaphragms, valves and face-piece parts will reveal any defect that should be repaired. The batteries for powered air RPDs will require recharging.

8.3 Protective Clothing

Appropriate protective clothing will afford protection to asbestos workers and prevent spreading contamination or health risk to others. All protective clothing used to carry out restricted work must be disposed of as asbestos waste. During other work involving asbestos, protective clothing may be reused but appropriate measures must be taken to ensure cleanliness (refer to Section 8.3.2 of these guidelines for information on laundering).

8.3.1 Types of Protective Clothing[39]

Persons involved in working with asbestos should always wear protective clothing that:

- is made of material that resists penetration by asbestos fibres, such as nylon or treated synthetic material of a type "P" Particulate Body Protection;
- covers the body and fits snugly at the neck, wrists and ankles. It should also cover the head by having an attached hood; and

[38] http://www.business.govt.nz/worksafe/information-guidance/all-guidance-items/new-zealand-guidelines-for-the-management-and-removal-of-asbestos-3rd-edition/respiratory-and-personal-protection-for-asbestos-work (Accessed 30 January 2014)
[39] http://www.hse.gov.uk/pubns/guidance/em6.pdf (Accessed 30 January 2014)

- is maintained in good condition and if torn or damaged, is immediately repaired or replaced.

NOTE: *Because of the impervious nature of this type of clothing the wearer may become affected by heat stress. The employer should ensure that workers are knowledgeable about the signs and symptoms of heat disorders and the means to prevent illness caused by heat.*

There are four types of overalls in general use for asbestos work. Each type has its advantages and disadvantages. The use of disposable or single-use overalls for all asbestos work is advisable because laundering is not required. Where the use of alternative types is necessary, the full implications of how they will be cleaned or laundered should be considered.

1. Disposable or single-use protective clothing which is generally used for one job and discarded as asbestos waste. These are particularly suitable for all types of asbestos work.
2. Overalls made from lightweight synthetic material such as nylon, which is also waterproof, or PVC waterproof clothing. The light nylon overall is particularly suitable for large on-going jobs because they can be washed under a shower when leaving the contaminated area. Laundering is necessary primarily for hygiene.
3. PVC-type overalls can be used in a similar way, but are heavy, cumbersome and too hot for longer jobs.
4. Cotton or poly-cotton overalls which are commonly used in industry and come in varying colours and styles. These are used in the manufacturing or service industry such as brake workshops, but are hot and heavy for longer tasks and involve special laundering considerations.

8.3.2 Laundering of Asbestos-Contaminated Clothing[40]

The laundering of contaminated overalls presents some difficulties:

- The transfer and handling of contaminated overalls may put other people at risk from asbestos. For this reason contaminated overalls should never be washed in a home laundry and workers in a laundry handling asbestos-contaminated clothing must take special precautions.
- While the washing process removes asbestos fibres, the spin-drying cycle deposits the fibres onto the garment again.
- During the mechanical drying process asbestos fibres are released into the air.

[40] http://www.hse.gov.uk/pubns/guidance/em6.pdf (Accessed 30 January 2014)

The NEPA recommends that clothing that has been used in asbestos work is laundered in accordance with the following requirements:

- The clothing is, wherever possible, laundered at the place where the work involving asbestos has been carried out.
- If it is not possible to launder the clothing at that place, before being taken for laundering the clothing is, dampened and placed in a closed container impermeable to asbestos dust and conspicuously marked with the words "Asbestos-Contaminated Clothing".
- Wherever the clothing is laundered, it is laundered in such a way as to clean the clothing and to suppress the release of asbestos dust into the air.
- Before being given the clothing, every employee to whom the clothing is given for laundering must receive instructions on the necessary handling precautions. These precautions must ensure that the clothing is laundered and handled in such a way as to protect the safety of every employee coming into contact with it during the laundering process.'
- The clothing is not laundered by an employee at an employee's home.

8.3.3 Footwear[41]

Footwear should be adequate for the type of work being undertaken. Generally, steel-capped work boots or gumboots are advisable.

8.3.4 Gloves[42]

If gloves are provided they should be made of impervious material for ease of cleaning. To assist with manual dexterity, disposable gloves may be more acceptable. On health grounds there are few reasons to require people handling asbestos casually to wear gloves. However extended contact with asbestos can lead to asbestosis.

9.0 Storage, Labelling and Disposal of Asbestos

All abated ACM must be clearly labelled before storage. NEPA representatives will not approve the storage of ACM which is not properly labelled.

[41] http://www.hse.gov.uk/pubns/guidance/em6.pdf (Accessed 30 January 2014)
[42] http://www.hse.gov.uk/pubns/guidance/em6.pdf (Accessed 30 January 2014)

9.1 General

This section outlines the steps necessary for the employer to ensure, as far as is practicable, the prevention of contamination by asbestos from any workplace and to ensure that asbestos-contaminated materials are stored, labelled and disposed of correctly.

9.2 Storage and Disposal of Asbestos

The asbestos contractor should take all practicable steps to ensure that asbestos waste products are not received into, stored, distributed or dispatched from any place of work unless in suitably sealed and labelled receptacles. The receptacles should be designed, constructed, maintained and closed so as to prevent escape of any of the contents when subjected to the stresses and strains of normal handling.

All asbestos waste must be sealed in plastic bags (200µm thick) and labelled "Asbestos hazard - wear respirator and protective clothing while handling contents".

9.3 Disposal Programme

A waste-disposal programme and record keeping should be developed taking account of:

- waste containment;
- the location for waste storage onsite;
- the transport of waste within the site and offsite;
- the location of the designated refuse site;
- approvals needed from the relevant local disposal authority;
- any local disposal authority requirements that may apply to the amount and dimensions of the asbestos waste; and
- verification of the volume of waste disposed of at the designated refuse site.

Loose asbestos should not be allowed to accumulate within the asbestos work area. Asbestos waste may be collected and disposed of in an asbestos waste bag, drum, bin, or waste skip bin.

If asbestos waste cannot be disposed of immediately (because of volume requirements for disposal, for example), it should be stored in a solid-waste drum or skip bin and sealed and secured upon completion of each day's work so that unauthorized access is prevented.

9.4 Waste Bags

Asbestos cement sheets and pipes or insulating board must not be broken or cut for disposal in plastic bags. The employer must ensure that these materials are suitably sealed in plastic and transferred to a truck or skip for transport to a disposal site. The skip or truck is either to be labelled as containing asbestos or the driver is to carry a copy of the disposal authorization permit from the registered landfill.

Asbestos waste must be collected in heavy duty 200µm polythene bags. The bags should be labelled with an appropriate warning, clearly stating that they contain asbestos and that dust creation and inhalation should be avoided.

See Figure 7 below for an example of a warning statement that may be used.

Figure 7: Example of warning statement that may be found on an asbestos waste bag[43]

Controlled wetting of the waste should be employed to reduce asbestos dust emissions during bag sealing or any subsequent rupture of the bag. Only new, unused bags should be used and bags marked for asbestos must not be used for any other purpose. Hard and sharp asbestos waste requires preliminary sealing or a protective covering before it is placed in the waste bags, to minimize the risk of damage to the bags.

In order to further minimize the risk of a bag tearing or splitting, and to assist in manual handling, asbestos waste bags should not be filled more than half full and excess air should be gently evacuated from the waste bag in a manner that does not cause the release of dust. The bags should then be twisted tightly, folded over (goose-necked) and the neck secured in the folded position with adhesive tape or any other effective method. The external surface of each bag should be cleaned to remove any adhering dust before the bag is removed from the asbestos work area. The asbestos waste should be double-bagged outside the work area immediately following the decontamination process.

The routes used for removing waste from the asbestos work area should be designated in the asbestos removal control plan before the commencement of each removal. The methods used

[43] http://www.screwfix.com/p/warning-asbestos-adhesive-labels-50-x-50mm-roll-of-250/55929 (Assessed 30 January 2014)

to transport wastes through the building should be determined by the asbestos contractor. In occupied buildings, all movements of waste bags should be outside normal working hours.

Once the waste bags have been removed from the asbestos work area, they should be placed in a solid waste drum, bin or skip. This container should then be inspected by the NEPA, who upon approval of the inspected hazardous waste will recommend that the National Solid Waste Management Authority (NSWMA) accept it for burial. Waste bags should not be stored at the asbestos removal site if they are not placed in an asbestos waste drum, bin or skip bin.

If a decontamination unit is being used for the asbestos removal then asbestos waste bags should be removed from the asbestos work area through the decontamination unit using the following "production line" operation:

- One worker is located in each section of the decontamination unit.
- The waste bags are passed from cubicle to cubicle and "showered out" to remove any asbestos residue.
- Once they have been removed from the decontamination unit, the waste bags are double-bagged prior to disposal.

9.5 Asbestos Waste Drums/Bins/Containers

All drums, bins or containers used for the storage and disposal of asbestos waste should be in a good condition with lids and rims in good working order and free of hazardous residues.

They should be lined with plastic (minimum 200µm thickness) and labels warning of the asbestos waste should be placed on the top and side of each drum or bin with the words, "DANGER: ASBESTOS. DO NOT BREAK SEAL" or a similar warning. If the container is to be reused the asbestos waste must be packed so that when the bin or drum is emptied there is no residue asbestos contamination.

Controlled wetting of the waste should be used to reduce asbestos dust emissions. Where possible, the container should be placed in the asbestos work area before work on asbestos-contaminated materials begins. The container should have their rims sealed and their outer surfaces wet-wiped and inspected before they are removed from the asbestos work area.

Where it is not possible to locate the containers inside the asbestos work area they should be located as close to the work area as possible. Routes for moving the waste from the asbestos work area to the waste containers should be designated prior to the commencement of each task. The asbestos contractor should decide the best means of moving the waste through the

building. In occupied buildings all movement of bags from the work area to the waste containers should be performed outside normal working hours.

Containers used to store asbestos waste should be stored in a secure location when they are not in use. Containers should not be moved manually once they have been filled. Trolleys or drum lifters should be used.

Vacuum suction (Super Suckers) may be used to collect removed asbestos-contaminated materials. The asbestos contractor should assess the process to prevent asbestos contamination. Air from the vacuum system must be passed through a HEPA filter before it is released outside the asbestos work area.

9.6 Asbestos Waste Skip Bins, etc

If it is not feasible to use asbestos waste bags, drums or bins because of the volume or size of asbestos wastes, a waste skip bin, vehicle tray or similar container may be used.

Skip bins should be in good condition with no holes or rust or sharp edges that may damage or snag wrapping material. The asbestos-contaminated materials should be sealed in a double-lined, heavy-duty plastic sheeting 250µm (or similar impermeable material such as Geotech material) or double-bagged before they placed in the skip bin. However, non-friable asbestos waste may be placed directly into a skip bin or vehicle tray that has been double-lined with heavy-duty plastic sheeting (200µm thickness) provided it is kept damp to minimize the generation of airborne asbestos fibres.

Should the asbestos load be of a large quantity and weight, the material may be required to be split loaded into skip bins, vehicle trays and trailers to allow for safer transfer to the registered tip-site for disposal.

This requires the asbestos material to be wetted, wrapped and sealed in more than one package for disposal. The asbestos contractor should consult with their appointed registered landfill for advice and assistance.

Once the skip bin is full its contents should be completely sealed with the plastic sheeting. If the skip bin is to be used for storing the asbestos waste it must be able to be secured (by using a lockable lid, for example).

9.7 Recycling of Construction Materials

Before any building materials are recycled, procedures need to be established to ensure asbestos-contaminated materials are not reused unless they have been successfully decontaminated.

These procedures should include the quarantining of incoming building materials that are intended for recycling to:

- allow screening these materials for asbestos-contamination before they are distributed within the recycling yard; and
- enable the removal of contaminated building products to prevent their redistribution.

9.8 Handling

The following practices should be applied:

- The employer should ensure that asbestos waste received into or dispatched from any workplace is double-packed in sealed six millimetre (6 mm) thick plastic bags. The bags must be sealed with goose-neck ties where possible. If goose-neck ties are not possible (for example when hindered by the shape of the ACM), the double bags must be sealed in an air-tight manner.
- Each double-bag containing ACM must be affixed with OSHA standardized asbestos warning labels (Figure 8).
- If the bags containing ACM are placed in a container, the container must be lined with 6mm thick plastic, and the external walls of the container are to be affixed with OSHA standardized asbestos warning labels.
- Pallet loads should be securely fastened by banding (in order to not cut or puncture the bags) and covered.
- Pallet loads should be securely mounted on suitable pallets that can be moved by hoist, forklift truck or other mechanical handling means without damage. Hooks or other sharp equipment should not be used for handling the bags.
- A supply of suitable adhesive tape should be made available by the employer to repair any damaged bags. Where the damage cannot be repaired to prevent the release of asbestos during handling, the damaged bag should be placed inside another receptacle that can be sealed effectively.
- Asbestos cement sheets and pipes or insulating board should not be broken or cut for disposal in plastic bags. The employer should ensure that these materials are suitably sealed in plastic and transferred to a truck or skip for transport to a disposal site. The skip or truck should be labelled as containing asbestos.
- The skip or other container should be cleaned thoroughly after use.

- Manufactured goods containing asbestos such as brake linings and clutch facings should be sealed or suitably packaged (by shrink-wrapping, for example) to prevent asbestos fibre arising from abrasion during transport.
- All abated ACM must be inspected by NEPA representatives to ensure compliance with the above-listed handling and storage criteria.

Figure 8a[44]: Examples of OSHA standardized asbestos warning labels

Fig. 8b[45]: OSHA standardized asbestos warning label

[44] https://www.osha.gov/Publications/osha3095.pdf (Accessed 30 January 2014)
[45] https://www.osha.gov/Publications/osha3095.pdf (Accessed 30 January 2014)

Fig. 8c[46]: OSHA standardized asbestos warning label

Figure 8d[47]: Example of airtight, labelled double bags packed with ACM

[46] https://www.osha.gov/Publications/osha3095.pdf (Accessed 30 January 2014)
[47] https://www.osha.gov/Publications/osha3095.pdf (Accessed 30 January 2014)

Figure 8e[48]: Gooseneck Tie

9.9 Disposal at Designated Refuse Site

Asbestos waste should to be buried in a designated area within a managed refuse disposal site under the control of the NSWMA and NRCA, and covered with at least 1 metre of earth.

There will be a need for some discretion on what constitutes "earth" used to cover waste asbestos in a refuse disposal site. The intention is that the waste asbestos be covered with material to prevent the spread of asbestos fibres. Relatively small quantities of asbestos waste, such as sanding from flooring, asbestos waste from brake workshops, asbestos cement from repair jobs, should be able to be safely disposed of by covering with compacted refuse. Operators of refuse disposal sites usually set aside an area for the disposal of large amounts of asbestos that are covered as necessary with clean fill or other material.

[48] http://www.biosch.hku.hk/clinicalwaste/clinicalwaste.html (Accessed 30 January 2014)

9.10 Reuse of Asbestos Products

The reuse or resale of products containing asbestos is strictly prohibited

10.0 Asbestos Friction Products

10.1 Removal of Asbestos Friction Products

10.1.1 Preparation and Enclosure

Asbestos friction products can be removed outside an enclosure using a low pressure wet-spray method. Asbestos vacuum cleaners should be used for the dry-removal method.

The removal of asbestos friction products should be performed in an area that is not affected by wind. The minimum respiratory protection suitable for this operation is a P2 respirator. Section 8 provides further information on the selection, use and maintenance of appropriate RPE and PPE.

10.1.2 Removal

The preferred method for removal is using a combination of vacuuming and the wet method. Either method can be used in isolation providing all precautions are taken. Compressed air must not be used to remove dust or debris from wheels or other parts of a vehicle. Power tools should not be used. Hand tools should be used to reduce the risk of airborne fibres.[49]

10.1.3 Wet Method

Use a suitable collection device (a tray or container, for example) below the location where the work will be carried out to collect any dust or run-off. Wet the wheel and brake area with a fine water spray. Wipe down the wheel or automobile part using the wet method before removal. A misting-spray bottle should be used to wet down any dust. If the use of spray equipment to wet the asbestos is likely to disturb asbestos fibres, alternative wetting agents such as a water-miscible degreaser or a water and detergent mixture should be used.

Partially open the housing and softly spray the inside with water using the misting-spray bottle. Any spillage of dust, debris or water must be controlled - for example, through the use of containers to capture run-off - and either filtered or disposed of as asbestos waste. Fully open the housing and remove the component.[50]

[49] http://www.safework.sa.gov.au/uploaded_files/hzs2.pdf (Accessed 30 January 2014)
[50] http://www.safework.sa.gov.au/uploaded_files/hzs2.pdf (Accessed 30 January 2014)

10.1.4 Dry Method

A collection tray should be placed under the components to capture any dust spilling from the brake assembly during removal. Use an asbestos vacuum cleaner to remove asbestos fibres from the brakes and rims or other asbestos-contaminated materials.[51]

10.2 General Guidelines for Working with Friction Materials Containing Asbestos

This section applies to all friction materials containing asbestos that are used in a way that may lead to an occupational exposure. It particularly applies to the following processes:

- manufacture or relining of brake and clutch assemblies for automotive and industrial applications;
- operating vehicle maintenance depots (fleet operators); and
- operating commercial garages and service stations.

This section does not apply to the manufacture of products incorporating raw asbestos fibre.

Wherever possible, friction materials that do not contain asbestos should be used. Where products containing asbestos are being handled, the number of people in the area should be kept as low as possible. Workshops should be isolated from other occupied parts of the building or areas that the public has access to.

This section applies to specialist relining workshops and other services that cut, grind, finish, drill, mill, saw, turn, bond or otherwise work the friction materials in a way that is likely to release asbestos fibre. Some of these processes - for example radius grinding - have the potential to release considerable amounts of asbestos fibre into the air.

10.3 Servicing of Brakes and Clutches in Garages or Workshops[52]

Airborne asbestos is most likely to be produced when friction materials are worked by cutting or machining. The dust that accumulates during normal usage also contains asbestos and handling or cleaning brake or clutch parts will produce airborne asbestos fibre. .The tasks that may result in exposures to asbestos in the brake and clutch industries can be broken into two groups:

- vehicle maintenance - the replacement of brake and clutch assemblies on vehicles by garages and brake and clutch specialists; and
- relining of brake and clutch assemblies.

[51] http://www.safework.sa.gov.au/uploaded_files/hzs2.pdf (Accessed 30 January 2014)
[52] http://www.safework.sa.gov.au/uploaded_files/hzs2.pdf (Accessed 30 January 2014)

While both of these tasks may be carried out in the same place of work, the risks are different and they should be considered under separate headings.

10.4 Vehicle Maintenance

Asbestos in moulded and woven materials is locked into the product with resin and binders thus limiting the release of asbestos during handling and installation. Heat and abrasion during usage produce a fine dust containing degraded resin, fillers and products of wear from the metal brake drums and discs.

The major portion of the particulate produced in the operation of the friction materials is relatively harmless but some asbestos of respirable size will be present. Any accumulated dust should be removed before parts are handled. Specialised local extraction systems are available that will collect dust from brake drums. The use of such devices is recommended. They should be constructed to prevent the release of respirable fibres into the atmosphere.

Alternatively, the dust may be removed with a vacuum cleaner or by using a wet process. A cloth moistened with water or other solvent may be used provided it is disposed of in accordance with Section 7 of these guidelines. Under no circumstances should compressed air or dry-brushing be used for cleaning purposes. If the brake or clutch parts are to be sent out for specialist servicing, they should be sealed in a bag to prevent the release of asbestos fibre.[53]

10.5 Relining of Brake and Clutch Assemblies

Manufacturers and suppliers of friction materials are, in many cases, able to provide pre-drilled and pre-ground products in final assembly form. Where possible, these should be used to eliminate the necessity for machining that will release asbestos fibre. Truck brake blocks and segments are also available in various thicknesses to minimize machining.

When products must be machined, the employer should ensure that the release of dust into the work environment is reduced to the lowest practicable level. Before applying adhesive to bond segments to brake shoes surface dust should be removed with a damp cloth. Dust should not be removed by hitting the linings against a solid surface or by the use of compressed air. The employer should require the supplier of friction materials to provide them shrink-wrapped[54] wherever possible.

[53] http://www.safework.sa.gov.au/uploaded_files/hzs2.pdf (Accessed 30 January 2014)
[54] http://www.safework.sa.gov.au/uploaded_files/hzs2.pdf (Accessed 30 January 2014)

10.6 Local Exhaust Ventilation (LEV)[55]

An effective dust-extraction system must be fitted to all equipment that is used to cut, grind or otherwise machine the friction materials. High velocity/low volume systems are the most appropriate for these applications. For occasional or intermittent use in various locations, a portable dust-extraction unit may be suitable. The collection hoods for the dust-extraction systems should be designed to enclose the source of dust where practicable. Some machines, such as drill presses, may require more than one collection hood to efficiently capture material released.

The employer should ensure that filter bags in dust-extracting systems used to remove asbestos from exhaust air are enclosed to prevent the escape of asbestos fibres. The filter bags should be:

- of a type that can be disposed of in a manner that does not place at risk the safety and health of people; and
- replaced immediately if damaged.

All joints in the ventilation system should be leak-proof to prevent the escape of asbestos fibres. After filtration, the exhaust air from the system should be discharged outside of the building. If this is not practicable, for example, with a portable system, the air should be passed through a HEPA filter before it is discharged. Exhaust ventilation equipment should be inspected regularly and tested for any possible malfunction.

10.7 General Ventilation

The most effective means of collecting dust and asbestos fibre is to remove it as close as possible to the source with a high velocity local exhaust system. Some material will inevitably escape into the workplace air and general ventilation should also be provided to limit the accumulation of airborne asbestos fibre. If natural ventilation does not provide a free flow of air through the area, forced ventilation should be provided to achieve at least 10 air changes per hour.

10.8 Cleanliness of Premises and Plant

The employer should ensure that cleaning of plant and machinery and other surfaces where asbestos-containing dust may accumulate is carried out regularly:

- by means of an asbestos vacuum cleaner;
- by wet cleaning; or
- by some other method which collects the dust without exposing people to it. Under no circumstances should dry sweeping or compressed air be used.

[55] http://www.safework.sa.gov.au/uploaded_files/hzs2.pdf (Accessed 30 January 2014)

10.9 Care and Housekeeping

The asbestos fibres that are hazardous to health are very small and invisible to the naked eye. The employer should ensure that employees are not placed at risk of inhaling asbestos fibres during any work processes and during clean-up and disposal of dust and waste.

All asbestos that is in a friable form and any loose asbestos must be kept in a closed receptacle when not in use. All receptacles that contain asbestos should be clearly labelled in accordance with Section 7 of these guidelines.

10.10 Protective Clothing

The employer should ensure that employees wear protective clothing such as overalls when working on any operation using materials containing asbestos. The style of garment is, to a large extent, determined by the operations undertaken.

The employer should provide separate storage for clothing not worn during work hours. Protective clothing contaminated with asbestos dust must be placed in an appropriately labelled plastic bag for laundering in accordance with Section 10 of these guidelines.

10.11 Respiratory Protective Equipment

Asbestos fibres in air levels should be controlled by the application of good work practices and effective ventilation. In some instances it may be necessary to use respiratory protective equipment for short periods when it is not practicable to maintain suitably low levels of asbestos fibres - for example, when the dust collection filters are cleaned. The employer should ensure that where respiratory protective equipment is used it complies with the requirements of Section 8 of these guidelines.

11.0 Instruction and Training

11.1 General

Persons carrying out asbestos removal work should be trained so they can carry out this work safely and without risk to their own health and others. This training must reflect the specific type of asbestos work to be undertaken.

All applicants for *a certificate of competence for restricted work* must have satisfactorily completed the following training:

- a minimum of two years' practical training under the supervision of an asbestos contractor;
- the health aspects and hazards associated with restricted asbestos work;
- the work practices to be followed in undertaking restricted asbestos work;
- the use, care and maintenance of respirators, vacuum cleaning and air extraction equipment;
- identification of products likely to contain asbestos;
- storage, labelling, transportation and disposal of asbestos; and
- dust concentrations, monitoring and clearance procedures.

This training must include information in the site-specific Asbestos Abatement Work Plan (refer to **Appendix A**), and specifically:

- safe work procedures;
- correct decontamination procedures;
- emergency procedures; and
- correct wearing and general maintenance of all PPE and RPE.

The asbestos contractor must also provide the following information to all their asbestos removal workers and to all applicants for employment as an asbestos removal worker:

- the health risks associated with exposure to asbestos;
- the need for, and details of, health surveillance, including medical and these guidelines.

The asbestos contractor should keep a written record of all training provided to each of their asbestos removal workers and ensure that these records are readily accessible.

11.2 Supervisory Personnel

The asbestos contractor must ensure that persons supervising the removal of asbestos-contaminated materials defined as restricted must carry a Certificate of Competency in such work from The Department.

The asbestos contractor must ensure that supervisory personnel have a detailed knowledge of the precautions and procedures outlined in these guidelines. With this knowledge and personal experience, the supervisory personnel should assume the following responsibilities:

- to effectively implement the total planned removal procedure;
- to perform the pre-removal setting up;
- to perform the actual removal and final cleaning operation;
- to ensure that all necessary measures are taken to reduce the airborne concentration of asbestos dust to the lowest practicable level;
- to ensure that asbestos fibres and asbestos-containing material do not contaminated adjacent areas;
- to arrange for, and assess results of, air monitoring where appropriate;
- to ensure that all workers under their supervision are adequately trained in the safe working practices outlined in these guidelines;
- to ensure that the removal is continually supervised and that the operation is carried out in a safe and proper manner in accordance with the precautions listed in these guidelines;
- to ensure that personal protective equipment is used and maintained in good condition;
- to ensure that the removal site is maintained in a clean condition, that waste is quickly and properly disposed of;
- to ensure personal hygiene procedures are continually observed;
- to maintain copies of all records;
- to establish decontamination procedures; and
- to arrange for the disposal or laundering of PPE and clothing.

11.3 Removal Personnel

The asbestos contractor must ensure that all removal personnel are properly trained in:

- safe removal procedures for the asbestos-contaminated materials they are working with (per the asbestos removal plan);
- hazards of exposure to asbestos and the controls intended to minimize their risk;
- the correct use, maintenance and storage of their personal protective equipment;
- the safe use of all plant and equipment they are required to use;
- monitoring procedures for the workplace;
- decontamination procedures; and
- emergency procedures.

The asbestos contractor may need to develop a Training Needs Analysis to identify specific areas that require behavioural improvement through training to improve performance.

Generally, most training (other than specialist training) can be given in-house so long as there are sufficient knowledge, expertise and resources available. Asbestos removal personnel should be sufficiently trained before they commence any removal activities. Removal personnel are required to undergo medical monitoring as outlined in Section 12 of these guidelines

11.4 Sampling/Testing Personnel

All persons undertaking asbestos sampling and/or testing must be competent to be able to undertake these tasks without any risk to their own safety and health.

Verification of competency to work in asbestos-hazard conditions would include experience and/or knowledge of:

- the varied types and applications of asbestos-contaminated materials (for sampling);
- hazards of exposure to asbestos and the controls intended to minimize their risk;
- the correct use, maintenance and storage of their personal protective equipment; and
- the safe use of all plant and equipment they are required to use.

This training would be over and above specific work training provided in relation to their task(s).

Further site-specific information must be provided to sampling/testing personnel by the asbestos contractor. Information on the type of instruction that should be given is provided in Sections 4.2 and 4.3 of these guidelines.

11.5 Refresher Training of Personnel

Retraining and/or refresher training should be given to all personnel who work with asbestos-contaminated materials to ensure that their knowledge remains consistent with current practices.

This is particularly important for those persons whose work with ACM is intermittent. Refresher training needs need to be assessed regularly.

In addition, refresher training can be used to:

- Impart new information such as legislative changes, improvements in work methods and technologies;
- Remind personnel of the risks of asbestos;
- Reinforce safe work practices such as removal techniques, decontamination etc. as identified in any Training Needs Analysis; and
- Provide examples of good practice in order to eliminate bad practices.

Refresher training (other than specialist training) can be provided in-house, provided sufficient knowledge, expertise and resources are available.

11.6 Waste Disposal Transporters

The asbestos contractor must ensure that the operators of transportation vehicles are properly trained in the correct:

- decontamination procedures for vehicular access to and from the asbestos removal area;
- operating procedures while in the asbestos work area to collect waste for disposal;
- requirements for the transportation of asbestos waste to the designated refuse site; and
- selection, use and maintenance of respiratory protective equipment.

11.8 Smoking

Employers should advise all people who work with asbestos to refrain from smoking in order to prevent the increased risk of lung disease.

11.9 Training in Maintenance of Control Equipment

The employer must ensure that any person carrying out any maintenance or servicing of exhaust ventilation equipment or other control equipment is trained to carry out the task.

11.10 Training in the Use of Respiratory Protective Equipment

All employees must be provided with training on the correct use and maintenance of RPE.

12.0 Medical Monitoring

12.1 Introduction

Employers are required to monitor the health of employees in relation to significant hazards. This section of the guidelines sets out some practicable steps to assist the asbestos contractor in complying with this requirement.

12.2 Initial Medical

Any employer directing employees to undertake restricted work with asbestos should ensure that the employee has:

- a full work history;
- a medical examination, chest X-ray (PA and lateral) and lung function tests (FEVI and FVC) or such other tests that may be appropriate within one month of starting employment in restricted work; and
- further asbestos medical checks as required in the schedule while the employee remains in the employment of the employer. The cost of the medical examinations must be the responsibility of the employer.

Notwithstanding these provisions, the NRCA may direct any person undertaking work involving asbestos to have a medical examination.

12.3 Personal Medical Information

The personal medical information, including X-rays, of the employee remains the property of that employee. The employer will receive certification from the medical practitioner stating whether the employee is fit or otherwise for the restricted asbestos work. The recommendation is that employees should share their medical information with their employer where appropriate. If an employee leaves, the employer should ensure that the employee is aware of the need to continue with the schedule of medical examinations. All medical records relating to asbestos should be retained by the employee for 40 years.

12.4 Medical Examinations[56]

Asbestos medical examinations must be performed by qualified medical practitioners with specialist qualifications in occupational or respiratory medicine and experience in asbestos-related diseases and conditions.

[56] Occupational Safety & Health Administration Regulations (Standards - 29 CFR) Medical surveillance guidelines for asbestos

12.5 Further Medical Investigations

The employer bears the responsibility and the cost of further investigations where, in the opinion of the NRCA, further investigations are warranted because of the presence of markers of asbestos exposure or disease.

APPENDIX I

Preparation of the Asbestos Abatement Plan

The Asbestos Abatement Workplan

All Asbestos Abatement Contractors are required to submit an Asbestos Abatement Work Plan to be approved by the National Environment and Planning Agency (NEPA) and the Ministry of Health, prior to the commencement of any abatement activity. The Plan should be prepared according to the Guidelines for the preparation of an Asbestos Abatement Work Plan:

The Work Plan should contain, but not be limited to the following:

1. Identification:
   a. Details of asbestos to be removed (e.g. the locations, whether asbestos is friable/non-friable, its type, condition and quantity being removed)

2. Preparation:
   a. Consult with relevant parties e.g. workers; person who commissioned the removal work
   b. Assigned responsibilities for the removal
   c. Program commencement and completion dates
   d. Emergency plansf
   e. Asbestos removal boundaries, including the type and extent of isolation required and the location of any signs and barriers
   f. Control of other hazards including electrical and lighting installations
   g. PPE to be used

3. Removal:
   a. Details of air-monitoring program; Control and clearance
   b. Waste storage and transportation program
   c. Details of Method for removing the asbestos (wet and dry methods)
   d. Asbestos removal equipment (e.g. spray equipment, asbestos vacuum cleaners, cutting tools)
   e. Details of required enclosures, including their size, shape, structure etc, smoke testing enclosures and the location of negative pressure exhaust units
   f. Details on temporary buildings required by the asbestos removal workers (e.g. decontamination units) including details on water, lighting and power requirements, negative pressure exhaust units and the locations of decontamination units
   g. Other risk control measures to prevent the release of airborne asbestos fibres from the area where asbestos removal is undertaken

4. Decontamination:
   a. Detailed procedures for workplace decontamination, the decontamination of tools and equipment, personal decontamination and the decontamination of non-disposable PPE and RPE

   b. Method of disposing of asbestos wastes, including details on:
   c. The disposal of protective clothing
   d. The structures used to enclose the removal area

5. Relevant Consultation:

- Consult with any people who may be affected by the removal work, including neighbours

APPENDIX II

Asbestos Abatement Post-removal Report

Asbestos Abatement Post-Removal Report

The asbestos contractor is required to submit to NEPA an Asbestos Abatement Post-removal Report within five (5) days of the completion of the abatement exercise unless otherwise stipulated by the NRCA.

The Post-removal Report should include, but not be limited to, the following information:

- Results of analyses of air samples and an interpretation of the results
- Final clearance of abatement work area
- Details of ACM storage (inclusive of location of disposal site and any approvals of same)
- Any anomalies that may have occurred during the abatement exercise

Example Waste Manifest

(A different form could be used, so long as it contains (A) sufficient elements to show what, when and where the waste was generated; what it will be contained in; where it is intended to go; (B) who is transporting the waste; (C) who receives it, where and when; and (D) the signature of a responsible person for the Generator of the waste:

Part A – To be completed by the GENERATOR

Source Site Location GPS coordinates, address or other location descriptor:	

Origin of waste:								Receiver use only (Part C)				
Waste description (use attachment(s) as necessary)	Waste type	Hazard	Container		Quantity shipped	Units, e.g. tonnes	Handling/ disposition	No. containers received	Container type	Quantity received	Units	Handling/ disposition
			No.	Type								

Generator additional information (e.g. condition of container)	

Intended receiver: Company / Waste Management Facility / Third Party Facility
Include facility (company) name, full address, telephone number and name of contact individual

Certification	I declare that the information I have provided in Part A is correct and complete.	
Name (print):	Signature:	Date (DD/MM/YY):
Telephone:	Fax:	24-hr Emergency

Generator's address: (this is the address to which the Receiver is to send the Waste Manifest)

Part B – To be completed by TRANSPORTER

Name of Transporter (Include company name, full address, telephone number and name of contact individual):

Certification	I declare that I have received the wastes as described in Part A for delivery to the Intended Receiver and that the information in Part B is correct and complete.	
Name (print):	Signature:	Date (DD/MM/YY):
Telephone:	Fax:	24-hr Emergency

Part C – To be completed by RECEIVER

Date received (MM/DD/YY):	Intended receiver? (see Part A) Yes No	

Receiving location: Company Waste Management Facility Third Party Facility
include facility (company) name, full address, telephone number and name of contact individual

Receiver additional information: e.g. condition of container, requirement to return empty containers

Certification	Except for the irregularities/discrepancies noted above, I declare that I have received the wastes as described in Part A and that the information in Part C is correct and complete.	
Name (print):	Signature:	Date (DD/MM/YY):
Telephone:	Fax:	24-hr Emergency

Part D – Completed form to be completed by GENERATOR

Name of Authorized Person (print):	Signature:	Date (DD/MM/YY):