SFG2842 V1

MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT

PROJECT MANAGEMENT UNIT

HCFC Phase-out Project (Stage II)

GENERIC ENVIRONMENTAL MANAGEMENT PLAN

(For Air Condition Manufacturing Sector)

November, 2016

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List of Abbreviations

AC	Air Conditioners
ASME	American Society of Mechanical Engineers
CAS No	Chemical Abstract System Number
CFC	Chlorofluorocarbons
CO_2	Carbon dioxide
dB	Decibel
EC	European Country
EHS	Environmental, Health and Safety
EMP	Environmental Management Plan
Ex	Explosive / explosion
GHG	Greenhouse Gases
GHS	Global Harmonized System
GWP	Global Warming Potential
HCFC	Hydro chlorofluorocarbons
HPMP	HCFC Phase-out Management Plan
IEC	International Electrical Code
LEL	Lower Explosive Limit
MLF	Multilateral Fund
MOLISA	Ministry of Labor, Invalids and Social Affairs
MOIT	The Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MSDS	Material Safety Data Sheet
MT	Metric Tons
NEC	National Electric Code
NFPA	National Fire Protection Association
NOU	The National Ozone Unit
ODS	Ozone-Depleting Substances
OHS	Occupational Health and Safety
PLC	Programmable Logic Controller
PMU	Project Management Unit
SME	Small and Medium-size Enterprises
SOP	Standard Operating Procedures

1. Objective and Structure of Generic Environmental Management Plan

This Generic Environmental Management Plan (EMP) is prepared for the air-conditioning sectors as the guidelines for the owners of air-conditioning sub-projects to prepare their specific EMP, which identifies the principles, approach, procedures and methods that could be used to control and minimize the environmental and social impacts of all construction and operational activities associated with the project.

The sub-project owners can use the template site-EMP in Annex 2 and information in the Generic EMP to prepare their site EMP for each specific case.
The Generic EMP is structured as follows:

- An overview of the project description is provided in section 3.
- HCFC Phase-out activities for air- conditioning in section 4.
- General introduction of alternative technology in section 5.
- Legal and regulatory framework requirements in section 6.
- Overview of environmental and social impacts and mitigation measures in section 7.
- Proposed measures for handling and Safety Operating of HFC-32 and HC290 in section 8.
- Estimated Budget for Mitigation Measures in section 9.
- Institutional Arrangement Organizations in section 10.
- Environmental and Safety Monitoring Requirements and Monitoring Plan in section 11.
- Training Plan in section 12.

The Generic EMP also contents the 9 annexes of which:

- Annex 1 is the Environmental Code of Practice (ECOP) for Small Civil Works to help enterprises manage small environmental impacts during construction if any.
- The sub-project owners can use the Annex 2 – template site- EMP and the Annex 3 - Outline of Measures on precautions and chemical emergency response to prepare the site-EMP and the chemical response reports;
- The typical air-conditioner manufacturing in Annex 4 and its risk in Annex 5 and the safety data sheet of used gases in Annex 6 will provide the information and guidance for site-EMP preparation;
- The Annex 7 and Annex 8 provide the guidelines on Area Classifications for the Design of Production Line Use Flammable Gas and Oxygen-Propane Brazing Safety; and
- The Annex 9 summaries the results of Stakeholder Consultation for Environmental Management Plan of the Air-conditioning Sector.

2. Project Description

Vietnam became one of the Bank's first two partner countries to receive approval of Stage II HCFC Phase out Management Plan (HPMP) funds at US$14.64 million by the Multilateral Fund for the Implementation of the Montreal Protocol (MLF) in May 2016. Vietnam is to reduce HCFC consumption by 35% of its baseline by 2020 in the three remaining manufacturing sectors, residential air-conditioning (AC), refrigeration and foam, as well as in the servicing sector. It agreed to a total elimination of HCFCs in the AC sector and in imported pre-blended polyols by January 1, 2022. The total phase-out of HCFC-22 and HCFC-141b in imported pre-blended polyol agreed to be achieved under the Stage II project would be 1,005.6 MT (55.31 ozone depleting potential (ODP) tons) and 684 MT (75.26 ODP tons)[1] respectively. Japan will join the Bank as a "cooperating agency" to specifically provide technical assistance to the AC sector through its

[1] Remaining HCFC-141b consumption that is eligible for MLF.

refrigeration and AC industry association (JRAIA). The Stage II project is a continuation of the ongoing Stage I project and the project duration is expected to be from 2017 to 2022. The project consists of three proposed components described below.

Component 1: HCFC Consumption Reduction (US$ 13.56 million)

AC manufacturing and servicing sector. The project will finance incremental capital costs (ICC) needed for converting to non-HCFC based AC production including procurement of new production equipment, performance testing of new AC models, and technician training for installation and servicing, and incremental operating cost (IOC) based on MLF financing guidelines at four enterprises (consuming a total 175 MT of HCFC-22 in 2014). After conversion at the four enterprises, no HCFC-22 will be used for AC production in the entire sector, i.e. 251 MT of HCFC-22 will be completely phased out. The approved funding is US$2.18 million. The lower GWP alternatives to HCFC-22 in the AC sector are HFC-32 with a GWP 675 or R-290 with a GWP of 5, however both are flammable which will require special safety precautions and investments.

Due to its classification as an A2L refrigerant, mildly flammable refrigerant, HFC-32 requires that certain measures be put into place before its wider use in Vietnam, including in manufacturing. Technical assistance (TA) will be needed specifically for effective adoption of this technology. Given its recent experience in this area including related to HFC-32 regulation, Japan has been approved under the MLF to provide TA as the Cooperating Agency while drawing practical expertise from Japanese AC manufacturers through JRAIA. TA activities are proposed at a total cost of $233,630: development of A2L policy measures, TA to the AC manufacturers, and TA for good practice in installation and operation. An additional 66.3 MT in HCFC-22 phase-out is expected from the AC servicing and Japan TA activities.

Refrigeration manufacturing sector. The project will finance conversion of priority industrial refrigeration systems where cost-effective and low global warming potential (GWP) alternatives (e.g. ammonia, hydrocarbons, HFC-32, etc.) are available through ICC (for system, component and process redesign, new equipment, performance verification, and safety training) and IOC at about 34 enterprises which are eligible for MLF funding.[2] Approved funding is US$3.64 million. A reduction of 303 MT will be achieved by project closing. The implementation of HCFC phase-out in the refrigeration sector will be phased, whereby 6-10 demonstration subprojects for applications including ice making units, stand-alone refrigeration units, cold storage rooms, and condensing units will be started at the beginning of the Stage II project. As soon as a body of experience has been accumulated, the knowledge will be used by experts to inform remaining companies.

Refrigeration servicing sector. The project will finance the following activities in the refrigeration servicing sector: training and certification in good servicing and maintenance practices, provision of servicing tools to selected vocational training centers to enable training in the handling of alternative flammable refrigerants and to selected servicing shops to inform the sector on alternatives and prepare for Stage III, TA demonstration for 10 selected industrial refrigeration end users on HCFC leakage management. The approved funding is US$1.37 million for an HCFC-22 phase-out impact of 285.3 MT.

Foam sector. The project will finance ICC needed for foam production conversion to

[2] Companies established before September 2007, the ExCom's cut-off date for determining total eligible funding. A total of 71 refrigeration manufacturing enterprises were identified during the 2015 survey.

hydrocarbon, methyl formate or hydrofluoroolefin (HFO) alternatives at about 44 enterprises. After completion of conversion at these enterprises, it will be prohibited to use HCFC-141b contained in pre-blended polyol for foam production in the whole sector. About 2035 MT of HCFC-141b will be completely phased out. In order to allow small and medium-sized enterprises (SMEs), which consumes less than 20MT of HCFC-141b, to convert to non-HCFC production in a cost-effective way, the project will also finance upgrading of two to four system houses to be competitively selected among existing foam producers or chemical suppliers that have established the basic system house infrastructure. These system houses would supply non-HCFC pre-blended polyol to SMEs. In addition, the project will finance conversion at an enterprise which used HCFC-22 of 100 MT in 2014 for XPS foam production. The approved funding for HCFC-141b phase-out and HCFC-22 phase-out in the foam sector is US$5.52 million and US$613,568 respectively.

Implementation in the foam sector will also be phased due to the limited funding approved in contrast to the large amount of HCFCs used. The largest consumer of pre-blended HCFC-141b polyol systems in Vietnam is the insulated roofing panel manufacturing industry. This subsector is made up of primarily SMEs in real terms. Therefore, four demonstration projects including establishment of system houses for the roofing subsector will be initiated first at the beginning of the Stage II project.

Component 2: Technical Assistance and Policy Actions (US$ 406,801)

This component aims to support sector-wide technology and knowledge transfer, TA and exchange of best practices, as well as to create a policy and market environment that will enable and sustain sector transformation. TA activities focusing on the AC, refrigeration and foam manufacturing sectors will include training workshops on subproject preparation, approval and implementation procedures and requirements, international and national technical consultant services for subproject appraisal and technical support for the Project Management Unit (PMU) and enterprises, development of technical standards of alternatives, training for government officials, training on the safe use of alternatives, study tours on HCFC alternatives, a joint study on integrating HCFC phase-out and energy efficiency (EE) improvement in the industrial refrigeration manufacturing and food process sectors, and others as needed.[3]

On policies, this component will cover the annual HCFC import quota issuance and the development and issuance of sector-specific policy and regulations by project completion, including a ban on local production and import of HCFC-22 based ACs, and a ban on import and use of pre-blended HCFC-141b polyol in foam production.

Component 3: Project Management (Estimated US$ 678,001)

The PMU currently implementing the Stage I HCFC Phase-out Project will most likely continue with financial, procurement, and safeguard management as well as monitoring and reporting responsibility. This component will finance the PMU staff including one project coordinator, two project officers, one procurement officer, one accountant and one administrative officer, project launch and completion workshops, financial audits, annual HCFC consumption verification, public awareness activities, and incremental operating cost (of the PMU).

3. HCFC Phase-out Activities for Air-Conditioning Sector

[3] TA for the AC and refrigeration servicing sector is included in Component 1 as it results in HCFC phase-out impact.

In phase II, Five AC enterprises that currently use HCFC-22 in the production of air-conditioners were identified. Therefore, the target of HCFC-22 phase out is about 251 MT (Table 3.1).

Table 3-1: AC Manufacturing in Vietnam: 2013 -2014

Company Name	Year Est.	Trade Name	Refrigerant Used	Output		HCFC-22 in MT	
				2013	2014	2013	2014
Hoa Phat Refrigeration Engineering Co., Ltd	2001	Funki	HCFC-22	30,430	40,816	38.7	46.55
MIDEA*	2006	Midea	HCFC-22	120,329	152,827	88	90
Nagakawa	2002	Nagakawa	HCFC-22	16,100	17,400	26	28
Refrigeration Electrical Engineering (REE) JSC	1999	Reetech	HCFC-22	3,000	3,000	10	10
LG	1995	LG	HCFC-22	69,426	97,818	53	76
Total				**239,285**	**311,861**	**216**	**251**

*****Midea also manufactured R-410 AC for export to the Philippines since 2012. In 2014, it produced 50,000 units.

Investment activities will aim at converting the four eligible AC manufacturers which are 100% Vietnamese or China owned (Midea). HFC-32 has been selected by REE, Hoa Phat and Nagakawa as an alternative to HCFC-22. As these companies also make larger size units over 36,000 Btu, they require a refrigerant that can be eventually used over a larger size range and want to avoid having their production based on more than one alternative. HFC-32 has been introduced by Daikin, Japan as a lower GWP alternative to both HCFC-22 and R-410A. As the refrigerant charge size can be reduced to 64% of HCFC-22 units with same cooling capacities, the actual GWP impact is lower than it would be with R-410A which can lead to an 80% reduced charge size.

As HFC-32 is classified by ASHRAE as an A2L gas (limited flammability), restrictions on charge sizes (and cooling capacities) may apply due to safety concerns. HFC-32 has been adopted as an alternative refrigerant to R-410A in Japan and the Thai and Indonesian industry is also in the process with MLF funding. MLF support is requested to cover the incremental cost of converting the HCFC-22 based AC models and manufacturing lines to HFC-32 in Vietnam, as well as for training of technicians for installing and servicing HFC-32 AC. One Japanese company is making its basic patent on HFC-32 available to all, and has provided technical support companies in Thailand and Indonesia. In addition, this company is already supplying HFC-32 ACs to Vietnam and to this, developed a temporary standard for use in Vietnam. Through Japan and its refrigeration and air-conditioning industry association (JRAIA), technical support will be sought by Japanese industry to assist the three enterprises to be converted to HFC-32.

HC-290 has been selected by MIDEA, as its mother company, MIDEA China, has converted one or more AC manufacturing lines to HC-290, it is expected that MIDEA China will provide the HC-290 patents free of charge and be able to provide compressors and heat exchangers for HC-290 air conditioner production to MIDEA, Vietnam. HC-290 is classified as an A3 substance by ASHRAE and there are therefore tighter restrictions on charge sizes (and cooling capacities) due to safety concerns. It is also expected that MIDEA, China will make available their training manuals and guidelines for installation and servicing of HC-290 similar to what Japanese industry offered for HFC-32. A comparison of HCFC-22, HC-290 and HFC-32 physical properties are provided below.

Table 3-2: Comparison of HCFC-22, HC-290 and HFC-32 Physical Properties

Physical properties	**HCFC-22**	**HC-290**	**HFC-32**
Flammable	No	A3	Yes, A2L
Flash point (C)	NA	-104	Not available
LEL-UEL	NA	1.8%-8.4%	12.7%-33.4%
GWP	1810	<25	650
Molecular weight	86.47	44.1	52.03
Heavy than air		1.6 times	3.82 times
Boiling point (C)	-40.8	-42.1	-51.7
Critical temperature (C)	96.2	96.7	78.45
Critical pressure Mpa	4.99	4.2	5.808
Specific heat of Liquid (KJ/(Kg*C)	0.31	2.75	2.35

Details in the Annex 6.

4. General Introduction of Alternative Technology

The typical Air conditioner Production line is presented in Annex 4, which is based on observation made during site visit and the document provided from the air conditioner factories who are participating in the program to phase out HCFC-22 to HFC-32 and HC-290.

As HFC-32 is flammable, safety requirement and worker safety will dictate the changes needed for safe production and testing of ACs with flammable refrigerants. As HFC-32 has much higher pressure than HCFC-22, it might demand changes of charging equipment and some procedures as following:

- Redesign the process, manufacture the prototype and test them;
- Modify the assembly line such as: change the high – pressure pump, equip handheld leak detector, test pressure and drying;
- Inspect quality and testing;
- Issue the certification;
- Process, operation maintenance and safety training; and,
- Provide technical assistance from external experts.

HFC-32 refrigerant has at given saturated temperature approximately 60% higher pressure (for example at 55°C condensing temperature 33 bar (g) for HFC-32 compared with 21bar (g) less for HCFC-22), which requires on high pressure side a 60% higher burst pressure of compressor shell, condenser, accumulator, filter-dryer and high pressure copper tubes to be reached by thicker walls; the pressure differential is similar.
HFC-32 compressors use synthetic POE, which is highly hygroscopic. It absorbs moisture quickly and once absorbed, the moisture cannot be removed through the system evacuation. Therefore, it is important to prevent moisture from getting into the POE oil in the first place. The cooling circuit elements, evaporator, condenser and tubes must by dried by dry Nitrogen before inserting them into the circuit.

HC-290 refrigerant has chemical characteristic similar to HCFC-22. The main concern is the

flammability of HC-290. The low explosion level (UEL) is only 2.37vol% against for HC-290 compared to HFC-32 with the UEL of 12.7vol%. The Table below summarizes the key changes for both technologies.

Table 4.1 Modifications Needed for HFC-32 and HC-290 to Replace HCFC-22

Modifications Needed	**HFC-32**	**HC-290**
System Redesign	Due to the different thermodynamic performance and flammability of HFC-32 and HC-290 compared to HCFC-22, the overall system, components and process would need to be redesigned for the use of HFC-32 and HC-290. The redesign work will include design and calculations, simulation, reengineering of the system components, such as compressors, expansion valves, heat exchanger, unit structure, electrical systems, prototype manufacturing, test runs, compilation of production process. Testing of prototypes would be needed during the model development. Documentation in form of drawings, specifications and complete bill of materials need to be developed for each model.	
Heat Exchanger Processing	Due to the lower charge and higher pressure with the alternative refrigerant, the finned tube heat exchanger design will need to be changed. Accordingly the finned tube punch dies and tube expander will need to be changed. The tube straightening/bending machine (fin threading) will need to be modified. A new brazing line for the heat exchanger suited for the alternative refrigerant will need to be introduced.	The changes to the heat exchangers will have to be based on the specific design of the AC units to ensure that the performance of same size ACs would be at least similar to the HCFC-22 based ACs. The changes might be smaller for HC-290 compared to HCFC-22.
Sheet Metal Processing	The sheet metal processing dies will need to be changed, including dies for end-plate hole punching and dies for end-plate rim bending and dies for rim bending.	Changes would be needed as for HC-290 and would depend on the final design of the units.
AC assembly line	Due to the flammability of HFC-32, the charging area will need to be isolated, with adequate ventilation, fire safety and alarm systems and explosion-proof fittings. The existing charging and evacuation equipment will need to be changed. The existing Halogen leak detectors cannot be used with HFC-32, because it contains no Halogen. Therefore Helium leak detectors will need to be introduced.	As HC-290 is classified as A3, significant changes is needed to ensure safety during assembling, charging and performance testing. Leak testing equipment would be needed. In addition, gas leak detectors and ventilation is needed in the production area to prevent built up of explosive concentration of HC-290.
Storage of refrigerants	HFC-32 is a flammable chemical and has to be stored and used consistent with national safety requirements. HFC-32 will have be stored outside	HC-290 is a flammable gas and will have to be stored in accordance with national safety requirements for storage hydrocarbons. I.e. outside the building.

	the production area, preferable outside the building and connected to the charging area through a piping system, including a transfer pump.	The storage tank would have to be connected to the charging unit through a piping system, including transfer pumps.
Quality inspection, testing and finishing	The safety inspection of electrical systems will need to be enhanced by introducing appropriately sensitive devices with protective features. The inspection area will need to be isolated with adequate ventilation, fire-safety and alarm systems and explosion-proof fittings. The existing test rig for HCFC-22 based products will need modifications such as test room ventilation and fire-safety, high-pressure sensor and sensor for monitoring refrigerant concentration levels.	
Prototype manufacturing, trials and testing	A pilot-level quantity of the selected models will need to be subjected to prototype production, trials and testing to establish the process and fine-tune as needed and establish product performance through testing. The results would be fed back into the process and product design, to ensure smooth conversion	
Product certification	As per the Vietnam regulation, any AC model put on the market must be tested and certified. Each unit must be labelled showing its star rating, name of producer etc. In the case of use of flammable	
Process and safety training	Process and safety training for both HFC-32 and HC-290 will need to be provided to the manufacturing, installation and maintenance personnel on alternative properties and handling, applications and safety precautions, process adjustments, installation and calibration of dies and on operating parameters, product operation and performance, installation, calibration and maintenance protocols and safety precautions.	
Installation and servicing of ACs	Due to the flammability of both HFC-32 and HC-290, all installers would need to be retrained to ensure that they are fully equipped to install and maintain HFC-32 ACs. They would also need to have new tools approved for use when working on units containing flammable gasses.	
Promotion and Sales of AC	Introduction of HFC-32 HC-290 will be a challenge. Brochures and sales catalogues would need to be changed. Special effort would be needed to marketing HFC-32 based ACs.	
Technical assistance	Technical assistance through JRAIA will be provided throughout the conversion process for various aspects of the conversion, such as component specifications and selection, technical and regulatory aspects, technical inputs for procurement, etc.	Technical assistance from China, MIDEA will be provided throughout the conversion process for various aspects of the conversion, such as component specifications and selection, technical and regulatory aspects, technical inputs for procurement, etc.

5. Legal and Regulatory Framework Requirements

5.1 Relevant International legal documents

- The Vienna Convention for the protection of the Ozone Layer and it's the Montreal Protocol on substances that deplete the Ozone Layer as well as the London (1990), Copenhagen (1992), Beijing (1997) and the Montreal (1999) Amendments to the Protocol.
- The Agreement between Government of Vietnam and the Executive Committee of the Multilateral Fund for the implementation of the Montreal Protocol for the Reduction in Consumption of HCFCs.

- The Trust Fund Grant Agreement between Vietnam Government and The International Bank for Reconstruction and Development (The World Bank) for the implementation of Vietnam National HCFC Phase-out Management Plan Stage I that was approved by the Executive Committee of the Multilateral Fund.

5.2 National laws and regulations

National law and regulations listed below should be applied for the environmental management of the conversion to HCF-32 and HC-290 in the air-conditioning manufacturing enterprises.

Table 5-1: Relevant National Laws and Regulations

National Laws and Regulations	Effective Date	Remarks to enterprises
Regulations on Environment and Safety		
Law on Environment Protection No 55/2014/QH13 dated 23 June 2014	01/01/2015	Change on EIA Requirement
Decree No. 18/2015/ND-CP dated 14 February 2015 by Government, providing details regulations on environmental protection plan, strategic environmental assessment, environmental impacts assessment and environmental protection plan	01/04/2015	Enterprises required to prepare the EIA/EMP should follow new Decree.
Decree No. 19/2015/ND-CP dated 14 February 2015 by Government on implementation guidance for environmental law	01/04/2015	
Circular No. 27/2015/TT-BTNMT dated 29 May, 2015 by MONRE on guidance of implementation of Decree No.18.	06/2015	Enterprises required to prepare the EIA/EMP should follow new Circular
Circular 36/2015/TT-BTNMT dated 30 June 2015 on hazardous waste management		Public the hazardous waste owner registration book
Decree No.38/2015/ND-CP on Management of Waste and Discarded Materials		Management of hazardous waste
National Technical Standard QCVN 07: 2009 on thresholds of hazardous waste		
Circular No 48/2011/TT- BTNMT dated 28 February 2011 on the Environment Management and Protection at industrial Zones		Refer on changes of waste management and EIA approval for enterprises located in industrial zones
Decree No. 179/2013/ND-CP on the Sanction of Administrative Violations in the Domain of Environmental Protection		Maximum fine of 01 billion VND for individuals and 02 billion VND for organization
Law on occupational safety and hygiene No.84/2015/QH13 dated 25 June 2015		Regulate safety and hygiene conditions applied for all enterprises and individual worker
Regulations on chemicals		
Chemical law No. 06/2007/QH12 dated 21 November, 2007	01/07/2008	

National Laws and Regulations	Effective Date	Remarks to enterprises
Decree No. 108/2008/ND-CP dated 07 October, 2008 by Government on implementation of chemical law	05/11/2008	
Decree No 26/2011/ NĐ-CP dated 8 April 2011 on the modification of the Decree 108/2008/ND-CP on the implementation of the Law on Chemicals	01/06/2011 Appendix IV and Appendix VII	HFC-32 (75-10-5) is the chemical No.1050 and HFC-290 (74-98-6) is the chemical No. 1040 in the list of chemicals which require the measures on precautions, chemical emergency response (Appendix VII)
Circular No.04/2012/BCT dated 13 February 2012 on classification and labels of chemicals	30/03/2012	
Circular No. 20/2013/TT-BCT dated 5 August, 2013 on the implement of Decree No.26/2011 and regulation of plans and measures on precautions, chemical emergency response for industrial sectors	15/10/2013	According to Article 12, chapter 3, the enterprises need to prepare the measures and submit to Department of Industry and Trading for approval
TCVN 5507:2002 – Hazardous chemical – Safety regulation in production, trade, utilization, storage and transport		
Regulations on fire prevention and protection		
Law on fire prevention and protection No. 27/2001/QH10 dated 29 June 2001	04/10/2001	All articles, fire prevention and protection
Decree No. 35/2003/ND-CP dated 04 March 2003 by Government on implementation of the Law 27/2001/QH10 on fire prevention and protection		
Law No.40/2013/QH13 dated 22 November, 2014 on amended law of fire prevention and protection	01/07/2014	
Decree No.79/2014/ND-CP by Government on implementation of amended laws	31/07/2014	
Circular No 11/2014/TT- BCA of the Ministry of Police on Fire prevention and protection dated 12 March, 2014 on detailed regulations in Decree No. 35/2003/ND-CP dated 04 March 2003, Decree No. 46/2012/ND-CP dated 22 May 2012	12/03/2014	Enterprises should prepare the Fire prevention and protection document following the PC-10 template mentioned in this circular
Circular No. 66/2014/TT- BCA of the Ministry of Police on Implementation of Decree No. 79/2014		
TCVN 3890:2009 on fire prevention and fight equipment for house and structures – Equipment, installation, inspection and maintenance		

National Laws and Regulations	Effective Date	Remarks to enterprises
Law on Standards and Technical Regulations of Vietnam No. 68/2006/QH11 dated on June 29, 2006, ratified by 11th National Assembly of Vietnam Socialist Republic	Applicable standards/national technical regulations	

Applicable National Technical Guidelines/Standards

QCVN 07:2009/BTNMT: National technical regulation on hazardous waste thresholds.

National Technical Standard TCVN 5507: 2002 regarding Hazardous chemicals – Code of practice for safety in production, commerce, use, handling and transportation.

Discharge, emission, and Waste management shall meet minimum requirement as stated on the QCVN 06:2009/BTNMT; QCVN 07:2009/BTNMT, QCVN 14:2006/BTNMT; QCVN 40:2011/BTNMT, QCVN 08-MT:2015/BTNMT requires that the licensed factories shall always comply with the established standard for discharging waste and emitting pollution.

In general, air conditioner production processes do not generate waste water and emission of air contaminants directly except the factory that has pre-treatment process of the metal parts for powder coating. In the air-conditioning factory that has waste water from metal cleaning pits, must ensure the quality of discharged effluent always within the limits.

There are regulations on management of waste and discarded material (Decree No.38/2015/ND-CP) and hazardous waste management (Circular 36/2015/TT-BTNMT) on guidance for transportation, storage, handling and disposal of chemical and hazardous substance packages (TCVN07:2002).

Law on Occupational Safety and Hygiene (2015)

- Occupational Safety, Health Law 2015.
- Ministerial Regulation of Occupation Safety, Health, biliteral circular No.14/1998/TTLT-BLDTBXH-BYT-TLDLDVN dated 31 October 1998 Section 2, Item 2.1 General, roles and responsibilities of appointed safety officers.
- Ministerial Regulation of Occupation Safety, Health, biliteral circular No.14/1998/TTLT-BLDTBXH-BYT-TLDLDVN dated 31 October 1998 also promulgates the reporting employee accident, injury/illness and lost.
- Ministerial Regulation of Occupation Safety, Health, biliteral circular No.14/1998/TTLT-BLDTBXH-BYT-TLDLDVN dated 31 October 1998 promulgates the preparation and implementation of occupational safety plan

This law is empowered by the 13th National Assembly (No.84/2015/QH13) to make sure that industrial sector in Vietnam are built their factory building and utilities, install machineries and equipment, operate their production in a way that causes no harm to workers, community and environment. To achieve that general aim, the authority uses their power through the process of granting licenses to the enterprises.

Electrical system inspection and maintenance

Depending on technical requirements and installed equipment, enterprises have to comply with QCVN 01:2008/BCT on electrical safety of MOIT. There are series of regulation on electrical safety which the enterprise should take into account such as: QCVN QTĐ 5:2009/BCT, QCVN QTĐ 6:2009/BCT, QCVN QTĐ 7:2009/BCT, QCVN QTĐ 2:2008/BCT. There is notification on occupational safety related on electrical equipment issued by Ministry of Labor, Invalids and Social Affairs in QCVN 12:2012/BLĐTBXH.

Fire precautions and preventions

Law on fire prevention and protection No. 27/2001/QH10 and No.40/2013/QH13.

National Technical Regulations QCVN 06:2010/BXD by Ministry of construction regarding fire safety prevention for buildings and structures.

National Technical Standard TCVN 3890:2009 regarding Fire Prevention and Protection Equipment for buildings and structures – arrangement, check and maintenance.

National Technical Standard TCVN 5760 regarding Fire Prevention and Protection System – General requirement on design, installation and utilization.

National Technical Standard TCVN 5507: 2002 regarding Hazardous chemicals – Code of practice for safety in production, commerce, use, handling and transportation.

National Technical Standard TCVN 2662: 1995 regarding Fire Prevention and Protection for Buildings and Structures – Design Requirements

Emergency response

Where required, HC-290 and HFC-32 are classified as hazardous substances, manifests or registers shall be established and shall comply with legislative requirements issued by the Department of Industry and Trading and Department of Natural Resources and Environmental. The plans or measures for chemical precautions and emergency response should be submitted to and approved by Department of Industry and Trading before commissioning as regulated by the Decree No.26 and Circular No.20/BCT. First aid requirements shall be assessed, and the first aid system shall be appropriate to the operational risks.

5.3 WB Policies and Other Guidelines

Of the 10 safeguards policies of the Bank, Environmental Assessment OP 4.01 is triggered and probably OP 4.12 (in few specific case if the resettlement is needed).

In addition, the World Bank Group Environment, Health and Safety Guidelines (EHS) and the ISO 817:2014 on Refrigerants – Designation and safety classification, are recommended to follow to address safety requirements associated with the hydrocarbon technology.

5.4 Stakeholder Consultation and Public Disclosure

The Project Stakeholder Consultation of Environmental Management Plan (EMP) for the Air-conditioning (AC) Sector under HCFC Phase out Project stage II was organized at 2 rounds

such as: (i) be consulted by surveyed enterprises during the Bank due diligent; and (ii) the stakeholder meeting hold at meeting room of the World Bank on 17 November, 2016.

The first consultancy, aimed at exploring the potential risks and challenges for converting the refrigerants, was addressed during the due diligent mission of the World Bank team from 6 to 10 November, 2015; 26 January, 2016, and from 12 **August to 16 September, 2016.** There were 9 participants from relative agencies attending this consultation, including Phuong Nam, SAREE, REE, Midea, Metero, Darling, Ngo Long, 6M, VietTrust meeting.

The main objective of the second stakeholder consultation meeting was to present the content and goal of the EMP for AC manufacturers comprising of general risk assessment for AC sector, local regulations applicable for the AC enterprises, local regulations specific for HFC-32 and HC-290 refrigerant and proposed mitigation measures for the conversion from HCFC-22 to HFC-32 and HC-290 refrigerants. More details of the consultation and stakeholders recommendations are provided in Annex 9.

All the comments from stakeholders was included in the final generic EMPs, which was disclosed on the website and office of the Bank, PMU and enterprises after 18 November, 2016.

Due diligence: A due diligence review of Environmental and Social Safeguard on occupational health and safety measures, fire and exposure risk will be conducted during the commission of subprojects and the early operation phase by the PMU. The Bank team will also selectively visit some subprojects to carry out safety and environmental review as well to ensure the full EMP implementation.

6. Overview of Environmental and Social Impacts and Mitigate Measures

In general, many major air conditioning manufacturers have determined that HFC 32 is the optimum choice for use in their products due to its advantages such as following:

- Zero Ozone Depletion
- 1/3 GWP of HCFC-22
- Superior energy efficiency
- High refrigeration capacity & thermal conductivity
- Low pressure drop
- Single component refrigerant easy to handle and recover
- Low toxicity
- Readily available (R32 is used in the manufacture of HCFC-22 which is a blend of 50% R32 & 50% R125)

There have been a number of performance comparison made between HC-290 and HCFC-22 which indicates that HC-290 has 2-9% higher efficiency and lower recharge levels (approximately 0.10-0.15 kg/kW of cooling capacity), and miscibility with mineral oils (synthetic lubricants are not required), reduced compressor discharge temperature and improve heat transfer due to favorable thermo-physical properties.

6.1 Potential Environmental and Social Impacts

The main environmental and social impacts of the phase-out of CFC for AC production due to change the refrigerants to HCF-32 and HC-290 are including:

a) **Social impacts:** The four AC enterprises have existed and operated and have no

requirement for relocation or land acquisition. In case of future relocation to industrial zone, the Bank will review when and how the land was acquired or being acquired for the Industrial Zone and the enterprise relocation plan at the preparation stage of sub-projects. For each sub-project which require involuntary resettlement, if the land has been acquired before the grant agreement is signed, a due diligence review of the land acquisition process will be undertaken by the Bank team to confirm whether there is any legacy issues. A Resettlement Policy Framework has been prepared to guide relocation and potential land issues if any during preparation of the subproject proposals (during the overall project implementation stage).

b) **Ozone depletion potential (ODP)**: The phase-out by the project of HCFC as blowing agent will contribute positively to the recovery of the ozone layer. HCFC-22 has ODP of 0.055 compared with zero value of HFC-32 and HC-290s. In phase II, project is aimed to remove 55.3 tons of ODP, i.e. volume of HCFC-22 phase-out of 1,0005 MT, of which 251 MT from air-conditioning sector.

c) **Global climate change**: HCFCs and HFCs are greenhouse gases with different global warming potentials (GWP). Due to a reduced formulation of CFC in refrigerants for AC production, the impact on the global climate due to switching from HCFC to HFC and HC is by and large neutral, whereas switching to HFC-32 results in 76% reduction of GHG emissions. HFC-32 has only about one-third the GWP and HC-290 has about one-seventy of currently used HCFC-22. HFC is also improves the energy efficiency of equipment by 10% and could reduce the charging volume by 30% compared to HCFC-22. HFC-32 offers favorable GWP and lower charging volume. HFC-32 related CO_2 emissions decrease by 76% thanks to the lower GWP and the charging volume reduction.

c) **Energy efficiency**:

The potential refrigerating effect of HFC-32 is 1.5 times that of HCFC-22. More specifically, pressure losses are lower with HFC-32 than HCFC-22 for the same capacity and the liquid density of HFC-32 is also 10% lower. Thus the piping diameter can be smaller. As a result, the charging volume can be 30% less than with HCFC-22. The cooling seasonal performance factor (CSPF) of HFC-32 is higher than conventional refrigerants. Its peak power consumption is also lower, helping to alleviate power shortages in large cities during periods of high demand.

Table 6-1: Climate Benefits from use of HFC-32 and HC-290

HFC-32

Company Name	Production volume by cooling capacity (BTU)							
	9000	**12000**	**18000**	**24000**	**36000**	**48000**	**>48000**	**Total**
REE	0	0	0	0	0	0	3000	3000
NAGAKAWA	7000	4500	1800	1500	0	2000	600	17400
HOAPHAT	16037	12440	6701	4725	0	0	913	40816
LG	65578	31244	0	0	0	818	0	97640
TOTAL	**88615**	**48184**	**8501**	**6225**	**0**	**2818**	**4513**	**158856**
	Average Charge (kg) per Unit							
HCFC-22 A/C	0.61	0.76	1.32	1.66	1.88	2.08	5.95	
HFC-32 A/C	0.39	0.49	0.84	1.06	1.20			
Climate Benefits (tCO2 per year)	74,244	50,728	15,416	14,222	-			**154,610**

HC-290

Company Name	Production volume by cooling capacity (BTU)							
	9000	**12000**	**18000**	**24000**	**36000**	**48000**	**>48000**	**Total**
MIDEA	91696	38207	7641	0	0	0	9000	146544
TOTAL	**91696**	**38207**	**7641**	**0**			**9000**	**146544**
	Average Charge (kg) per Unit							
HCFC-22 A/C	0.61	0.76	1.32	1.66	1.88	2.08	5.95	
HC-290 A/C	0.30	0.38	0.66	0.83	0.94	1.04	2.98	
Climate Benefits (tCO2 per year)	100,770	52,761	18,175	-	-			**171,707**

Table 6-2: Climate Benefits from Improved Energy Efficiency of HFC-32 and HC-290

Company Name	Production volume by cooling capacity (BTU)							
	9000	**12000**	**18000**	**24000**	**36000**	**48000**	**>48000**	**Total**
REE	0	0	0	0	0	0	3000	3000
NAGAKAWA	7000	4500	1800	1500	0	2000	600	17400
HOAPHAT	16037	12440	6701	4725	0	0	913	40816
MIDEA	91696	38207	7641	0	0	0	9000	146544
LG	65578	31244	0	0		818	0	97640
TOTAL	**180311**	**86391**	**16142**	**6225**	**0**	**2818**	**13513**	**305400**
	Power Supply (kW)							
HCFC-22 A/C	0.9420533	1.256071	1.8841065	2.512142				
HFC-32/HC-290 A/C	0.8792497	1.1723329	1.7584994	2.3446659				
Reduced Power Supply	0.0628036	0.0837381	0.1256071	0.1674761				
Energy Savings (kWh)	24799934	15842932	4440334.1	2283160.3				47366361
Climate Benefits (tCO2 per year)								**25,616**

d) **Occupational health and safety**:

All refrigerant gasses classified in ISO 817 can initiate some form of adverse health effect if the concentration is high enough, therefore it is technically incorrect to claim any classified refrigerant as “non-toxic”. However, compared to all other common refrigerants, HFC-32 requires the highest concentration level to cause any adverse health effect.

International Standard ISO 817 defines 2 toxicity classes for refrigerants: Class A – Lower Chronic Toxicity and Class B – Higher Chronic Toxicity. R32 is categorized as Class A. Compared to all other Class A (Lower Toxicity) refrigerants such as R22, R410A, R134a, R290 (Propane) and R600a (Isobutane), R32 has the highest (safest) Acute Toxicity Exposure Limit (ATEL) of 220,000 ppm of the 99 refrigerants designated in Table 5 of ISO 817[4].

e) **Flammability and Safety:** International Standard ISO 817:2014, segregates the flammability of refrigerants into 4 categories as follows: - no flame propagation (Class 1), lower flammability (Class 2L), flammable (Class 2) and higher flammability (Class 3). In general language these classifications are called Non Flammable, Mildly Flammable, Flammable and Highly Flammable. HFC-32 falls into the “lower flammability” or Class 2L "mildly flammable" category.

Under ISO 817, any refrigerant and air mixture that is capable of self-propagating a flame falls into one of the three flammable categories. Class 2L refrigerants present the lowest

[4] http://www.arema.com.au/2012/wp-content/uploads/R32-Common-Questions-Sept-2014.pdf

risk of the 3 flammable categories and are defined by having a burning velocity of less than 10 cm per second. The characteristic of this low burning velocity is that the flame front does not propagate readily in a horizontal direction. This is because the convection rise due to combustion creates a higher velocity than the burning velocity. This effectively means that a Class 2L refrigerant is not explosive if ignited because the flame only propagates in an upwards direction from the ignition point and not rapidly outwards in all directions.

Table 6-3: ISO 817-2014 Safety Group Classification

	Flammability		Low Toxicity A		High Toxicity B
Class 3	Higher flammability	A3	Propane, Isobutene, Others	B3	n/a
Class 2	**Lower** Flammable	A2	R-152a	B2	R-40, R-611
Class 2L	Lower flammability	A2L	R-32(675), R-1234yf(4), R-1234ze (E)(6), Others	B2L	Ammonia
Class 1	No flame propagation	A1	R-410A(675), R-134a(1430), R-407C(1770), Others	B1	R-123, R-245fa

A2L and B2L are lower flammability/midly flammability refrigerants with a maximum burning velocity ≤ 10 cm/s (3.9 in./s).
GWP value is indicated in parenthesis based on IPCC 4th AR.

ISO 817 lists the burning velocity of R32 at 6.7 cm/s (0.24 km/h) and HC-290 is 39 cm/s in comparison the burning velocity of ammonia is 7.2 cm/s, and hydrogen is 317 cm/s (meanwhile R-22 is non-flame propagation). The burning velocity of a gas is the speed of the flame front relative to motionless gas. The actual flame speed can be several times higher due to the expansion of combusting gas in combination with the burning velocity. This is especially applicable to A2 and A3 refrigerants as their higher heat of combustion generates rapid expansion and turbulence to dramatically increase the flame speed. ISO 817 also requires a Class 2L refrigerant to have a heat of combustion of less than 19 MJ/kg. R32 has a heat of combustion of 9.5 MJ/kg; for ammonia it is 18.6 MJ/kg, for R-290 is 46.9 MJ/kg.

Table 6.3 show that HCFC-22 has been classified under Safety Group A1 based on the test result that indicates two characteristic; no flame propagation and lower toxicity. Meanwhile HFC-32 has been classified under Safety Group A2L because it is Lower flammability and Lower toxicity refrigerant with a maximum burning velocity of less than or equal 10 cm. per second. More detail information indicated safety data for refrigerants such as HCFC-22, HFC-32 and HC-290 can be found in Annex 6.

f) **Soil and water pollution**: Other chemical involved in air-conditioning production is the synthetic Polyol ester (POE) oil. POE oil is a family of synthetic lubricants. Unlike natural mineral oils, POE oil is completely wax-free and is the best choice of lubricants due to their better thermal stability, more miscible and highly biodegradable. POE oils are more hygroscopic than mineral oils, so exposing POE oils to air will result in their absorbing moisture more quickly than mineral oils. When POE oils are exposed to

moisture and heat, they may react, forming acid that is harmful to the system. POE oils should also be stored properly in their original container because many plastics used to package oils are permeable to moisture. It is also important to keep compressors and systems closed, except when work is actually being done on the equipment, and to filter out undesirable contaminants. This can be achieved with proper installation and service techniques as well as the use of correct filters and driers. The proper technique should be applied to recover the POE to avoid the discharges could affect on surrounding environment cause water or soil pollution.

g) **Local air:** the alter refrigerants are not toxicity therefore not harm to environment and health. However, the accumulative concentration at one site could result in falling into range of lower explosive limits to upper explosive limits and causing fire. When fire exists, it will damage and cause significant air pollution.

h) **Solid waste management:** Improper disposal of contaminated containers could be a problem for waste management. However, this is not issue because all enterprises have to sign the contract for collecting and treatment their waste properly.

6.2 Environmental and Social Impacts Mitigation Measures

Due diligence review found that four AC enterprises have existed and operated and have had no requirement for relocation or land acquisition. During project implementation phase, it they need to move in the industrial zone, the procedures for undertaking land due diligence review is presented as bellowed:

a) PMU/MONRE submits to the Bank, a report containing general information on the actual status of the resettlement and compensation on the proposed project enterprises (within the selected IZ) as part of the package required for the subproject grant appraisal submission procedures.

b) World Bank undertakes a due diligence (DD) of the resettlement and compensation in the selected area. The DD serves to confirm that involuntary resettlement and compensation in the proposed IZs is completed or substantially advanced. It will confirm that was undertaken following government norms and regulations and for general consistency with Bank policies and objectives. Additionally, it should confirm pending issues as per Grievances and Redress Mechanisms reports of the pertinent authorities, recommending actions to be followed.

Preparation of Abbreviated RAPs. An abbreviated RAPs (A-RAP) if applicable will be prepared for subprojects (as part of the sub-project proposals) to handle the relocation and potential land issues. Possible social issues if any outside resettlement will be reviewed as an annex to the generic EMP, as no significant social issues are expected.

If enterprises have to be relocated to industrial zone, this will be done before implementing the alter refrigerants. Therefore, there is almost no impacts during construction phase or the construction work requirements will be very minor (if need to redesign the manufacture). The mitigation measures in the construction phase for the non-relocated enterprises are likely minor.

The Table 6-4 below summarizes the adverse impacts of chemicals used, key mitigation measures and residual impacts for the air-conditioning production during the operation phase.

Table 6-4: Summary of Chemical Impacts, Key Mitigation Measures and Residual Impacts for Air-conditioning production

Chemical	Theoretical impact	Potential impact in air-conditioning production	Key mitigation measures
Difluoromethane (HFC-32) CAS No. 75-10-5	ENVIRONMENT IMPACTS This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).  ***Ecotoxicity*** LC50 Inhalation Gas for Rat 3780 mg/m³ when exposed 1 hour; LC50 Inhalation Vapour for Rat 1890 g/m³ when exposed 4 hours; Bioaccumulative potential: Low; **LogPow : 0.21**	ENVIRONMENT IMPACTS Danger, extremely flammable gas. May form explosive mixtures with air. Contains gas under pressure; may explode if heated. May cause frostbite. May displace oxygen and cause rapid suffocation. Highly reactive or incompatible with the following materials: oxidizing materials and acids. The product is stable. Under normal conditions of storage and use, hazardous reactions will not occur.	- Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow gas to accumulate in low or confined areas. - Efficient and adequate extract ventilation. - Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. - Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode. More detailed measures in Fire precaution and fight plan report.
	OHS IMPACTS	OHS	- First Aid measures:

Chemical	Theoretical impact	Potential impact in air-conditioning production	Key mitigation measures
	Skin contact – No known significant effects or critical hazards. ***Eye contact*** – No known significant effects or critical hazards. ***Inhalation*** – No known significant effects or critical hazards. **Frostbite -** Try to warm up the frozen tissues and seek medical attention. ***Ingestion*** – As this product is a gas, refer to the inhalation section.	The direct contact of HFC-32 can be harmful to skin.	+ Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse. + Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs. _+Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. - Hazard communication and training programs to prepare workers to recognize and respond to workplace chemical hazards
	<u>ACCIDENTS RELEASE</u> Accidental releases pose a serious fire or explosion hazard.	Explosion if not handled correctly	Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

Chemical	Theoretical impact	Potential impact in air-conditioning production	Key mitigation measures
	Spills, leakage	Spill, leakage	Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. - Avoid any spills during the storage and production by means of constructing storage facilities More detailed measures are listed in the Chemical emergency precaution measures.
Synthetic Polyol ester oil (POE 32 & 68)	Non-hazardous mixture of synthetic polyol ester HMIS Hazard Ratings: Fire – 1, Health – 0, Reactivity – 0, Specific – 0 • Inhalation: Low hazard for usual industrial handling by trained personnel. • Eyes: Causes irritation. • Skin: Low hazard for usual industrial handling by trained personnel, see label warnings.	When POE oils are exposed to moisture and heat, they may react, forming acid that is harmful to the system and difficult to be recovered. <u>OHS impacts</u> Product is considered stable. Carbon monoxide and unidentified organic compounds may be formed during combustion.	- Proper installation and service techniques, as well as the use of the correct filter driers and moisture indicators to minimize water contact. - Use filter driers remove moisture circulating through the refrigeration system and then hold that moisture to prevent it from contaminating the expansion device, evaporator, compressor, or oil. - Personal Precautionary Measures: Avoid contact with eyes and skin. Wash thoroughly after handling. Do not breathe vapors or fumes. Inhalation: If symptomatic, move to fresh air. Get medical attention if symptoms persist. Eyes: Immediately flush with plenty of water for at least 15 minutes. Get medical attention. Skin: Remove contaminated clothing, wash affected skin with soap and water immediately. Get medical attention if

Chemical	Theoretical impact	Potential impact in air-conditioning production	Key mitigation measures
	• Ingestion: Components are of low oral toxicity.__	Acute toxicity data: not available Explosion if not handled correctly Large Spill	symptoms occur. Ingestion: Drink plenty of water. Get immediate medical attention. - Prevention of Fire and Explosion: Keep from contact with oxidizing materials, alkalis and acids. Store away from heat, sunlight and moisture - Leaks should be stopped. Absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Large liquid spills should be removed by using a vacuum truck, flush spill area with water spray. Prevent run-off from entering drains, sewers, or streams, collect run-off. Solid spills should be scooped up and placed in approved containers for disposal. The spill area should then be flushed with water followed by liberal covering of sodium bicarbonate.
Propane (HC-290) CAS No. 74-98-6	ENVIRONMENT IMPACTS This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).  ***Ecotoxicity*** Not available	ENVIRONMENT IMPACTS Danger, extremely flammable gas. May form explosive mixtures with air. Contains gas under pressure; may explode if heated. May cause frostbite. May displace oxygen and cause rapid suffocation.	- Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow gas to accumulate in low or confined areas. - Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance.

Chemical	Theoretical impact	Potential impact in air-conditioning production	Key mitigation measures
	Bioaccumulative potential: Low; **LogPow :1.09**	Biodegradation: The product is stable and not biodegradable. Bioaccumulation: has poor water-solubility Under normal conditions of storage and use, hazardous reactions will not occur.	- Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode. More detailed measures in Fire precaution and fight plan report.
	OHS IMPACTS ***Skin contact*** – No known significant effects or critical hazards. ***Eye contact*** – No known significant effects or critical hazards. ***Inhalation*** – No known significant effects or critical hazards. **Frostbite -** Try to warm up the frozen tissues and seek medical attention.	OHS No specific data.	- First Aid measures: + Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse. + Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs. _+Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. If unconscious, place in recovery position and get medical attention

Chemical	Theoretical impact	Potential impact in air-conditioning production	Key mitigation measures
	Ingestion – As this product is a gas, refer to the inhalation section.		immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. - Hazard communication and training programs to prepare workers to recognize and respond to workplace chemical hazards
	<u>ACCIDENTS RELEASE</u> Accidental releases pose a serious fire or explosion hazard.	Explosion if not handled correctly	Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment. Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).
	Spills, leakage	Spills, leakage	Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. - Avoid any spills during the storage and production by means of constructing storage facilities More detailed measures are listed in the Chemical emergency precaution measures.

6.3 Proposed Measures for Handling and Safety Operating of HFC-32 and HC290

The refrigerants are delivered in a cylinder as it is liquefied gas.

The given information above indicates HFC-32, when it released from the container and enter to the atmosphere, it will be turned to gas phase instantly because of very low flash point at below -40 degree Celsius (^{0}C). When it mixes with the air around the area of leaking, the first lowest concentration that the air mixture can be ignited is 12.7%.
On the other hand, HC-290, when it released from the container and enter to the atmosphere, it will be turned to gas phase instantly because of very low flash point. When it mixes with the air around the area of leaking, the first lowest concentration that the air mixture can be ignited is 1.8%.

The general condition of refrigerant charging procedure has very low likelihood of HFC-32 and HC-290 to be released uncontrollable and reach the lower flammable limit. However, in the event that refrigerants may leak out due to failure of connections, hose ruptures, the possibility to have HFC and air mixture at the level of lower flammable limit is likely. Well designed, and maintained equipment used in charging process will minimize the likelihood of uncontrolled release of HFC-32. On the other hand, poor connection, under specification hoses, seal and connector and combination with incompetent and unskilled worker who perform the task may increase the likelihood of leakage of HFC-32 and HC-290. In this case, the risk of fire in the charging area is increased.

The air-HFC32 or air-HC-290 mixtures can cause flash fire. Because of the HFC-32 is almost 4 times and HC-290 is 1.6 times heavier than air. When it leak, the gas can travel along the lower area such as sump pit, drainage and find the way to be ignited by the ignition sources away from the location where it leak. The fire will flash back into the source of leaking and burn vigorously. Ventilation in the area where HFC-32 or HC-290 is stored, handled and used is critical.

Auto-Ignition temperature of HFC-32 is 530°C and of HC-290 is 287°C. At this temperature, the naked flame from brazing torch used at the assembly line nearby or a small arc from electrical sockets due to poor installation can simply ignite the flammable atmosphere.

Therefore, the additional safeguards to put in place before HFC-32 and HC-290 is to be used including:

1. Redesign of work area to keep distance where HFC-32 or HC-290 is used and the area where ignition sources from the adjacent process.
2. Redesign of storage facility. The use of electric fans from the ceiling, ventilation exhaust fans on the wall are example of the term “General ventilation”.
3. Installation of the Ex-Proof (explosion-proof) electrical equipment in the storage area, production line around HFC-32 or HC-290 refrigerant charging, vacuum and also the electrical used in performance test labs.
4. Ex-proof type of transfer pumps, vacuum pumps, charging machines, and piping are required.
5. Ventilation system – general ventilation and local ventilation at the charging station. Because of HFC-32 and HC-290 is heavier than air, it tends to accumulate near the

ground level. Well-ventilated area will eliminate the likelihood of HFC-32 or HC-290 in the air at lower flammable limit which can be ignited by the ignition sources. Generally, ventilation can be classified into two types; first is natural ventilation which is mainly benefit from building design and construction to have air movement naturally and no need additional mechanical devices, and second is artificial ventilation. This type requires mechanical devices such as exhaust fan, hood and ducts. General ventilation is simple way to induce air movement in the building. The term "Local exhaust ventilation (LEV)" is a ventilation system consisting of hood to capture air contaminants at the source of generation and move it through the duct. The exhaust fan creates suction at the face of the hood and make the air contaminant to be ventilated away.

6. Gas detection and alarm system is recommended to be installed at:
   - HFC-32 or HC-290 storage area
   - Refrigerant charging area
   - Vacuum area
   - Finish good warehouse

   Flammable gas detectors can make a valuable contribution to the safety of these processes. They can be used to trigger alarms if a specified concentration of the gas or vapor is exceeded. This can provide an early warning of a problem and help to ensure people's safety. However, a detector does not prevent leaks occurring or indicate what action should be taken. It is not a substitute for safe working practices and maintenance.

   Detectors can be fixed, portable or transportable. It is recommended to have 'fixed' detectors, permanently installed in a location mentioned above to provide continuous monitoring of HFC-32 and HC-290. The components of a gas detection system include sensors, control unit and alarm. The position of the detection sensors for HFC-32 and HC-290 should be at the low level above ground surface due the fact that they are heavier than air and tend to accumulate there. The control unit or control panel of detection system should be located outside of the hazardous zone. The alarm should be installed at the locations mentioned above and at the location where general area can be alerted. It is also recommended that the alarm should be installed at security guard house.

7. Redesign or improvement on fire protection is required. Especially when large volume of container like 1 ton is to be stored, adequate fire water for cooling gas container to prevent Boiling Liquid Expanding Vapor Explosion (BLEVE).

8. Reviewing of fire emergency response plan shall be done to ensure that the local fire department is familiar with fire at the compressed gas cylinders. Fire water cooling system shall be redesigned to cover HFC-32 and HC-290 storage area.

9. Training of the workers who handling HFC-32 and HC-290 to be aware of its physical properties, flammability, immediate health hazards and personal protective equipment to be used.

The following proposed mitigation measures are made to the air-conditioning enterprises participating in the HCFC Stage 2 project to take into consideration to implement in addition

to their existing programs. Some of these mitigations are prescribed by Vietnamese laws and regulations, some of them are considered recognized best practices among the industrial sectors as recommended.

6.3.1 Building and Structure

Safe access and egress shall be provided for personnel during normal and emergency conditions, including appropriate entry and exit from the building. Good housekeeping should be maintained in the area near the plastic injection to ensure no plastic is jammed inside the more and catch on fire. The designated walkway shall be kept clear.

Management shall assess the security risks for all permanent and temporary places of work prior to use and after significant structural or layout changes have been made. Potential security controls include restricted access (e.g. by using fences, gates, locks or electronic card entry), the presence of security personnel, alarms, CCTV cameras, adequate lighting and signage. When practicable, buildings and structures shall be designed so that access to certain areas can be restricted to authorized personnel. It is recommended that the area where HFC-32 to be stored, LPG tanks, and the storage of Oxygen cylinders are sensitive and require security control. CCTV or regular patrol by security guard is suggested.

The layout and condition of buildings and structures are designed and maintained to eliminate or effectively control ergonomic risks, manual handling risks, exposure to noise, exposure to atmospheric contaminants or hazardous substances, exposure to extreme temperatures, slips, trips and falls, spills and leaks, fire and explosion and falling objects.

Use adequate protection from fire and explosion as required by laws and regulations. Managers shall ensure that established housekeeping standards are communicated and maintained, including arrangements for: safely storing tools, equipment and materials when not in use ensuring that passageways, pathways, aisles, emergency exits and equipment are not obstructed maintaining the cleanliness of work areas and amenities identifying and removing any slip and trip hazards.

6.3.2 Safety Criteria for Construction of Storage Facility for refrigerants

This guideline should be applied for the air conditioner manufacturing company who are seeking for instruction to make the storage facility for HFC-32 and other compressed gases, chemicals used in their facility safe.

Table 6-3: Guidelines should be applied for the air conditioner manufacturing company for storage facility for HFC-32 and other compressed gases and chemicals.

Structures	TCVN 5507: 2002 and TCVN 2622:1995
Building wall, compartment and fire wall	Wall/ compartment must be fire resistant material. Width and height of the fire wall has been defined by this guideline (Section 5 Safety Requirement, item 5.1.3) The air conditioner plant that plan to build new storage room for HFC-32 must be aware that the new building which is located near the other building in 10 meter distance, the wall and

	compartment must be capable of fire resistant for at least 120 minutes (in case that the storage facility is used for flammable materials – section 5.1.4). Storage area for compressed gases including HFC-32 shall be under the roof to prevent exposure directly to sun light.
Floor	To maintain good ventilation, solid wall is not recommended. Specific requirement for the floor of storage room for HFC-32 is conductive floor to prevent electro static charge. There should have no pits or drainage near the area where HFC-32 is stored
Doors ways and emergency exit	The storage room must have at least 2 doors for entrance and exit. The size of the door must meet design criteria. Emergency light, safety signs are required.
Roof	Non-combustible material
Ventilation system	Required and must meet specified criteria.
Electrical system	Meet Engineering design criteria. HFC-32 storage room requires meeting Explosion Proof type and electrostatic charge protection, grounding.
Emergency lighting	Required at least at doors and exit.
Electrical appliances	HFC-32 storage room requires to meet Explosion proof type and electrostatic charge protection, grounding
Lightning protection	Building near the storage room in the distance 30 meter must have lightning protection system. The design must meet Engineering design criteria.
Detection and alarm system	Detectors can be fixed, portable or transportable. It is recommended to have 'fixed' detectors, permanently installed in a location mentioned above to provide continuous monitoring of HFC-32. The components of a gas detection system include sensors, control unit and alarm. The position of the detection sensors for HFC-32 should be at the low level above ground surface due the fact that HFC-32 is heavier than air and tend to accumulate there. The control unit or control panel of detection system should be located outside of the hazardous zone. The alarm should be installed at the locations mentioned above and at the location where general area can be alerted. It is also recommended that the alarm should be installed at security guard house.
Fire protection system	Fire extinguishers, portable or fixed system.
Fire water	Must have adequate fire water based on the size of storage facility. HC-290 and HFC-32 storage tanks can explode in case of fire. Cooling storage tanks with sufficient of water is to prevent Boiling Liquid Expanding Vapor Explosion.

6.3.3 Plant Equipment, Machineries Hazard Identification and Risk Management

Hazards review of process equipment for either new or existing facilities. Occupational, Health

and Safety laws and Regulations set out specific safety requirements for all power-operated plant and equipment that every workplace shall enforce in order to meet their legal responsibility of providing a safe working environment. The following minimum mandatory requirements shall be implemented to ensure workplace compliance in relation to plant and equipment:

The Site/Operations Manager or their delegate shall establish hazard identification and a risk assessment process for all existing plant and equipment in use at the workplace. An appropriate site based plant and equipment database shall be developed and maintained. A Plant and Equipment Risk Assessment shall be undertaken prior to purchasing any new plant and equipment, and during the design or modification of plant and equipment. In addition, the Plant and Equipment Design/Modification Hazard Identification shall be completed. Consultation shall occur with relevant employee representatives when conducting plant and equipment risk assessments. A maintenance program that includes inspections, maintenance and cleaning shall be established for plant. Safe Work Method Statement (SWMSs) and site Standard Operating Procedures (SOPs) shall be \developed for all medium-to high-risk tasks that are associated with the use, adjustment, cleaning, repair or maintenance of any plant and equipment. All plant and equipment shall be registered where required by legislation or the regulated governing body. All plant and equipment that poses a mechanical/electrical hydraulic pneumatic or kinetic hazard shall be appropriately guarded. All personnel using plant and equipment shall be equipped with suitable Personal Protective Equipment (PPE). All unsafe plant and equipment shall be identified and quarantined or withdrawn from service.

Appropriate induction and training, including high-risk training, shall be provided where required.

6.3.4 Electrical System Inspection and Maintenance

Occupational, Health and Safety standards set out specific electrical safety requirements that every workplace shall enforce in order to meet their legal responsibility of providing a safe working environment in all Air conditioner production plant workplaces. The following minimum mandatory requirements shall be implemented to ensure workplace compliance in relation to electrical safety:
All electrical work, equipment and materials shall fully comply with regulated Vietnam and recognized Industrial Standards, Local Regulations and this EMP.

All electrical equipment and materials shall be fit for their intended purpose and the environment in which they are being applied.

Electrical work shall only be undertaken by: Licensed Electricians. All electrical work must be supervised by a licensed Electrician with an Electrical Supervisors Qualification (A Qualified Electrical Supervisor can supervise themselves).

Site/Operation Manager shall ensure that all electrical personnel are aware of the “No Live Electrical Work” rule.

6.3.5 Mobile Plant Equipment Inspection and Maintenance (applied depending case to case)

To prevent accident during transporting refrigerant from one location to the other locations.

All operators shall be assessed as competent and hold a current statutory license for the mobile plant that they operate where such a license is required.

Employees shall complete a Mobile Plant and Vehicle Pre-Start Check prior to using mobile plant for each shift, and this shall be retained by the Front Line Supervisor.

The selection, purchasing, leasing or hiring process for mobile plant shall include a thorough risk assessment to ensure that the vehicle is fit for its intended purpose.

Standard Operating Procedures that cover all aspects of a mobile plant's operational use and maintenance activities shall be developed.

6.3.6 Standard Operating Procedures and Safe Work Method Statement

The purpose of this Standard Operating Procedure (SOP) is to develop and maintain safe systems of work for persons responsible for the use and handling of compressed oxygen, LPG gas, Refrigerant cylinders and pressure vessels associated with the air condition making process.

Pressure equipment Regulated air receivers covered by (other than gas cylinders) shall be inspected, operated and maintained.

6.3.7 Accident Reporting and Investigation Procedure

It is the obligation of management and designated personnel required by laws to have standard management system that cover reporting and investigation incident in the workplace.

Any person involved in or close to any incident, shall notify the site/operations manager or supervisor. The site/operations manager or supervisor shall, as far as is reasonably practicable, make the area of any incident safe and prevent further escalation. Immediate first aid, medical and other assistance shall be provided to any injured person.

The site/operations manager or their delegate shall ensure that all relevant persons are informed of the incident in accordance with the incident consequence rating.

The scene of an incident, where appropriate, shall be secured for incident investigation purposes. All incidents shall be reported to management and communicated in accordance with their consequence rating.

All incidents shall be recorded.

All incidents shall be investigated by a team, which is formed in accordance with the incident consequence rating.

The investigation team shall identify the corrective actions required to prevent a re-occurrence of the incident, using controls selected in descending order from the Hierarchy of Control.

6.3.8 Permit To Work Procedures

The hazards, risks and controls associated with a particular task shall be identified, assessed

and understood by those carrying out the work. Risk control measures shall be developed and implemented. For example, a group of maintenance and out-sourced contractor are about to remove a section of roller conveyor near the refrigerant charging area. The tasks they are going to perform generate ignition sources from cutting, grinding and welding. In this example situation; the interactions between maintenance work, construction work and plant operations shall be safely managed. All personnel either issuing or receiving a Permit to Work shall be authorized to fulfill that role. The critical roles are, to be someone who gives permission and to be someone who receives permission. These does not means to create new position or to hire additional man power. It is the working procedure that nobody should just bring the tools and start working then causing fire and explosion in the production area without any controls.

6.3.9 Warehouse and Storage Facilities Management, Hazardous Material Handling and Storage

There are specific regulation related to the qualification of workers who involve in receiving, unloading, handling and storage of compressed gases used in air conditioner production factory that need to be complied. The following minimum mandatory requirements shall be implemented to ensure Air conditioner production plant workplace compliance in relation to hazardous substances and dangerous goods:

Adequate storage shall be provided for hazardous substances, which may include suitable containers, adequate segregations and separation and loss containment.

Containers, tanks, pipes, plant and storage areas associated with hazardous substances and dangerous goods shall be clearly and appropriately labeled.

The suppliers of refrigerants, LPG, N2 and Oxygen shall be carefully selected and ensure that the compressed gases purchased and used in air conditioner production always meet the safety standards specified by authority.

A Hazardous Substance Risk Assessment shall be conducted to identify the hazards involved with the use of each hazardous substance or dangerous goods, and the likelihood of these hazards causing injury or harm.

Material Safety Data Sheets (MSDSs) shall be obtained for all hazardous substances and made available to all employees in hard copy as a minimum.

All employees shall be trained in using and handling Hazardous Substances. Personal Protective Equipment (PPE) appropriate and necessary for handling hazardous substances and dangerous goods shall be provided and maintained in good condition.

Adequate first aid facilities appropriate to the hazards associated with hazardous substances shall be readily available.

Warehouses should be designed and laid out to allow for the safe movement of goods, materials and people. The warehouse design and layout should consider:

Storage areas and the appropriate width of aisles and gangways

- slip, trip and fall hazards

- pedestrian and vehicle traffic routes and turning circles
- staircases and ramps
- lighting
- ventilation
- blind spots
- emergency escape routes
- speed limits
- Surface type, condition, camber and slope.

Information about the warehouse design and layout should be included in the Traffic Management Plan.

6.3.10 Transportation and Traffic Management

Site/operations managers or their delegates shall identify and assess all hazards related to powered mobile plant and vehicles at the workplace and the risk of people, facilities, plant and equipment coming into contact with those hazards. Appropriate controls to eliminate or minimize all identified risks shall be implemented.

A Traffic Management Plan especially in the area where transportation of flammable gases, refrigerants are taken place, shall be developed to ensure that pedestrians are physically separated (as far as is reasonably practicable) from all vehicles and powered mobile plant traversing or operating in any shared work space.

Management shall consult key stakeholders (such as powered mobile plant operators and other employees) when assessing and developing a Traffic Management Plan.

Site/operations managers or their delegates shall provide information and instruction to employees, contractors, customers and site visitors on the requirements of the Traffic Management Plan (e.g. through signage, workplace inductions and toolbox talks).

All drivers and operators shall hold a current license or certificate and are required to be deemed competent to operate the relevant mobile plant or vehicles.

Workplace inductions shall incorporate key traffic management requirements.

Contractors performing work for the plant shall be inducted into the work area or workplace in which they will be working.

Visitors who are at the workplace for the sole purpose of delivering or picking up goods shall remain on marked roadways, walkways or in the immediate proximity of their vehicles at all times when entering mobile plant areas.

Children are not permitted in operating areas of air condition production plants. Any children visiting workplaces are to be supervised at all times.

Employees shall supervise and, where applicable, escort all visitors to mobile plant work areas if they have not been officially inducted to the workplace.

Employees, contractors and visitors shall observe all posted or marked signs, including speed

limits, traffic flow directions and mobile phone exclusion zones, at all times.

Employees, contractors and visitors shall wear high-visibility upper-torso garments at all times in areas where mobile plant operates, and shall remain on marked walkways (as appropriate).

An auditing and review process shall be implemented to ensure that the Traffic Management Plan is current and to review the effectiveness of controls.

Management shall provide adequate technical and financial resources to implement and maintain agreed controls.

6.3.11 Workplace Environmental Management

Every workplace shall enforce in order to meet their legal responsibility of providing a safe working environment. The following minimum mandatory requirements shall be implemented to ensure workplace compliance in relation to health surveillance:

Prospective employees and relevant contractors shall participate in a pre-placement medical assessment using the Pre- and Post-Placement Health Assessment.

6.3.12 Personal Protective Equipment

The Site/Operation Manager or Front Line Supervisor shall ensure that a PPE risk assessment is completed for all Personal Protective Equipment requirements.

Appropriate signage which indicates the identified hazard and the required PPE shall be displayed wherever PPE is required to be worn.

All employees (including management), contractors, and visitors shall wear PPE when required to do so. If contractors fail to wear the appropriate PPE their contract shall be reviewed and may be cancelled without further payment.

Employees shall be consulted in the PPE selection process.

All employees shall receive comprehensive training in the use of PPE relevant to their duties.
When professional assessment deems it necessary, PPE shall be individually made and fitted to ensure maximum effectiveness.

All PPE shall be stored and maintained according to the manufacturer's specifications. Employees are expected to actively assist management in maintaining PPE.

PPE audits shall be conducted regularly to ensure that the equipment offers maximum protection, and daily pre-use visual checks by the user shall occur to ensure the equipment is fit for use.

If for any reason an employee cannot be equipped with the appropriate PPE (e.g. the employee has a medical condition that prevents them from wearing the item), they will not be permitted to enter the hazardous area.

6.3.13 Training and Certification Management

Refer to: Occupational Safety, Health law by Ministry of Labor, Invalids and Social Affairs and Circular 27/2013/TT-BLDTBXH by MOLISA dated 18 October 2013 regarding training and certification on occupational safety and health.

To ensure the level of knowledge, skills and competencies of employees who involve in storage, handling, charging, evacuating, and leak testing refrigerants, flammable gases, non-flammable compressed, liquefied gases, and hazardous materials in the production process of air conditioner.

Occupational, Health and Safety (OHS) training objectives and targets and performance indicators shall be identified, monitored and evaluated for effectiveness. Resources shall be provided to ensure the effective implementation of the OHS training program. OHS training shall be provided to ensure persons understand and are aware of their OHS responsibilities. OHS Training shall ensure individuals required to perform work or operate equipment hold appropriate current licenses or certificates of competency in accordance with OHS legislative requirements Managers or supervisors shall ensure all persons under their authority can demonstrate competency to perform the work or operate equipment and not be solely reliant on the person's license or certificate as proven competence. OHS skills and knowledge requirements relating to contractors and the supply of labor shall be documented and communicated to the supplier, before the purchasing/tendering process commences. Employees, other workers, visitors and contractors shall be inducted to the workplace. The level of induction will be relevant to the level of risk and supervision. A Training Needs Analysis shall be completed for each site or area. Training plans and programs shall be developed based on the skills of the persons and the outcomes of the training needs analysis. Differences in learning, language, literacy and numeracy skills of trainees shall be taken into account in training programs. OHS training shall include clearly stated learning outcomes and where relevant, include a competency or assessment activity related to the learning outcomes.

6.3.14 Emergency Response

The site/operations manager or their delegate shall identify Potential emergency situations on, or in the vicinity of, the workplace and develop a Site Emergency Response Plan. Emergency procedures are documented and regularly reviewed. As the refrigerants are risk chemicals, a measures of precautions and chemical emergency response must be prepared and submitted to DoIT. The guidance of outline of this measures is proposed in Annex 3.

Each workplace shall have an established communications system that allows effective communication.

Each workplace shall establish immediately available internal and external emergency contact details.

The site/operations manager or their delegate shall allocate overall responsibility for the control of emergency situations to specific individuals, and shall communicate this information to all employees by completing and displaying the Emergency Response Contacts.

Competent personnel shall assess the suitability, location and accessibility of emergency equipment.

Emergency and fire-protection equipment, exit signs and alarm systems shall be regularly inspected, tested and maintained.

Where required, dangerous goods and hazardous substances manifests or registers shall be established and shall comply with legislative requirements.

First aid requirements shall be assessed, and the first aid system shall be appropriate to the operational risks.

Emergency exercises, drills and review of effectiveness shall be conducted and details documented at least once a year.

6.3.15 Waste Management

In the production of air conditioner few types of solid waste are generated such as empty chemical drums, oil drums, waste paint sludge from paint booth, powder coating waste from dust collector, metal dust from metal workshop, etc. These shall be collected, contained, transferred, and disposed properly by contract with legal authorized agencies.

Hazardous/special waste generator locations must be especially careful to comply with regulatory Requirements: Government authorities usually must be notified to obtain an identification number or License: A written waste management and/or contingency plan for emergencies may be required. Moreover, regulatory requirements include the followings: Waste storage; Labeling; Inspections; Manifesting (Duty of Care); Record-keeping; and Reporting requirements.

Documented training of employees handling or exposed to hazardous waste is also often required by Legislation.

Note: all equipment that is removed and replaced with the Ex-Proof for HFC-32 shall be disassembled, and disposed by the approved waste disposers.

7. Estimated Budget for Mitigation Measures

7.1 Estimated cost for installation and change refrigerants

The Table below provides more details on conversion cost for the four enterprises.

Table 7-1: Total Conversion Cost of the Four Enterprises (US$)

Cost components	Midea	Nagakawa	REE	Hoa Phat
Model redesign, R&D plus in-house testing	196,000	70,000	30,000	50,000
HC-290 software for design of ACs		30,000	30,000	30,000
Prototypes for testing and certification		31,500	9,000	9,000
Official testing for rating and labeling at MEIT		0	30,000	30,000
Technical assistance		0	25,000	25,000
Training	5,000	4,000	4,000	4,000
Charging equipment	130,000	65,000	65,000	65,000
Vacuum pumps	48,000	52,000	36,000	36,000
Leak detectors	4,000	2,000	4,000	4,000
Safety measures, ventilation, grounding and electrical installations	70,000	25,000	25,000	25,000
Storage of HC-290, transfer pump and piping.	50,000	20,000	20,000	20,000

Total IC	**503,000**	**299,500**	**278,000**	**298,000**

Installation, servicing and sales of HC-290 ACs	**Midea**	**Nagakawa**	**REE**	**Hoa Phat**
Installation kits for HC-290 ACs	25,000	20,000	20,000	20,000
Training of in-house technicians and installers and service technicians from dealers	10,000	10,000	4,800	4,800
Dealers: installer and service teams	20,000	10,000	40,000	40,000
Brochures etc.	10,000	0	10,000	10,000
Total	**65,000**	**40,000**	**74,800**	**74,800**

Summary	**Midea**	**Nagakawa**	**REE**	**Hoa Phat**
ICC Charging line	503,000	299,500	278,000	298,000
ICC HE	0	0	0	0
ICC servicing	65,000	40,000	74,800	74,800
Sub-total	568,000	339,500	352,800	372,800
Contingency	56,800	33,950	35,280	37,280
Total	624,800	373,450	388,080	410,080
IOC	470,717	176,400	63,000	296,100
TOTAL cost	1,095,517	549,850	451,080	706,180

Source: FS, 2016.

7.2 Estimated annual cost for environmental management during operation phase

During the operation phase, the enterprises should assign a technical staff to control the chemical spill and leakage, if any and the cost for this assignment should be monthly salary of average 6,000,000 VND for the whole operation cycle.

For the waste collection, including empty chemical drums and foam wastes and hazardous wastes, the monthly cost should be 1,000,000 – 1,500,000 VND depending the location and contract with local environment servicing company and amount of waste. These costs will be borne by the beneficiary from their counterpart funding.

8. Institutional Arrangement Organizations

The following institutions are involved in the implementation of environment protection for the foam production conversion and refrigerants change:

Enterprises that are eligible for funding under the Vietnam HPMP Stage I and II will conduct the conversion in accordance with sub-grant agreement to be signed between the Vietnam HPMP PMU and the beneficiary. The beneficiary will play the main role in implementing the environment management plan and in carrying out the mitigation measures during the conversion and after conversion operation. The enterprises have to prepare and submit documents on fire prevention and protection to Department of Police and report of measures or plans of chemical precaution and emergency responses to Department of Industry and Trading for approval. The enterprises have to have the licence on fire prevent and protection before commission They also need to sign the contract with the assigned hazardous management companies for their industrial and hazardous waste treatments. The enterprise should prepare an Annual Environment Monitoring Report as requested by the Law and Regulations of the Country (twice a year) and submit to Department of Natural Resources and Environment.

The Vietnam HPMP PMU, set up by MONRE and the Vietnam National Ozone Unit will manage and coordinate implementation of the HPMP and sub-projects in Stage I and Sateg II phase out plan. The PMU or its hired consultant will also monitor the subproject implementation and the beneficiary's compliance with the occupational health and environment requirements. The PMU will report to the Bank all the progress reports, especially the environmental monitoring reports.

The equipment suppliers who will be awarded the contract for providing equipment and service for the conversion will provide the refrigeration equipment and installation in the safe environment manners They also provide the technical trainings on safety operations of the equipment and technology.

The local government including the Environment Protection Agency, Fire Protection Police and Industrial Zone Management Body, the Department of Industry and trading, Department of Industrial Safety Techniques and Environment (DISTE) and the Department of Chemicals (DC) of MOIT to be invited by the MONRE/PMU will participate in controlling the company's compliance with the environment/fire protection regulations as per their functions defined by the Vietnam Laws.

The correlation among these stakeholders is described by a chart as follows:

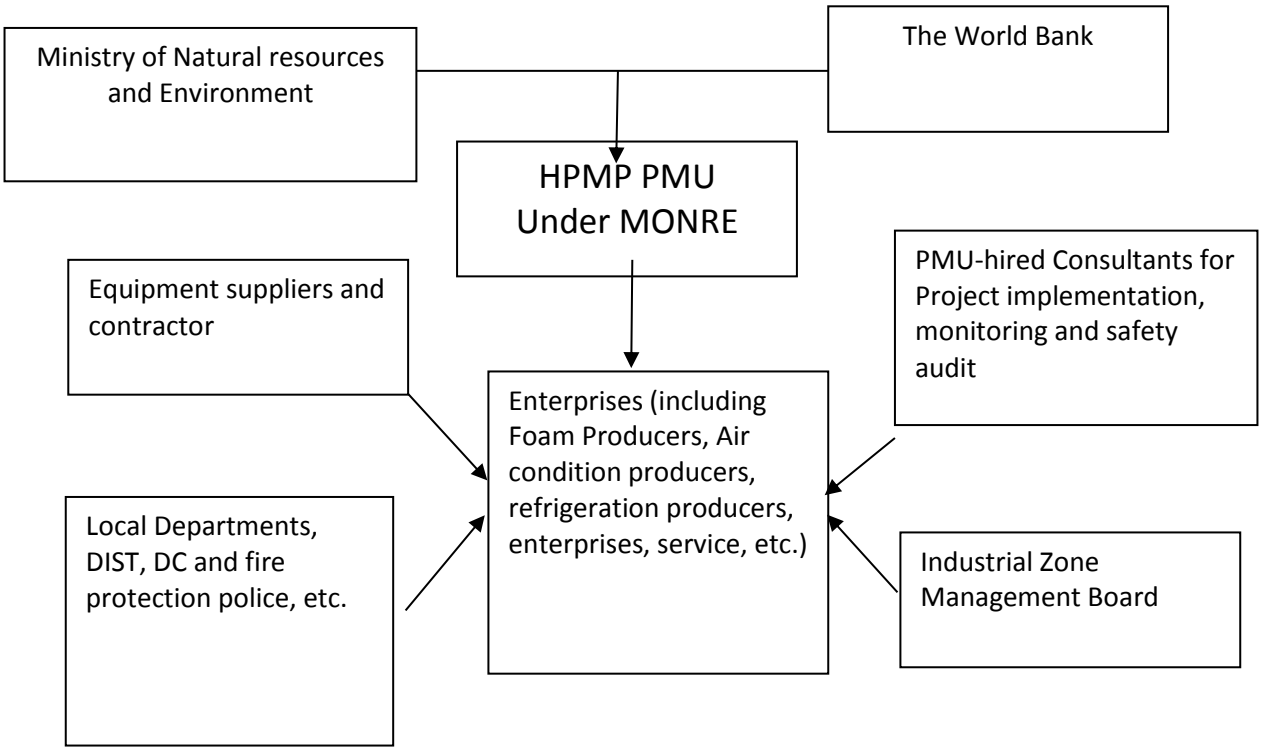


Table 8-1: Responsibilities of Stakeholders for Implementation and Supervision of EMP

Organization	Responsibilities
Enterprises/ Producers	To bear all responsibilities, but under monitoring and supervision of the World Bank and the PMU, for the conversion from HCFC-22 to HFC-32, HC-290 for refrigerants. Technical assistance will be provided through the Project to these

	enterprises. To request the chemical supplier to provide safety data sheets for each chemical and full guidance and training on safety handling these chemicals To follow stringently the safety data sheets when handling these chemicals To assign technical staff to (i) monitor the compliance with the safety occupational health and environment requirements on using chemicals and (ii) monitor the compliance with safety requirements when working with HC-290, HFC-32 and fire protection rules during the conversion process and after conversion operation. To have safety audit and fire safety certificate from the fire protection authority. To keep the workers continuously trained, in cooperation with PMU and chemical and equipment suppliers on the safe foam production; To take all necessary measures to prevent leakage of the foam chemicals during the manufacturing process. To carry out the mitigation measures described in the parts 3 above for each chemical and each case of chemical leakage. To have contract with local environment servicing company for collection and disposal of the polyurethane waste and empty chemical drums. To prepare the Site-specific mitigation measures for each sub-project as well, in addition to following the generic EMPs, as part of the subproject proposal during the project implementation stage To prepare an EIA following the national regulations in case that a new plant will be constructed to implement the HCFC phase-out subproject. To prepare and submit documents on fire prevention and protection to Department of Police To prepare and submit the measures on precautions and chemical emergency responses to submit to Department of Industry and Trading. To prepare Annual Environment Report and send it to the local government environment agencies as requested by the Laws and copy to the PMU for monitoring purposes. To fulfil with Environment Protection Commitment made by the Company as defined by the Government regulations.
The PMU of Vietnam HPMP and NOU	To sign the subproject grant agreement (GA) with each participating AC enterprise. The sub-GA will list enterprise responsibilities and documents / plans it is obligated to adhere to on implementation of the EMP. To coordinate and supervise the subproject implementation, including all environmental and safety requirements listed in Section 3 by hiring technical consultants as necessary To ensure the project implementation will achieve the HCFC phase-out target and safety requirements for the used chemicals and refrigerants in accordance with the National Law and regulations and the World Bank safeguard policies and guidelines To cooperate with Department of Industry Safety Techniques and Environment and the Department of Chemicals under MOIT and Local Environment Protection Agencies, Local Fire Protection Police, and the Industrial Management Body to carry out the enforcement measures for the environment protection for each foam producer involved in the conversion.

	To prepare the project progress and environmental monitoring reports
Equipment Suppliers	To provide the environmentally safety design and installation of the production line of the air condition, refrigerator production using HFC 32. To provide adequate training and guidance on safe operation of the supplied equipment, including the environmental and health risks and mitigation measures. To provide good after-sale service and warranty in the case of accident due to the technical faults.
Enforcement Agencies:	Local Environment Protection Agencies, Local Fire Protection Polices, Department of Industry Safety Techniques and Environment, Department of Chemicals and Local IZ Management Body to be invited by the MONRE/MU to carry out the enforcement control and monitoring of the occupational health, environment and fire safety at each foam company.

9. Environmental and Safety Monitoring Requirements and Monitoring Plan

The main environment and safety monitoring requirement for the HCFC phase out subproject is to assure negative impacts of the conversion on the occupational health and local environment could be reduced or prevented.

The site environment management plan for the conversions to HFC-32 and HC-290 at air condition and refrigerator producers eligible for the Project funding should be in accordance with Decree 18/2015/NĐ-CP; Circular 27/2015/TT-BTNMT; the Circular No **40**/2014/TT-BTNMT of the Ministry of Natural Resources and Environment on the Environment Management and Protection at industrial zones; and Circular of the Ministry of Police No 66/2014/TT-BCA on Fire Protection**,** and the Environment Protection Commitments of the company. The enterprises have to receive the licience on fire precautions and fighting before commissioning. The report of plans or measures on chemical precautions and emergency responses following the Circular of the Ministry of Industry and Trade No 20/2011/TT-BCT and the Government Degree 26/2011/ND-CP on the implementation of the Law on Chemicals.

As practice, the surrounding environment at the Industrial Zones is monitored by the IZ management body and local environment agencies, and the Environment Monitoring Report is to be sent to the City/Provincial Department of Natural resources and Environment annually. In the case of large scale pollution or serious violation of the environment protection law and regulations, the environment police will conduct investigation and identify the responsibility of the personnel or organizational entities.

The monitoring will be conducted **during all phases** of the conversion for refrigerants as HFC-32 at each enterprise by the enterprises, the PMU, local accredited agencies, and local authorities. It includes design and construction of the AC workshop to meet safety requirement of new refrigerants usage, preparation of technical specifications of the equipment, installations and commissioning of procured equipment, trial, safety audit and production start up, and the collection and disposal waste and empty chemical drums during use of HFC-32 and HC-290 to replace HCFC-22.

The Monitoring Plan is proposed as each of participating enterprise. The annual Environment Monitoring Report prepared by each enterprise and reported by the PMU to the Bank team should include the progress on all mitigation measures proposed in the Table 9-1 to address the environmental and safety impacts raised in Section 7.

Table 9-1: Monitoring Plan During Conversion and Operation Phases

Parameters to be monitored	Place/ location	Method of monitoring	Time of monitoring	Standard applied	Monitoring Cost	Responsibility	Report to
Design of workshop	for production sites	Verification done by technical consultant hired by the PMU and local authorities if applicable	Before the construction of the workshop and accepted by the enterprises	Safety requirements when working with explosive gas	Included in the conversion cost to be financed by the enterprise counterpart funding	Enterprises and PMU-hired technical consultant	PMU and the Bank team (it should be included in the sub project proposal)
Technical specifications and appropriate installation of the equipments	for production sites	Verifications done by PMU-hired consultant and/or by enterprises	Before procurement of the equipments	Equipment suppliers standard	Included in the conversion cost to be financed by the enterprise counterpart funding	Enterprises to prepare; installation will be included in the equipment purchase contract.	PMU and the Bank team (it should be included in the sub-project proposal)
Preparation of Explosion Protection Document (EPD)	For production sites	Prepared by each enterprise and reviewed by PMU consultant	Before production start-up	International experience Law on fire precaution and protections, Decree No. .29/2014, Circular No. 6/2014.	Included in the conversion cost to be financed by the enterprise counterpart funding	Enterprises to prepare and PMU-hired consultant to review Department of Police will approve and issue the licence	local authorities, PMU and the Bank team
Preparation of site EMP for cases of existing factories	Enterprises	Prepared by each enterprise and reviewed by PMU consultant	Before production start-up	Decree No.18 and Circular No.27	Included in the conversion cost to be financed by the enterprise counterpart funding	Enterprises to prepare and PMU-hired consultant to review	local authorities, PMU and the Bank team
For the new factories EIA is required.	Enterprises	EIA needs to be prepared by an accredited agency hired by enterprises	Before the construction of new factories	Local regulations Decree No.18 and Circular No.27	EIA preparation will be part of the conversion cost and can be financed by enterprise counterpart	Enterprises to hire accredited agencies/ individuals; PMU to ensure that the EIA is approved	Local authorities for approval of the EIA

Parameters to be monitored	Place/ location	Method of monitoring	Time of monitoring	Standard applied	Monitoring Cost	Responsibility	Report to
					funding	by relevant authorities	
Report of measures on chemical precautions and emergency response	Enterprises	Report needs to be prepared by enterprise and reviewed by DOIT	Before commission	Local regulations Decree No.26 and Circular No.20	Included in the conversion cost to be financed by the enterprise counterpart funding	Enterprises prepare	DOIT
Spills and leakage of chemicals (if any)	Chemical storage and production area	Visually	Continuously	Chemical suprplier's or as described in Section 3 above and Explosion Protection Document	6,000,000 VND per month for one technician/ staff to be financed by the enterprise counterpart funding	Enterprises and its assigned staff	Enterprise management body and to local authority in case of accident
Concentration of gas	Storage, mixing and production area	Control panel and HC sensors	Continuously	Explosion Protection Document		Enterprises and its assigned staff	Enterprise management body
Chemical empty drums and wastes	Enterprises	Neutralize the remaining chemicals in the drums and having contractors for collection of waste and empty drums	As per contract weekly or monthly	Local regulations	1,500,000 VND per month to be financed by the enterprise counterpart funding	Enterprises to have a contract with qualified waste company and PMU will verify the contract.	IZ Management body or local authorities and included in the sub-project proposal
Safety audit	Enterprise production workshop	Local authorities to review documentation and pay site visits	Before foam production start-up	International experience and local requirement	Eligible expenditures to be financed by the project	Enterprises to be prepared for the safety audit; PMU-hired consultant to review and local authorities to approve the safety measures	local authorities, PMU, and the Bank

Table 9-2: Recommended Environmental Monitoring Indicators

Indicators	Schedule	Responsible party/person
Accident statistics and	Once a year	Safety officer of enterprises
Waste disposal record (from the production line)	Once a year	Safety officer of enterprises
Waste disposal record (from conversion	Once	Safety officer of enterprises
Maintenance of equipment in a good condition i.e. preventive maintenance	Once a year	Manager of assembly line
Pre-commissioning audit	After installation of equipment	MONRE- PMU
Post-commissioning audit	After commissioning of equipment	MONRE- PMU

Implementation Schedule and Reporting Procedures

The PMU would carry out supervision of the implementation of the conversion sub-project during the implementation period of 2017 – 2021 After receiving enterprises' Project Progress Report, all mentioned conversion activities would be reviewed by PMU and the details of conversion activities such as time of conversion, testing, trials, and the project Environmental Monitoring Report should be included in the Project Progress Report. All activities of enterprises' conversion would be reported to PMU and the World Bank. The report is to submit semi-annually to the World Bank by January 31 and July 30 each year and annually to MONRE.

Table 9-3: Time Schedule for Implementation of the Environmental Management Plan

Actions	Schedule	Responsible party/person	Monitoring/ Measurement
Develop action plans against mitigation measures	January 2017	Participating Enterprises	Approved action plan under sub-project
Implement mitigation action plans, re-layout, install new equipment.	After signing of sub-grant agreement	Participating Enterprises	Approved action plan under sub-project
Re-arrange and construct storage area for HFC-32 or HC-290	After signing of sub-grant Agreement	Participating enterprises	Approved action plan under sub-project
Install gas detectors and alarm at refrigerants charging, vacuum, leak testing, test labs, and warehouse.	After installing new equipment	Participating Enterprises	Approved action plan under sub-project
Install fire protection system at storage area of HFC-32 and HC 290.	During and after construction	Participating Enterprises	Approved action plan under sub-project
Provide training/ SOPs training and coaching	After signing of sub-grant Agreement	Participating enterprises	Training records

During conversion period of 2017 – 2020, enterprises should detail all activities of conversion in the Progress Report such as implementation timing, testing, trials and proto sample to be produced, and progress and results of mitigation and monitoring measures. Frequency and duration of

mitigation measures and monitoring as well as remedial actions, if any, showing consequences in accordance with the phasing-out targets and schedule should be inclusive. A breakdown timetable consisting of detailed activities should be inclusive in the report. Besides, the Annual Environmental and Safety Report prepared by enterprises should be submitted to provincial DONRE. The report of Plans/or Measures on chemical precautions and emergency response. A copy of both reports should be sent to PMU.

The implementation schedule and reporting procedure will be the following:

Table 9.4: Implementation Schedule and Reporting Procedure

Stakeholder/ Organization	Implementing schedule	Report on/to	Time	Frequency
PMU	2017	- **The Project Implementation Progress Reports** of the conversion sub-project and submit to MONRE/World Bank	31 July and 31 January	Semi-annually
		- **The Project Environment Monitoring Report** (with inputs from the enterprises), including environment monitoring requirements/indicators listed in Table 6 and submit to the Bank	by the end of each quarter	Quarterly
Enterprises	2017	- **Annual Environment Monitoring Report** required by the national and local regulations prepared by the enterprise to Local Department of Natural Resources and Environment and copy to PMU.	By 31 December each year	Yearly
		- **Subproject Implementation Progress Report** to PMU	By 30 June and 31 December	Semi-annually
		- Environment and safety issues, if any, to local authority and to PMU	When needed	
		- Notification to the chemicals and equipment suppliers and copy to the PMU on any faults happened during the conversion and after conversion operation	When the fault takes place	Occasionally
		- Site-EMP report for existing enterprises or EIA report for enterprises to build new factories for implementation of subprojects	One-time reporting before construction or installation starts and EIA should be approved by local EPA	One time
		- Plans or Measures on chemical precautions and emergency response	One time before commissioning and approved by DOIT	One time

Supervision of sub-project implementation and environment requirements

The Vietnam HPMP PMU will be responsible for supervision of the implementation of the conversion sub-projects. A PMU-hired monitoring technical consultant will undertake supervision and prepare quarterly Environmental Monitoring Reports.

Environmental Compliance Framework

Warranty of the equipment supplier and its responsibility in case of fire risk, accidents happening due to the fault of the system will be defined in the contract for equipment supply.

Enterprises take full responsibility to implement the commitment seriously stated in the site-EMP, Explosion Protection Documents and Measures of Chemical Precautions and Emergency Responses.

Any failure implementation or risks found, the enterprises have to report to and work with local authority to find the best solutions for production in the environmental friendly approach.

10. Training Plan

The training for the enterprise technical staff and all workers of each air conditioning company on the safe AC production using HFC-32 and HC-290 will be conducted by the Vietnam HPMP PMU in cooperation with chemical and equipment suppliers and local fire polices and local EPAs. The training courses will be conducted regularly, particularly on preparation and commission stage of enterprises.

Table 11-1: Training Plan

Organizer	Number of Courses	Participants	Frequency	Duration	Content	Budget
PMU in cooperation with chemical and equipment suppliers and local fire polices/EPAs	for each enterprises or group enterprise depending on scale	All technical staff and workers of enterprises	One at the beginning of the project in early 2017 Before production start up and after conversion operation About twice a year from 2018 to 2020	1-2 days	The Montreal Protocol and HCFC phase out; Environment and fire risk during the conversion and after conversion operations Environment and OHS risk mitigations measures Safe handling of chemical and refrigerants. Cheminal and waste collection and treatment Emergency Responses in case of accidents	USD 25,000

					Formulation of Explosion Protection Document for each enterprise (guidance takes about one day per company – however can be done at one work shop)	

The training cost will be covered by the Project under the Project Component 2. It is estimated that the funding for these training activities will be 25,000 USD.

References

1. ANSI Z49.1 2005 Safety in welding cutting and allied process
2. Asia Industrial Gases Association, SAFETY AUDIT GUIDELINES, AIGA 01405
3. Designation and Safety Classifications of Refrigerants, ANSI/ASHRAE Standard 34- 1997, ANSI/ASHRAE Standard 34-2010, ANSI/ASHRAE Standard 34-2007
4. Environmental, Health, and Safety (EHS) Guidelines GENERAL EHS GUIDELINES: INTRODUCTION, IFC World Bank
5. IPCC (Intergovernmental Panel on Climate Change). Special Report on Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydro fluorocarbons and Per fluorocarbons, Special Report of the Intergovernmental Panel on Climate Change, Cambridge, England, 2005.
6. OP 4.01, Annex B - Content of an Environmental Assessment Report, OP 4.01 - Annex B January, 1999 revised May 2011
7. US EPA Ozone Layer Protection, Class II Ozone-depleting Substances
8. WMO (World Meteorological Organization), Scientific Assessment of Ozone Depletion: 2006, Global Ozone Research and Monitoring Project—Report No. 50, 572 pp., Geneva, Switzerland, 2007.

ANNEX 1 - Environmental Codes of Practice (ECOP) for Small Civil Works

1. Objectives

The Environmental Codes of Practice (ECOP) is prepared to manage small environmental impacts during construction. The ECOPs will apply to manage small scale infrastructure investments subproject. ECOP will be a mandatory part of construction contract or bidding documents so that contractor complies with environmental covenants. PMU/VCIC and construction supervisors will be responsible for monitoring of compliance with ECOP and preparing the required reports.

There are a number of national technical regulations related to environmental, health and safety that apply to construction activities below:

- *Water Quality*: (QCVN 01:2009/BYT, QCVN 02:2009/BYT, QCVN 08:2008/BTNMT, QCVN 09:2008/BTNMT, QCVN 10:2008/BTNMT, TCVN 5502:2003; TCVN 6773:2000, TCVN 6774:2000, TCVN 7222:2002)
- *Wastewater (*QCVN 14:2008/BTNMT; QCVN 40:2011/BTNMT)
- *Air Quality* (QCVN 05:2013/BTNMT, QCVN 06:2008/BTNMT)
- *Soil Quality (QCVN 03:2008/BTNMT)*
- *Solid Waste Management* (TCVN 6696:2009, QCVN 07:2009)
- *Vibration and Noise* (QCVN 27:2010/BTNMT, QCVN 26:2010/BTNMT)
- *Labor Health and Safety*: Decision No.3733/2002/QĐ-BYT issued by Ministry of Healthcare dated on 10/10/2002 about the application of 21 Labor health and safety standards that concerned about microclimate, noise, vibration, Chemicals – Permitted level in the working environment.

2. Responsibilities

The SME owner and Contractors are the key entities responsible for implementation of this ECOP. Key responsibilities of PMU/VCIC and the contractors are as follows:

(a) PMU

- PMU/VCIC is responsible for ensuring that the ECOP is effectively implemented. The PMU/VCIC will assign a qualified staff to be responsible for checking implementation compliance of Contractors, include the following: (a) monitoring the contractors' compliance with the environmental plan, (b) taking remedial actions in the event of non-compliance and/or adverse impacts, (c) investigating complaints, evaluating and identifying corrective measures; (d) advising the Contractor on environment improvement, awareness, proactive pollution prevention measures; (e) monitoring the activities of Contractors on replying to complaints; (f) providing guidance and on-the-job training to field engineers on various aspects to avoid/mitigate potential negative impacts to local environment and communities during construction.

(b) Contractor

- Contractor is responsible for carrying out civil works and informs PMU, local authority and community about construction plan and risks associated with civil works. As such, contractor is responsible for implementing agreed measures to mitigate environmental risks associated with its civil works.

- Contractor is required to obey other national relevant legal regulations and laws.

Part 1 – Contractor's Responsibilities

This is an example and is not necessarily a full treatment of all requirements for a specific project. For example, there might be reason to have contractor deal with sexually transmitted diseases, medical and hazardous waste s (e.g., oil from vehicle or furnace repair and similar, oily rags).

Issues/Risks	Mitigation Measure
1) Dust generation/ Air pollution	• The Contractor implement dust control measures to ensure that the generation of dust is minimized and is not perceived as a nuisance by local residents, maintain a safe working environment, such as: - water dusty roads and construction sites; - covering of material stockpiles; - Material loads covered and secured during transportation to prevent the scattering of soil, sand, materials, or dust; - Exposed soil and material stockpiles shall be protected against wind erosion.
2) Noise and vibration	• All vehicles must have appropriate "*Certificate of conformity from inspection of quality, technical safety and environmental protection"* following Decision No. 35/2005/QD-BGTVT; to avoid exceeding noise emission from poorly maintained machines.
3) Water pollution	• Portable or constructed toilets must be provided on site for construction workers. Wastewater from toilets as well as kitchens, showers, sinks, etc. shall be discharged into a conservancy tank for removal from the site or discharged into municipal sewerage systems; there should be no direct discharges to any water body. • Wastewater over permissible values set by relevant Vietnam technical standards/regulations must be collected in a conservancy tank and removed from site by licensed waste collectors. • At completion of construction works, water collection tanks and septic tanks shall be covered and effectively sealed off.
4) Drainage and sedimentation	• The Contractor shall follow the detailed drainage design included in the construction plans, to ensure drainage system is always maintained cleared of mud and other obstructions. • Areas of the site not disturbed by construction activities shall be maintained in their existing conditions.
5) Solid waste	• At all places of work, the Contractor shall provide litter bins, containers and refuse collection facilities. • Solid waste may be temporarily stored on site in a designated area approved by the Construction Supervision Consultant and relevant local authorities prior to collection and disposal. • Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof.

Issues/Risks	Mitigation Measure
	• No burning, on-site burying or dumping of solid waste shall occur. • Recyclable materials such as wooden plates for trench works, steel, scaffolding material, site holding, packaging material, etc. shall be collected and separated on-site from other waste sources for reuse, for use as fill, or for sale. • If not removed off site, solid waste or construction debris shall be disposed of only at sites identified and approved by the Construction Supervision Consultant and included in the solid waste plan. Under no circumstances shall the contractor dispose of any material in environmentally sensitive areas, such as in areas of natural habitat or in watercourses.
6) Chemical or hazardous wastes	• Used oil and grease shall be removed from site and sold to an approved used oil recycling company. • Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and machinery shall be collected in holding tanks and removed from site by a specialized oil recycling company for disposal at an approved hazardous waste site. • Unused or rejected tar or bituminous products shall be returned to the supplier's production plant. • Store chemicals in safe manner, such as roofing, fenced and appropriate labeling.
7) Disruption of vegetative cover and ecological resources	• Areas to be cleared should be minimized as much as possible. • The Contractor shall remove topsoil from all areas where topsoil will be impacted on by rehabilitation activities, including temporary activities such as storage and stockpiling, etc; the stripped topsoil shall be stockpiled in areas agreed with the Construction Supervision Consultant for later use in re-vegetation and shall be adequately protected. • The application of chemicals for vegetation clearing is not permitted. • Prohibit cutting of any tree unless explicitly authorized in the vegetation clearing plan. • When needed, erect temporary protective fencing to efficiently protect the preserved trees before commencement of any works within the site. • The Contractor shall ensure that no hunting, trapping shooting, poisoning of fauna takes place.
8) Traffic management	• Before construction, carry out consultations with local government and community and with traffic police. • Significant increases in number of vehicle trips must be covered in a construction plan previously approved. Routing, especially of heavy vehicles, needs to take into account sensitive sites such as schools, hospitals, and markets. • Installation of lighting at night must be done if this is necessary to ensure safe traffic circulation.

Issues/Risks	Mitigation Measure
	• Place signs around the construction areas to facilitate traffic movement, provide directions to various components of the works, and provide safety advice and warning. • Employing safe traffic control measures, including road/rivers/canal signs and flag persons to warn of dangerous conditions. • Avoid material transportation for construction during rush hour. • Signpost shall be installed appropriately in both water-ways and roads where necessary.
9) Interruption of utility services	• Provide information to affected households on working schedules as well as planned disruptions of water/power at least 2 days in advance. • Any damages to existing utility systems of cable shall be reported to authorities and repaired as soon as possible.
10) Restoration of affected areas	• Cleared areas such as disposal areas, site facilities, workers' camps, stockpiles areas, working platforms and any areas temporarily occupied during construction of the project works shall be restored using landscaping, adequate drainage and revegetation. • Trees shall be planted at exposed land and on slopes to prevent or reduce land collapse and keep stability of slopes. • Soil contaminated with chemicals or hazardous substances shall be removed and transported and buried in waste disposal areas.
11) Worker and public Safety	• Training workers on occupational safety regulations and provide sufficient protective clothing for workers in accordance with applicable Vietnamese laws. • Install fences, barriers, dangerous warning/prohibition site around the construction area which showing potential danger to public people. • The contractor shall provide safety measures as installation of fences, barriers warning signs, lighting system against traffic accidents as well as other risk to people and sensitive areas. • If previous assessments indicate there could be unexploded ordnance (UXO), clearance must be done by qualified personnel and as per detailed plans approved by the Construction Engineer.
12)Solid waste generated from rehabilitation	• The Contractor shall develop a solid waste control procedure (storage, provision of bins, site clean-up schedule, bin clean-out schedule, etc.) before construction and strictly comply with developed procedure during construction activities. • The Contractor shall provide litter bins, containers and waste collection facilities at all places of work. • The Contractor store solid waste temporarily on site in a designated place prior to off-site transportation and disposal through a licensed waste collector. • The Contractor shall dispose of waste at designated place identified and approved by local authority. Opened burn or bury of solid waste in hospital shall not be allowed. Under no circumstances shall the contractor dispose of any material in environmentally sensitive areas, such as watercourses

Issues/Risks	Mitigation Measure
	• Recyclable materials such as wooden plates for trench works, steel, scaffolding material, site holding, packaging material, etc shall be segregated and collected on-site from other waste sources for reuse or recycle (sale). • The removal of asbestos-containing materials or other toxic substances shall be performed and disposed of by specially trained and certified workers.
13) Communication with local communities	• The contractor shall coordinate with local authorities (leaders of local communes, leader of villages) for agreed schedules of construction activities at areas nearby sensitive places or at sensitive times (e.g., religious festival days). • Copies in Vietnamese of these ECOPs and of other relevant environmental safeguard documents shall be made available to local communities and to workers at the site. • Disseminate project information to affected parties (for example local authority, enterprises and affected households, etc) through community meetings before construction commencement. • Provide a community relations contact from whom interested parties can receive information on site activities, project status and project implementation results. • Inform local residents about construction and work schedules, interruption of services, traffic detour routes and provisional bus routes, blasting and demolition, as appropriate. • Notification boards shall be erected at all construction sites providing information about the project, as well as contact information about the site managers, environmental staff, health and safety staff, telephone numbers and other contact information so that any affected people can have the channel to voice their concerns and suggestions.
14) Chance find procedures	• If the Contractor discovers archeological sites, historical sites, remains and objects, including graveyards and/or individual graves during excavation or construction, the Contractor shall: • Stop the construction activities in the area of the chance find; • Delineate the discovered site or area; • Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities or the Department of Culture and Information takes over; • Notify the Construction Supervision Consultant who in turn will notify responsible local or national authorities in charge of the Cultural Property of Viet Nam (within 24 hours or less); • Relevant local or national authorities would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values;

Issues/Risks	Mitigation Measure
	• Decisions on how to handle the finding shall be taken by the responsible authorities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration and salvage; • If the cultural sites and/or relics are of high value and site preservation is recommended by the professionals and required by the cultural relics authority, the Project's Owner will need to make necessary design changes to accommodate the request and preserve the site; • Decisions concerning the management of the finding shall be communicated in writing by relevant authorities; • Construction works could resume only after permission is granted from the responsible local authorities concerning safeguard of the heritage.

Part 2 – Contractor's Workers Environmental Code of Conducts

This is an example for typical project, but for a specific project, some other requirements might be relevant. For example, washing hands protocol, or agreeing to attend STDs (Sexually Transmitted Diseases) workshops.

Do:	Do not
◆ Use the toilet facilities provided – report dirty or full facilities ◆ Clear your work areas of litter and building rubbish at the end of each day – use the waste bins provided and ensure that litter will not blow away. ◆ Report all fuel or oil spills immediately & stop the spill from continuing. ◆ Smoke in designated areas only and dispose of cigarettes and matches carefully. (Littering is an offence.) ◆ Confine work and storage of equipment to within the immediate work area. ◆ Use all safety equipment and comply with all safety procedures. ◆ Prevent contamination or pollution of streams and water channels. ◆ Ensure a working fire extinguisher is immediately at hand if any "hot work" is undertaken e.g. welding, grinding, gas cutting etc.	◆ Remove or damage vegetation without direct instruction. ◆ Make any fires. ◆ Poach, injure, trap, feed or harm any animals – this includes birds, frogs, snakes, etc. ◆ Enter any fenced off or marked area. ◆ Drive recklessly or above speed limit ◆ Allow waste, litter, oils or foreign materials into the stream ◆ Litter or leave food lying around. ◆ Cut trees for any reason outside the approved construction area ◆ Buy any wild animals for food; ◆ Use unapproved toxic materials, including lead-based paints, asbestos, etc.; ◆ Disturb anything with architectural or historical value ◆ Use of firearms (except authorized security guards) ◆ Use of alcohol by workers during work hours ◆ Wash cars or machinery in streams or creek

◆ Report any injury of workers or animals. ◆ Drive on designated routes only. ◆ Prevent excessive dust and noise	◆ Do any maintenance (change of oils and filters) of cars and equipment outside authorized areas ◆ Dispose trash in unauthorized places ◆ Have caged wild animals (especially birds) in camps ◆ Work without safety equipment (including boots and helmets) ◆ Create nuisances and disturbances in or near communities ◆ Use rivers and streams for washing clothes ◆ Dispose indiscriminately rubbish or construction wastes or rubble ◆ Spill potential pollutants, such as petroleum products ◆ Collect firewood ◆ Do explosive and chemical fishing ◆ Use latrines outside the designated facilities; and ◆ Burn wastes and/or cleared vegetation.

ANNEX 2 - Template of Site Environmental Management Plan

(The Subproject owners can use this template to prepare the Site EMP)

VIETNAM HCFC PHASE OUT PROJECT STAGE 2

SUB-PROJECT PROPOSAL

Implementing company: …….
Name of company:……

Coordinating agency:
The PMU of Vietnam HCFC Phase out Project Stage II
Ministry of Natural Resources and Environment

SUBPROJECT PROPOSAL FOR ……..

PROJECT COVER SHEET

COUNTRY :	**VIET NAM**		
PROJECT TITLE:			
SECTOR COVERED:			
HCFC-22 USE IN THE ENTERPRISE			
PROJECT IMPACT (2009)	Before	After	Reduction
Reduction in the use of Ozone Depleting substance (in ODP ton)			
Reduction in the use of green house gases (ton CO_2 e) (impact of HFC-245fa is not included)			
PROJECT DURATION			
PROJECT COST (for conversion of refrigerants)			
Incremental Capital Costs:			
Contingencies (10%):			
Incremental Operating Costs:			
Total Project Cost			
MLFs FUNDING			
Eligible funding from MLFs			
Total			
Counterpart funding			
Cost effectiveness by Grant Funding			
BENEFICIARY ENTERPRISE:			
NATIONAL COORDINATING BODY:			
PROJECT SUMMARY			

HO CHI MINH CITY, DECEMBER 2017

Prepared by: …….

(Sign and seal)

Mr. ….
Director …….
Date: …….

Reviewed by: the PMU of Vietnam HCFC Phase out project
Director of the PMU:
(Sign and seal)

Date: January,.... 2017

Reviewed by the World Bank's Task Team
Date:…….. 2017

1. **INTRODUCTION**
2. **PROJECT OBJECTIVE**
3. **EMP OBJECTIVE**
4. **ENTERPRISE BACKGROUND**

[*Name of Company*]

[*Address*]
[*Tel*]:
[*Fax*]:
[*E-mail*]:
[*Website*]:

[*Name of Company*] was established in [*month, year*], and subsequently, the production of single model Ceiling/Floor Mounted air-conditioner unit, commenced on [*date, month, year*], with a workforce of [*quantity number*] employees.

Besides selling the products locally, [*Name of Company*] is also exporting worldwide under its own brand name and to countries like [*name(s) of nations*].

Types of Air Conditioners: [*for example: Fan Coil Units, Residential, Floor Ceiling, Floor Ceiling With Auto Swing, Floor Ceiling With Manual Swing, Wall Mounted, Cassette, Commercial and Industrial, Ceiling Concealed, Ceiling Concealed w/o Plenum, Hydronic Ceiling Concealed w/o Plenum, Floor Standing, Medium Static Ducted, Condensing Unit, Side Discharge Condensers, Top Discharge Condensers, Evaporative Air Cooler: Hybrid Cool Unit, Portable and Floor Standing, Commercial and Industrial, EVA-18B (Bottom Discharge), EVA-18S (Side Discharge), EVA-18T (Top Discharge)]*. Other;

- [*Water Chiller*
- *Panel Air*
- *Medical Device*
- *Cold Plasma Air Purifier*
- *Electronic Controllers*
- *Steel works and Telephone Booths*]

In order to fulfill the ever-growing local and world-wide demand for better quality and more efficient air-conditioners, [*Name of Company*] had in the past, invested a certain sum in the purchase of advanced technology Production and Testing equipment's, such as, [for example: *CNC Machines, Programmable Shearing and Bending Machines, Automatic Surface Mounted Machines, Wave-Soldering Machines, Circuit Tester, Noise Interference Simulator*], and will continue to do so in the future.

[*Name of Company*] was established in [*month, year*], located in [*name of province*] in Vietnam. It's production of [*name of product(s)*], commenced on [*date, month, year*], with a workforce of [*quantity number*] employees with [*quantity number*] Capital Registered, today, [*Name of Company*] employs a total staff of [*quantity number*] with [*quantity number*] of them as engineers and technicians, has successfully developed a complete range of air-conditioner product, covering [*for example: Wall-Mounted , Floor/Ceiling Mounted , Floor Standing Package, Air Handling, Concealed, Portable and Cassette Unit*]. Besides selling the products locally, [*Name of Company*] is also exporting worldwide under its own brand name to countries like [*name of country(ies)*]. In order to fulfill the ever-growing local and world-wide demand for better quality and more efficient air-conditioners, [*Name of*

Company] had in the past, invested a certain sum in the purchase of advanced technology Production and Testing equipment, such as, [for example: *CNC Machines, Programmable Shearing and Bending Machines, Automatic Surface Mounted Machines, Wave- Soldering Machines, Circuit Tester, Noise Interference Simulator*], and will continue to do so in the future. High quality standards for manufactures depend on efficient and up-to-date technology. In order to build [*Name of Company*] according to standards that are universally acceptable, the company has from the outset, made it a policy to be continually in search of new technology and know-how. At the factory, state-of-the-art equipment such as [for example: *fin press machine, hair pin bender machine, automatic brazing machine*], are extensively used to ensure precision and accuracy at every stage of production. Production is computer controlled at each stage, and quality controls are in place throughout the production process, beginning with the arrival of raw materials. Finished products are tested to ensure they conform to the desired standards before leaving the factory.

Table 1 - Production of …… and amount of HCFC-22 Conversed

Year	Procurement of raw materials (ton)			Used raw materials (ton)			Production of AC (BTUs)
	POE	HCFC-32/HC-290	HCFC-22	POE	HCFC-32/HC-290	Replaced HCFC-22	
2015							
2016							
2017							

Table 2 – Existing production line condition: Observed impacts/risks and proposed changes during conversion of refrigerants

No.	Section [*photo*]	Concerned Process/Location	Observed impacts/risks related to refrigerant conversion	Proposed Changes
	Metal parts production	Sheet metal forming and shaping		
		Metal pre-treatment and powder coating		
		Plastic injection		
		Spraying solvents		
		Brazing and welding		
	Assembly line			
	Refrigerant charging			
	Finish good, handing			

	Storage			

5. PROJET DESCRIPTION

5.1 Technology of refrigerant conversion

5.2 Project costs

Table 5-1: Project cost for conversion of refrigerants (US$)

Cost components	**Amount (US$)**
Model redesign, R&D plus in-house testing HC-290 software for design of ACs Prototypes for testing and certification Official testing for rating and labeling at MEIT Technical assistance Training Charging equipment Vacuum pumps Leak detectors Safety measures, ventilation, grounding and electrical installations Storage of HC-290, transfer pump and piping.	
Total IC	

Installation, servicing and sales of HC-290 ACs	**Amount (US$)**
Installation kits for HC-290 ACs Training of in-house technicians and installers and service technicians from dealers Dealers: installer and service teams Brochures etc.	
Total	
Cost efficiency rate	

Summary	**Amount (US$)**
ICC Charging line ICC HE ICC servicing Sub-total Contingency Total IOC	

TOTAL cost Cost Effectiveness	

5.3 Project implementation schedule

Table 5-3: Implementation Schedule

No	TASK	2016				2017				2018			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Project proposal (technical and financial appraisal)												
2	Sub-grant Agreement signing												
3	Preparation of equipment procurement												
	Selection of supplier												
4	Equipment Contract Signing												
5	Civil work and preparation for the installation of equipment												
6	Transportation, equipment arrival												
7	Installation of equipment and ventilation system and Plant Modifications												
8	Operation and safety Training												
9	Validation of production and Trials												
10	Safety Certification/Audit												
11	Production start-up												
12	Disposal of baseline HCFC-base equipment												
13	Submit the measures of precautions and chemical emergency response to local authorities												
14	Project completion report preparation and submission												
15	Monitoring												
15	Training												

6. **LEGAL AND REGULATORY FRAMEWORK REQUIREMENTS**
7. **ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATIONS**

Table 7-2. Summary of Chemical Impacts, Key Mitigation Measures and Residual Impacts

Items	Theoretical impact	Potential impact in AC production	Key mitigation measures	Residual impacts
Land acquisition				
Project commission				
Construction				
Operation				

8. **MEASURES FOR HANDLING AND SAFETY OPERATING FOR NEW REFIRGERANTS**
9. **ENVIRONMENTAL AND SAFETY MONITORING**
10. **TRAINING**
11. **EMP DISLOSURE**

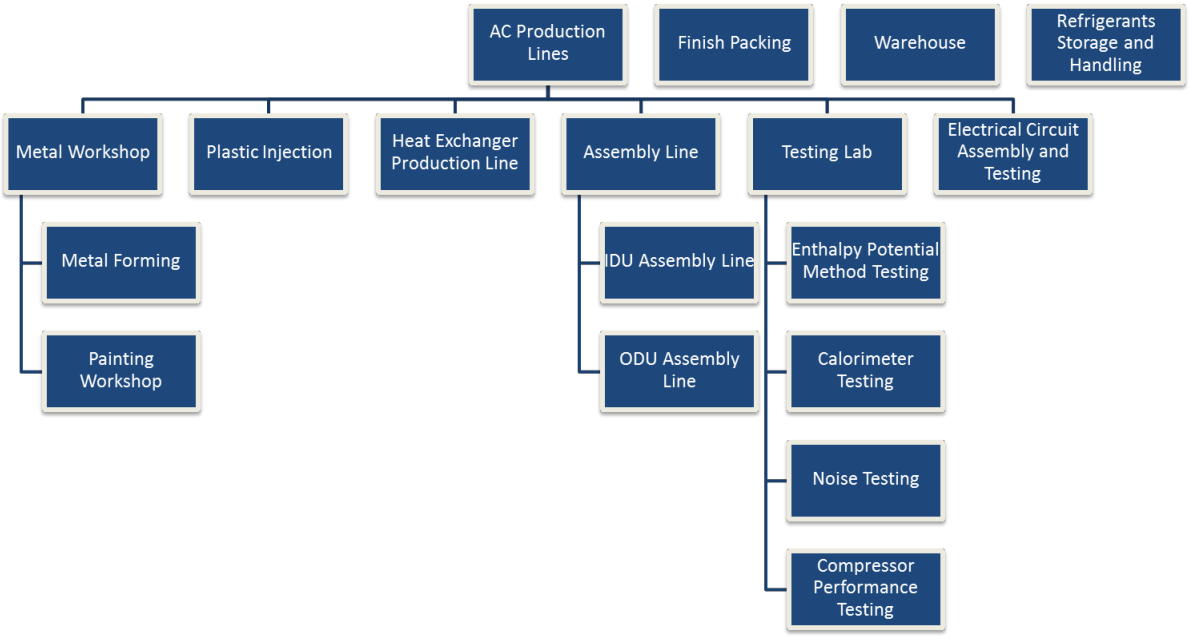
ANNEX 3 – Outline of Measures on precautions and chemical emergency response

(The Subproject owners can use this outline to prepare the measurements on precautions and chemical emergency response)

MEASURES OF CHEMICAL PRECAUTIONS AND EMERGENCY RESPONSES

CONTENTS

ANNEX 4 - Typical Air-conditioner Production Equipment and Overall Lay-out



Air Conditioner Manufacturing Processes:

This assessment is based on the observation made during site visit and the document provided from the air conditioner factories who are participating in the program to phase out HCFC-22 to HCFC-32 or HCFC-290. Many of them are a large scale where most of the parts required for AC assembly lines are produced in-house. Typically, there are three major components in the AC production lines;

1. Metal parts produced from metal forming machines. The process starts from custom cut size
   -metal sheets to be cut, folded, punched, weld, to form the casing of the AC unit. In the process of making metal parts, powder coating spray and heat treatment is commonly observed at most of the AC factories. Some of them has very well design of the working area where all metal parts production line and dry powder coating process are located separately from the area where flammable gases and solvent are used.

2. Plastic injection and molding to produce plastic case, frame, front panel and accessories.
   This includes the process of spraying liquid adhesive and installation of noise acoustic material onto the panel of the in-door units.

3. Coil making is the process of making copper, aluminum tubes, bending, expanding, brazing, and pressure testing.

4. AC Assembly is a process where all components to be assembled. Air compressor which is the most important component of the AC system is to be installed. There is a lot of brazing work during this process. The electronic components are also installed onto the units. Functional testing process is taking place during the assembly steps.

5. Refrigerant vacuum, and charging is a process take place

6. Leak Testing is a critical step to ensure there is no leak of the charged refrigerant.

7. Performance Testing is the quality control test to ensure all required quality are met the local industrial standards.

8. Packing and shipment to the warehouse

ANNEX 5 - Typical Air Conditioner Production Risk Profile

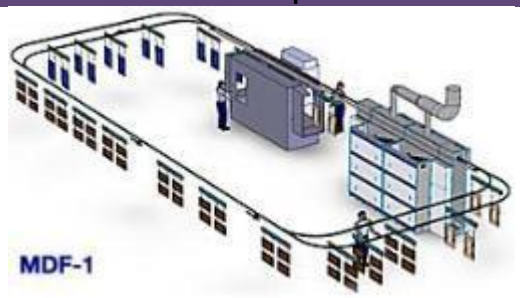
The purpose of this document is to provide a the air conditioner manufacturing overview of Occupational Health Safety and Environmental risk associated with the production processes, activities and tasks in air conditioner assembly, metal forming, powder coating , plastic parts injection, condenser units and evaporator units assembly, etc.

General guideline and best safe practices to elimination or control of all reasonably foreseeable risks are to be described. To comply with proposed control measures are the responsibility of the management of the workplace.

Table A5.1- Referenced Matrix of Activities and Potential Risks and Their Mitigation Measures
For references

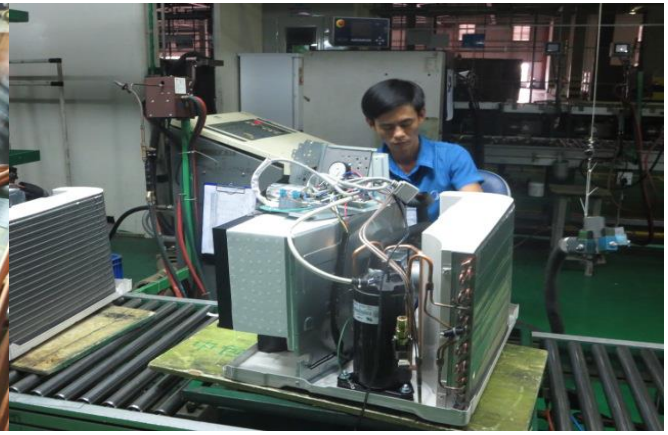
Process/ activity	Description	Potential Hazards and Risk	Suggested Control measures
Metal Parts production **Common sheet metal forming and shaping machines:** Mechanical Power Presses Power Press Brakes Powered and Non-Powered Conveyors Printing Presses Roll-Forming and Roll-	 Machine operator manually feed metal piece into the power press machine. Risk of hand and finger injury. 	 **Reciprocating Motion** is back-and-forth or up-and-down motion that may strike or entrap an employee between a moving part and a fixed object. Understanding the mechanical components of machinery, the hazardous mechanical motion that occurs at or near these components and specific employee activities performed in conjunction with machinery operation will help employees avoid injury.	 Good example: Fix guarding and limit switch that will stop the machine once the fixed guard has been removed.
Bending Machines Shearing Machine Band Saws Drill Presses Milling Machines Grinding Machines Slitters Roll Former CNC	Two hand buttons have been defeated. Risk of hand injury	Employees operating and caring for machinery perform various activities that present potential amputation hazards. Machine setup/threading/preparation, Machine inspection, Normal production operations, Clearing jams, Machine adjustments, Cleaning of machine, Lubricating of machine parts,	Effective implementation of Machine Safe Guarding Implement Lock Out Tag Out Procedure Training and Certification Preventive Maintenance Programs Housekeeping Material handling equipment Manual Handling PPE

Process/ activity	Description	Potential Hazards and Risk	Suggested Control measures
Metal parts Arc welding Spot welding			Separate lay-out Good housekeeping Keep clear from combustible and flammable material Safety sign Fire extinguisher
Metal pre-treatment **Powder Coating**	Part preparation or the pre-treatment The powder application Curing	The pre-treatment process both cleans and improves bonding of the powder to the metal. Recent additional processes have been developed that avoid the use of chromates, as these can be toxic to the environment	Solid Waste management Waste water treatment Hazardous material spill and leakage control procedure Housekeeping, Dust control PPE
Chemical pre-treatments involve the use of phosphates or chromates in submersion. These often occur in multiple stages and consist of degreasing, etching, de-smutting, various rinses and the final phosphating or chromating of the substrate.		.	Keep the workplace clean Aware of storage and handling chemical hazard MSDS Emergency eye wash and shower Training and certification

Process/ activity	Description	Potential Hazards and Risk	Suggested Control measures
Powder spray takes place in a confined spray booth. The metal work pieces are hung from the over head conveyor.		When a thermoset powder is exposed to elevated temperature, it begins to melt, flows out, and then chemically reacts to form a higher molecular weight polymer in a network-like structure. This cure process, called crosslinking, requires a certain temperature for a certain length of time in order to reach full cure and establish the full film properties for which the material was designed. Normally the powders cure at 200°C (390°F) for 10 minutes Risk of LPG gas leak, fire and explosion of the dry oven during shut down and start up.	Pre-start up check list Follow standard installation code for LPG piping and manifolds Emergency response plan that cover LPG leak
Plastic Injection This process associated with plastic injection and molding machines. Storage and handling plastic raw material. Operating machine and make sure no plastic is jammed inside the mold and catch on fire.		Fire hazards Exposure to hot surfaces Hand and finger injury when clearing jam 	Pre-start up checklist PPE Housekeeping

Process/ activity	Description	Potential Hazards and Risk	Suggested Control measures
Spraying solvent based adhesive material onto the plastic front panel and install acoustic sheet on it.	   Adhesive material is solvent based which contain toluene, or other type of solvent.	Spraying process generate emission of flammable and toxic vapor Health hazards Fire and explosion hazards	Spray booth with LEV Eliminate ignition sources Flammable liquid handling and storage Housekeeping PPE

Process/ activity	Description	Potential Hazards and Risk	Suggested Control measures
Brazing and welding Is a common activities observed in the process of making coils for condensors and evaporator. Brazing also used in the process of assembly air compressor.	  	Fire and explosion hazards associated with LPG and Oxygen mixture Health Hazard from expose to welding radiation, metal fume and the exposure to welding flux. Hand and finger injury from heat burn	Control of LPG storage, installation of LPG header, piping, regulator, valves, hoses, welding torch, and the use of flash back arrestor Control of Oxygen cylinder storage, handling, awareness of oxygen incompatibility hazards, valves, and regulator control Flash back arrestor Pre-start checklist Housekeeping Fire emergency plan Fire extinguishers Training and competency management

Process/ activity	Description	Potential Hazards and Risk	Suggested Control measures
Assembly line		Manual Handling Electrical hazards Fire hazards Portable powered tools Slip and tripping Repetitive motions and ergonomics	
Refrigerant charging	 		Storage and handling procedure Area classification Detection and alarm system LEV Pre-start up checklist Charging equipment inspection and maintenance Elimination ignition sources Leak testing procedure Fire suppression system Housekeeping Piping and manifold design criteria

Process/ activity	Description	Potential Hazards and Risk	Suggested Control measures
		See detail discussion about HFC-32 Annex 6	
Finish good handling and storage	  		Follow safe warehouse Inspect rack and storage area Keep the walkways, forklift ways clear Fire hazard inspection Leak test Housekeeping

Finish goods when charged with the refrigerant are packed inside the package that protects them from damage due to mishandling

ANNEX 6 - Summary of Material Safety Datasheet for Gases used in Air Conditioning

SAFETY DATA SHEET

Airgas

HCFC-22 Chlorodifluoromethane - CAS NO. 75-45-6

Physical property:

Colorless, volatile liquid with ethereal and faint sweetish odor. Non-flammable material. Overexposure may cause dizziness and loss of concentration. At higher levels, CNS depression and cardiac arrhythmia may result from exposure. Vapors displace air and can cause asphyxiation in confined spaces. At higher temperatures, (>250°C), decomposition products may include Hydrochloric Acid (HCI), Hydrofluoric Acid (HF) and carbonyl halides.

Transportation:

Figure A4-1: Color Code for Refrigerant container

Health Hazards:

SKIN: Irritation would result from a defatting action on tissue. Liquid contact could cause frostbite.

EYES: Liquid contact can cause severe irritation and frostbite. Mist may irritate.

INHALATION: R-22 is low in acute toxicity in animals. When oxygen levels in air are reduced to 12- 14% by displacement, symptoms of asphyxiation, loss of coordination, increased pulse rate and deeper respiration will occur. At high levels, cardiac arrhythmia may occur.

INGESTION: Ingestion is unlikely because of the low boiling point of the material. Should it occur, discomfort in the gastrointestinal tract from rapid evaporation of the material and consequent evolution of gas would result. Some effects of inhalation and skin exposure would be expected.

DELAYED EFFECTS: None Known

Flammability:
FLASH POINT: Gas, not applicable per DOT regulations
FLASH POINT METHOD: Not applicable
AUTOIGNITION TEMPERATURE: Unknown
UPPER FLAME LIMIT (volume % in air): None* LOWER FLAME LIMIT (volume % in air): None*
*Based on ASHRAE Standard 34 with match ignition FLAME PROPAGATION RATE (solids): Not applicable OSHA FLAMMABILITY CLASS: Not applicable
It is not flammable at ambient temperatures and atmospheric pressure. However, this material will become combustible when mixed with air under pressure and exposed to strong ignition sources. Contact with certain reactive metals may result in formation of explosive or exothermic reactions under specific conditions (e.g. very high temperatures and/or appropriate pressures). R-22 should not be mixed with air above atmospheric pressure for leak testing or any other purpose.

Store in a cool, well-ventilated area of low fire risk and out of direct sunlight. Protect cylinder and its fittings from physical damage. Storage in subsurface locations should be avoided. Close valve tightly after use and when empty.

US DOT PROPER SHIPPING NAME: Chlorodifluoromethane
US DOT HAZARD CLASS: 2.2 – Non-Flammable Gas
US DOT PACKING GROUP: Not applicable US DOT ID NUMBER: UN1018

HFC-32 Safety Data: Difluoromethane - CAS NO. 75-45-6

Methylene fluoride; Carbon fluoride hydride (CF2H2); Difluoromethane; Freon 32; Genetron 32; Methylene difluoride; CH2F2; R 32

Physical property: Gas. [Liquefied gas] WARNING!

- EXTREMELY FLAMMABLE GAS.
- MAY CAUSE FLASH FIRE.
- MAY BE HARMFUL IF SWALLOWED.
- CAN CAUSE TARGET ORGAN DAMAGE.
- Keep away from heat, sparks and flame.
- Use only with adequate ventilation. Wash thoroughly after handling. Keep container closed.

Flammability of the product: Flammable

Auto-ignition temperature: 530°C - Flammable limits: Lower =14% Upper = 31% Heavier than air 3.82

US DOT PROPER SHIPPING NAME: Difluoromethane
US DOT HAZARD CLASS: 2.1 – Flammable Gas
US DOT PACKING GROUP: Not applicable
US DOT ID NUMBER: UN 3252

HC-290 Safety Data: Propane - CAS NO. 74-98-6

Propyl hydride; n-Propane; Dimethyl methane; Bottled gas; propane in gaseous state; propane liquefied, n-Propane; Dimethylmethane; Freon 290; Liquefied petroleum gas; Lpg; Propyl hydride; R 290; C3H8; UN 1075; UN 1978; A-108; Hydrocarbon propellant.

Physical property: Gas. [Liquefied gas] WARNING!

- DANGER
- EXTREMELY FLAMMABLE GAS.
- MAY CAUSE FROSTBITE.
- MAY FORM EXPLOSIVE MITURES IN AIR
- MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION

Flammability of the product: Flammable

Auto-ignition temperature: 497°C - Flammable limits: Lower =1.8% Upper = 8.4% Heavier than air 1.6.

US DOT PROPER SHIPPING NAME: Propane
US DOT HAZARD CLASS: 1 – Flammable Gas

Transportation:

Always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Disposal:

The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Summary
Reference from: MSDS No. 001054 Dated from 4/27/2010
AIRGAS INC., on behalf of its subsidiaries 259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

The table A4.1 is showing ODP, GWP and lifetime depending on the type of fluid:

Table A4.1: Comparison of ODP, GWP and life time of refrigerants

Type of		ODP	100 year GWP	Life cycle	
Halons		3 to	1300 to 80 000	20 to 70 years	Prohibited ODP>0
CFC	**11**	1	3 800	45 years	
	12	1	8 100	100 years	
	115	0,6	9 300	1 700 years	
Bromide of methyl		0,6	1 300	0,7 year	
HCFC		0,05	400 to 1 800	1 to 20 years	Prohibited in 2005
HFC		0	140 to 11 700	1 to 300 years	Authorized ODP=0
PFC		0	6 500 to 9 200	10 000 to 50 000 years	
SF6		0	23 900	3 200 years	
Ammonia		0	0	few days	

Name	Formula and proportion of every constituent for mixtures	GWP (100 years)	ODP
CFC			
R11	CFCl3	400	1
R12	CF2Cl2	850	1
HCFC			
R22	CF2HCl	1700	0.055
R408A	R125/143a/22 (7/46/47)	(2650)	
R401A	R22/152a/124 (53/13/34)	(970)	
HFC			
R32	CH2F2	580	0
R125	CF3CHF2	320	0
R134a	CF3CH2F	1300	0
R143a	CF3CH3	440	0
Mixtures HFC			
R404A	R125/143a/134a	326	0
R407C	R32/125/134a (23/25/52)	152	-
R410A	R32/125 (50/50)	173	-

R422A	R125/134a/600a	253	-
R422D	R125/134a/600a	223	-
R427A	R32/125/143a/134a	1830	-
R507A	R125/143a (50/50)	330	-

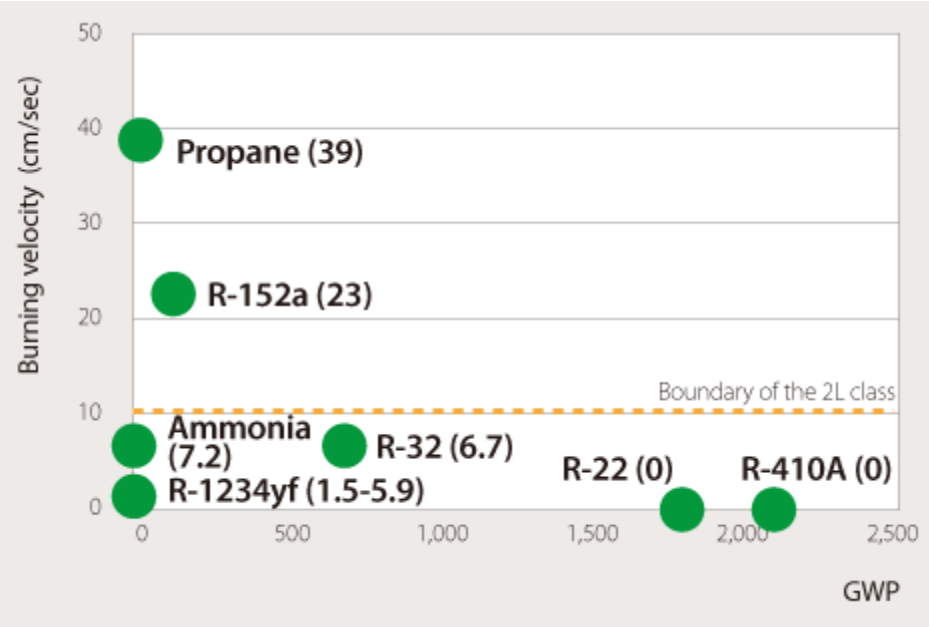
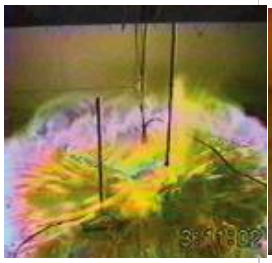


Figure A4-2: Relationship between Burning Velocity and GWP
BV is indicated in parentheses.
Source: Japan Refrigeration and Air Conditioning Industry Association (JRAIA). Risk Assessment of Mildly Flammable Refrigerants 2013 Progress Report, April 2014, The Japan Society of Refrigerating and Air Conditioning Engineers

Table A4-2: Behavior of Flames

Classification	Class 3	Class 2	Class 2L	
	A3	A2	A2L	B2L
Substance	Propane	R-152a	R-32	Ammonia
Burning velocity	39 cm/sec	23 cm/sec	6.7 cm/sec	7.2 cm/sec
Heat of combustion	46 MJ/kg	16 MJ/kg	9 MJ/kg	19 MJ/kg
Combustion state				

2L refrigerants do not horizontally propagate due to their slow BV. Additionally, heat of the combustion of R-32 is low and the range of any impact by its flame is limited.

Related information is available at the AREMA (The Air Conditioning and Refrigeration Equipment Manufacturers Association of Australia) homepage.

ANNEX 7-Area Classifications for the Design of Production Line Use Flammable Gas

Objective:

In a situation in which there may be an explosive (flammable) atmosphere, the following steps should be taken:

a) Eliminate the likelihood of an explosive gas atmosphere occurring around the source of ignition, or
b) Eliminate the source of ignition.

Where this is not possible, protective measures, process equipment, systems and procedures should be selected and prepared so the likelihood of the coincidence of a) and b) is so small as to be acceptable.

Vietnamese Legal implication:

According to Hazardous Substances registration, it is compulsory for the authority to prepare the standards for controlling;

- Ingredients
- Characteristics
- Purity
- Container and package inspection and testing requirement
- Labeling
- Manufacturing
- Importing
- Exporting
- Transportation
- Storage
- Container disposal requirement

According to Hazardous Substances, HCFCs and HFCs are classified as hazardous substance for which production, import, export or having in possession must have a license. To obtain a license, full compliance to relevant regulatory requirements is mandatory.

DoIT Notification on Storage of Chemical and Hazardous Substances establishes a complete set of directives that can be used as a reference when air conditioner manufacturer are planning for new storage area of HFC-32 or making improvement of the existing storage facility.

In summary the Chemical and Hazardous Material Storage Manual covers;

- Specific criteria for fire wall
- Type and characteristic of the floor
- Means of egress and emergency exits
- Type and characteristic of roofing material
- Ventilation requirement
- Electrical, emergency light, and electrical appliances requirement
- Lightning protection
- Detection and alarm systems
- Fire protection

Ministerial order on Fire prevention and control is applicable to all air conditioner manufacturers. Since most of the air conditioner plants are registered under the type 70, or 71 which are classified by this regulation as "medium fire risk factory". Fire detection system, fire alarm, and fire suppression system requirements are specified.

ANNEX 8 - Oxygen-Propane Brazing Safety Guideline

Oxy/fuel gas brazing is a common process in air conditioner manufacturing plant. Oxygen-Propane blow torch are used in copper tube- welding, heating, straightening. Small air conditioner plants use many Oxygen cylinders and Propane Gas cylinder in their operation. Large plant set propane and oxygen gas station outside the factory building. Gases supplied through manifold and piping system. Liquid Gas Flux connected to the gas manifold and fed into the welding/brazing tools. Oxy-Fuel welding is also being used in maintenance activity. Many people are injured each year by the incorrect or careless use of oxy/fuel gas equipment. Some people die. This guideline describes the hazards associated with portable or fixed oxy/fuel gas equipment and the precautions for avoiding injury and damage to property in air conditioner manufacturing process.

Legal obligation:

Employers are legally required to assess the risks in the workplace and take all reasonably practicable precautions to ensure the safety of workers and members of the public. Before using oxy/fuel gas equipment, a careful assessment of the risks should be carried out. This is particularly important if work is being carried out in unfamiliar surroundings.

Permit To Work System:

It recommended that the companies operate a written permit system for hot work. The permit details the work to be carried out, how and when it is to be done, and the precautions to be taken. A written permit system is likely to result in a higher standard of care and supervision. Oxy/fuel gas equipment should not be used unless it has been authorized by a suitably experienced manager or supervisor who has knowledge of the site, the work to be carried out, the risks involved and the precautions to be taken.

Training and Certification:

No one should use oxy/fuel gas equipment unless they have received adequate training in:

- the safe use of the equipment;
- the precautions to be taken;
- the use of fire extinguishers;
- the means of escape, raising the fire alarm and calling the fire brigade.

Oxy-Fuel Gas Welding Equipment:

All oxy/fuel gas processes operate in the same way. A fuel gas such as propane or acetylene is mixed with oxygen in a blowpipe (often called a 'torch') to produce a flame that is hot enough for the purpose. The main components of oxy/fuel gas equipment are:

- cylinders of oxygen and fuel gas (propane or acetylene);
- a means to shut off or isolate the gas supply, usually the cylinder valves;
- a pressure regulator fitted to the outlet valve of the
- gas cylinder, used to reduce and control gas pressure;
- a flashback arrester to protect cylinders from flashbacks and backfires;
- flexible hoses to convey the gases from the cylinders to the blowpipe;
- non-return valves to prevent oxygen reverse flow into the fuel line and fuel flow into the oxygen line;

- a blowpipe or other burner device where the fuel gas is mixed with oxygen and ignited.

ry

Oxygen Bottom Entry Regulator

LPG Rear Entry Regulator

Twin Oxygen/ LPG Hose

Blowpipe +Mixer

Cutting Attachment Nozzle

Welding Tip Cutting

Hazards and Risk:

The main hazards are from fire and explosion. These are caused by:

- careless handling of a lighted blowpipe resulting in burns to the user or others;
- using the blowpipe too close to combustible material;
- cutting up or repairing tanks or drums which contain or may have contained flammable materials;
- gas leaking from hoses, valves and other equipment;
- misuse of oxygen;
- backfires and flashbacks.

Most of the air conditioner manufacturing plant participating are not well manage the welding/brazing kits that being used in the production line. Oxygen gas cylinder should be secured to prevent falling down.

Gas hoses are in poor condition.

The flame from an oxy/fuel gas blowpipe is a very powerful source of ignition. Many fires have been caused by the careless use of oxy/fuel blowpipes. The flame will quickly ignite any combustible material it comes into contact with: wood, paper, cardboard, textiles, rubber, plastics. Many processes also generate sparks and hot spatter which can ignite these materials. In the assembly line of air conditioner process where the process of adhesive spraying is done near to the area where welding/brazing is taking place is considered high risk. The production

lay-out should be modified.

The following precautions will help to prevent fire:

- move the work piece to a safe location for carrying out the hot work process;
- remove any combustible materials (such as flammable liquids, wood, paper, textiles, packaging or plastics) from within about 10 meters of the work;
- ventilate spaces where vapors could accumulate, such as pits or trenches;
- protect any combustible materials that cannot be moved, from close contact with flame, heat, sparks or hot slag. Use suitable guards or covers such as metal sheeting, mineral fiber
- boards or fire retardant blankets;
- Check that there are no combustible materials hidden behind walls or partitions which could be ignited, particularly if prolonged welding or cutting is planned. Some wall panels contain flammable insulation materials;
- use guards or covers to prevent hot particles passing through openings in floors and walls (doorways, windows, etc.);
- maintain a continuous fire watch during the period of the work, and for at least an hour afterwards;
- Keep fire extinguishers nearby.

There is a risk of fire and explosion if oxy/fuel gas equipment is allowed to leak. Acetylene, Propane and other fuel gases are highly flammable, and form explosive mixtures with air and oxygen. Even small leaks can have serious consequences, particularly if they are leaking into a poorly ventilated room or confined space where the gases can accumulate. A leak of flammable gas could cause a flash fire or explosion. Gas leaks are often the result of damaged or poorly maintained gas control equipment, hoses, blowpipes and valves, poor connections and not closing valves properly after use.

The following precautions will help to prevent leaks:

- keep hoses clear of sharp edges and abrasive surfaces or where vehicles can run over them;
- do not allow hot metal or spatter to fall on hoses;
- handle cylinders carefully. Keep them in an upright position and fasten them to prevent them from falling or being knocked over. For example, chain them in a wheeled trolley or against a
- wall;
- always turn the gas supply off at the cylinder when the job is finished;
- maintain all equipment and keep in good condition;
- regularly check all connections and equipment for faults and leaks.

Oxygen leaks also increase the fire risk. In particular, if clothing is contaminated with oxygen, it will catch fire easily and burn very fiercely resulting in severe injury. Even fire retardant clothing will burn if contaminated with oxygen. Also oxygen can cause explosions if used with incompatible materials. In particular, oxygen reacts explosively with oil and grease.

Always take the following precautions:

- never allow oil or grease to come into contact with oxygen valves or cylinder fittings;
- never use oxygen with equipment not designed for it. In particular, check that the regulator is safe for oxygen and for the cylinder pressure.

Back Fire and Flash back hazards:

A backfire is when the flame burns back into the blowpipe often with a sharp bang. This may happen when the blowpipe is held too close to the work piece, or if the nozzle is blocked or

partly blocked. The flame may go out or it may re-ignite at the nozzle. Sometimes the flame burns back into the blowpipe, and burning continues at the mixing point. Backfires do not usually cause serious injury or damage but they indicate a fault in the equipment.

Flashbacks are commonly caused by a reverse flow of oxygen into the fuel gas hose (or fuel into the oxygen hose), producing an explosive mixture in the hose. The flame can then burn back through the blowpipe, into the hose and may even reach the pressure regulator and the cylinder. The consequences of a flashback are potentially very serious. They can result in damage or destruction of equipment, and could even cause the cylinder to explode. This could end in serious injury to personnel and severe damage to property. To protect a cylinder, you should fit flashback arresters onto the regulator, on both the fuel and oxygen supply. Arresters may be fitted on the blowpipe but these do not give protection from a fire starting in the hose. For long lengths of hose, the arresters should be fitted on both the blowpipe and the regulator.

ANNEX 9 - Summary of Project Stakeholder Consultation of Generic Environmental Management Plan for the Refrigeration and Air Conditioning Sectors

1. Introduction

The Project Stakeholder Consultation of Generic Environmental Management Plan (Generic EMP) for the Air- conditioning (AC) and Refrigeration Sectors under HCFC Phase out Project was organized at the meeting room of World Bank on 17 November, 2016. The main objective of this consultation meeting was to present the content and goal of generic EMP for Air-conditioning and refrigerant manufacturers and proposed mitigation measures for the conversion from HCFC-22 to other alternative gases such as HFC-32, NH3 or HC-290.

The meeting is the second change for stakeholder consultant.

2. Background and Objectives

The HCFC Phase out Management Plan (HPMP) Stage II was continued from the Stage I by MONRE with assistance from the World Bank with the main objective to assist Vietnam to comply with the Montreal Protocol HCFC phase out obligations. The Executive Committee of the Multilateral Fund has already approved in principle the grant fund to Vietnam through the World Bank to implement activities proposed under HPMP Stage II during 2017-2020. In air-conditioning sector, HPMP Stage II will provide financial and technical assistance to 5 AC manufacturers with major Vietnamese-ownership to convert to HFC-32 or HC-290. In refrigeration sector, HPMP Stage II will provide financial and technical assistance to 34 refrigeration manufacturers among of 71 known ones.

Given that 5 AC manufacturing and 34 refrigerant enterprises have been already identified and already confirmed their participation in the HPMP Stage II. The Executive Committee of the Multilateral Fund has already approved grant funds to these companies to convert to HFC-32 technology. A site- EMP must be prepared for individual enterprise following the generic EMP and be submitted as part of the sub-project proposal. Therefore, this stakeholder consultation would be a good forum to disseminate outcomes of generic EMP preparation as well as to receive valuable feedbacks from the stakeholders to improve and finalize the EMP, then later, each enterprise could complete and implement their own site-EMP.

The first consultant is aimed to explore the potential risks and challenges for conversing the refrigerants during the due diligent of the World Bank team conducted from 6 to 10 November, 2015; 26 January, 2016 and from 12 August to 16 September, 2016. There were 11 participants from relative agencies attending this consultation, including Phuong Nam, SAREE, REE, Midea, Metero, Dien An, Darling, Ngo Long, 6M, Viet Trust, and Phu Vuong.

There were 10 participants from relative agencies attending this consultation, including Hoa Phat, My Viet, Dien An, SYTMHMC, PMU, MONRE, etc. The consultant prepared the project summary EMP and generic EMP, a questionnaire which were sent to enterprises one week before meeting. For those enterprises could not attend the meeting, they can send their concerns and comments via email.

3. Presentation on Generic Environmental Management Plan for the Air-conditioning or Refrigeration Sectors

3.1 The consultants presented scope and content of generic EMP and provided an overview of related law and regulations for which the AC and refrigeration enterprises need to comply for the conversion gas HFC-32 or NH3 and HC-290 technology, which are more flammable, therefore, all enterprises must follow and comply the following regulations such as:

- Occupational Safety and Health law 2015;
- National Technical Regulations QCVN 06:2010/BXD by Ministry of construction regarding fire safety prevention for buildings and structures.
- National Technical Standard TCVN 3890:2009 regarding Fire Prevention and Protection Equipment for buildings and structures – arrangement, check and maintenance.
- National Technical Standard TCVN 5760 regarding Fire Prevention and Protection System – General requirement on design, installation and utilization.
- National Technical Standard TCVN 2662: 1995 regarding Fire Prevention and Protection for Buildings and Structures – Design Requirements
- TCVN 2622:1995 regarding fire prevention and protection for buildings and structures – Design requirement
- TCVN 9385:2012 regarding protection of structures against lightning.
- TCVN 5507: 2002 regarding "Hazardous chemicals - Code of practice for safety in production, commerce, use, handing and transportation"
- Circular No. 20/2013/TT-BCT dated 5 August, 2013 on the implement of Decree No.26/2011 and regulation of plans and measures on precautions, chemical emergency response for industrial sectors.
- Circular No 11/2014/TT- BCA of the Ministry of Police on Fire prevention and protection dated 12 March, 2014 on detailed regulations in Decree No. 35/2003/ND-CP dated 04 March 2003, Decree No. 46/2012/ND-CP dated 22 May 2012.
- QCVN 07:2009/BTNMT: National technical regulation on hazardous waste thresholds.
- Discharge, emission, and Waste management shall meet minimum requirement as stated on the QCVN 06:2009/BTNMT; QCVN 07:2009/BTNMT, QCVN 14:2006/BTNMT; QCVN 40:2011/BTNMT.

3.2 The consultant also raised the responsibility of enterprises related on environment. The discussion was opened with all stakeholders and find out that all participating enterprises were able to fulfill their legal environmental protection responsibility.

3.3 The consultant presented main potential adverse impacts due to refrigerant changes. The consultant proposed mitigation measures and good practices which were introduced in the generic EMP. The major areas to be associated with alternative gases are (i) charging line, (ii) storage area of alternative gases and (iii) the storage area of finished products.

3.4 The requirements of monitoring, training and reporting was also presented.

- For the storage area of HFC-32 or HC-290, there is need for installation of gas detector to alert the enterprise as well as exhaust fan to dilute HFC-32 or HC-290 concentration from the ground (as they are heavier than air, the exhaust fan should installed at the low ground level);
- The charging line needs to have at least exhaust fan, but the gas detector may be needed depending on the condition of the enterprise;
- Refrigerant cylinder should not be put in the same place with oxygen tank. Liquefied oxygen cylinder and LPG cylinder should be 6 meter away from HFC-32/NH3/HC-290 cylinder or must have fire wall. Crane and sling need to be check regularly;
- HFC-32 is a liquefied gas and less flammable when compare with LPG. However, safety transport HFC-32 cylinder is essential. HFC-32 cylinder should be put on the pallet and use fork lift to lift the pallet not directly life HFC-32 cylinder;
- HFC-32 is heavier than air and will sink down. Leaked HFC-32 can penetrate to drainage system and reach smoker outside the working area. This will cause back fire to the leaked storage tank or assembly line;
- Enterprise should be aware of back fire and flash back when dealing with oxygen tank. A diabetic compression and flask back arrester is important. No flashback arrester will cause back fire or flash back and lead to hire hazard;
- The enterprise shall ensure that no free standing compressed gas cylinder will be allowed and avoid boiling liquid expanding vapor explosion (BLEVE).
- Zoning classification of the working area was explained to the stakeholders.
- The consultant emphasized the project proponents to ensure the continuity of the implementation of those mitigation measures.
- NH3 is toxic and flammable gas which needs more investment and concerns on safety and fire precaution and fire fighting.

4. Comments Received from Air-conditioning or Refrigeration Enterprises

The enterprises expressed that they have experience in using LPG and thus have no objection with the proposed mitigation measures for HFC-32, NH3 and HC-290. With these mitigation measures, the enterprises can design the plant layout to suit the use of HFC-32, NH3 or HC-290. Participants expressed the following recommendations/suggestions to improve the EMP:

- One enterprise raised a concern on high cost of installation of gas detector when compared to the approved funding by the Executive Committee. The approved funding may not be sufficient for the enterprise to install the device. The World Bank should consider the approval of reallocation of approved funding from other component i.e. incremental operating cost to cover the deficit of the budget;
- The poor practice during transportation of finished products to the end user's site should be improved. HCFC-22 is not flammable gas and the poor practice does not affect the safety of the transportation (but may affect the condition of the product). Awareness should be educated to the workers of the retailers and wholesalers. Moreover, the use of warning label at the box of the products would help to increase

awareness of the workers;

- For storage of finished product, the need for gas detector depends on the practice of the enterprises (i.e. the enterprise has checked leak test during the assembly process or not). The enterprise may consider installing sprinkle at the storage warehouse of finished product but not gas detector;
- Suppliers of oxygen tank, refrigerant cylinder, LPG cylinder should play an important role and responsibility to support the AC and refrigeration enterprises in dealing with flammable substances.
- The Government or the Bank should enforce the enterprises collect and treat the old gas (HCFC-22) when doing maintenance or replacing them with new gas in service sectors to avoid discharge them to environment.

5. List of Stakeholders and meeting persons

Mr. Dinh Hoang Chuong – tel: 003820352
Phuong Nam Company

Mr. Huynh Nhat Vu – tel: 0909026262
Sai gon Electric Appliances Co., Ltd.
SAREE

Mr. Khoa, Administration Manager
Ms. Trang, Executing manager – tel 0913909395
Metero Company

Mr. Dinh Van Hien
General Director
Dien An Co., Ltd

Mr. Nguyen Chi Toan – tel0908080123, Vice Director
Mr. Doan Van Huong, Factory Manager
R.E.E Electric Appliances J.S. Company

Mr. Duong Van Thao, A/C factory manager
Mr. Dam Hai Binh, factory manager
Ms. Nguyen Thi Hoa, Admin. Officer
Midea Consumer Electric (VN) Co. Ltd.

Mr. Ngo Nguyen Ngoc Sang
Deputy Director
Phu Vuong Corp.

Mr. Nguyen The Long, Vice Director 090620227
Darling Electronic –Refrigeration Co. Ltd.

Mr, Ngo Tu Diep, General Director – 0903888999
Mr. Ngo Tu Quarng, Vice Director – 0902004949
Ngo Long Co. Ltd.

Mr. Canh
6 M Co., Ltd.

Mr. Nguyen Van Hung – factory Manager
Mr. Tran Van Son – Chairman of Financial Committee
Viet Trust Co., Ltd.

6. *List of Stakeholders attend the* **2nd** *consultation meeting*

Tran Ngoc Tuan
Vice Director of Hoa Phat Com. Ltd.

TranThi Minh Chinh, Pham Nhat Quang
My Viet Com. Ltd.

Vu Manh Cuong
Director of LLMC

Dinh Van Hien
SYTM HMC Com. Ltd.

Pham Phan Anh Thu, Vu Thi Thu Thuy
Nagakawa VN

Tran Van Cuong

Hoang Minh Quan, Le Cam Van
HPMPI- PMU

Photo of survey - Some snap-shots of products and activities in project enterprises

		
Air conditioner product of Nam Phuong Co.Ltd	**Air conditioner product of SAREE Co.Ltd**	**Air conditioner product of REETECH Co.Ltd**
		
Production line of AC	**Gas Compressor**	**Gas recharging**
		
Products	Make 1 unit	**Packaging**