GOOD ENVIRONMENTAL MANAGEMENT PRACTICES FOR THE INDUSTRIAL GAS INDUSTRY

AIGA 006/15

Revision of AIGA 006/10

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As part of a programme of harmonization of industry standards, the Asia Industrial Gases Association (AIGA) has issued publication 006, *Good Environment Management Practices for Industrial Gases Industry*, jointly produced by members of the International Harmonisation Council and originally published by the European Industrial Gases Association (EIGA) as IGC Doc 88, *Good Environment Management Practices for Industrial Gases Industry.*

This publication is intended as an international harmonized publication for the worldwide use and application by all members of the Asia Industrial Gases Association (AIGA), Compressed Gas Association (CGA), EIGA, and Japan Industrial and Medical Gases Association (JIMGA). Each association's technical content is identical, except for regional regulatory requirements and minor changes in formatting and spelling.

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Contents

Appendices

Amendments to 006/10

Section	Change
All	Editorial to align style with IHC associations
2.1	Nitrous oxide manufacturing added to include all processes covered in existing appendices.
2.2	Text edited to provide more clarity for environmental aspects.
3.1	Publication terminology
4 and 5	‘Emissions’ added to list of aspects in multiple places for clarity.
6	References section added and revised
Appendices A through I	Revised to for completeness and clarity and to reflect operational experience

Note: Technical changes from the previous edition are underlined

1 Introduction

This document is a practical guide to good environmental management practices in the industrial gases industry and has been developed in conjunction with the European Industrial Gases Association who publishes this guidance as EIGA Doc 88 [1] [1]. It can be used on its own or in conjunction with other AIGA publications on environmental management.

The environmental management system standard ISO 14001 *Environmental Management Systems – Requirements with guidance for use* [2] requires organisations to review their environmental aspects and put in place practices to minimise and control their impacts. This document provides a standardised list that can be used in any industrial gas company.

2 Scope and purpose

2.1 Scope

This document provides guidance on good environmental management practices to industrial gas facility managers. It does not give specific advice on health and safety issues, however consideration shall always be given to these issues when conducting operational risk assessments before undertaking any activity.

Industrial gas facilities have distinct activities and associated environmental aspects that can impact the environment. This publication provides good environmental practices at air separation and helium production facilities, hydrogen and carbon monoxide facilities, and carbon dioxide facilities. It also provides good environmental practices for truck maintenance and distribution, acetylene and nitrous oxide manufacturing, cylinder fill operations, specialty gases operations and customer installation (bulk tanks) activities.

2.2 Purpose

This publication identifies typical industrial gas industry activities and associated environmental aspects that can have a negative impact on the environment and identifies corresponding practices that can minimize or eliminate those impacts.

Environmental aspects can include solid/hazardous waste, air emissions, waste water discharges, storm water discharges, noise, and releases generated at various industrial gas facilities.

For each activity, environmental aspects, potential environmental impacts, and good environmental management practices (GEMP) have been identified that can be used to prevent pollution, minimize the generation of wastes, discharges and releases, manage any residuals and use of energy, raw materials, water and land.

3 Definitions

For the purpose of this publication, the following definitions apply.

3.1 Publication terminology

3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should

Indicates that a procedure is recommended.

[1] References are shown in bracketed numbers and are listed in order of appearance in the reference section

3.1.3 Will

Is used only to indicate the future, not a degree of requirement.

3.1.4 May

Indicates that the procedure is optional.

3.1.5 Can

Indicates a possibility or ability.

3.2 Environmental aspect

Element of an organization's activities, products or services that can interact with the environment.

3.3 Environmental impact

Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services.

3.4 Good environmental management practices (GEMP)

Suggested practices that can be used to minimize or eliminate potential environmental impacts.

4 Implementing good environmental management practices

Companies should periodically and systematically review processes and operating practices to identify waste, emissions, discharges, and release reduction opportunities, and to optimise the use of resources.

Conducting an inventory assists in targeting pollution prevention opportunities. When conducting an inventory, the following information should be gathered for each waste, emission, discharge or release to assist in prioritising opportunities:

- Source of each major waste, emission, discharge or release;
- Rates of generation;
- Toxicity or hazard characteristics; and
- Disposal method and costs.

When implementing GEMP, preference should be given to the following waste minimization hierarchy:

- Reduce at source (most preferred);
- Reuse or recycle;
- Treatment and/or energy recovery; and
- Disposal (least preferred).

Objectives and targets for improvement should then be set for the priority items, and these targets should be monitored, measured and reviewed on a regular basis.

When practical, companies should systematically identify and implement GEMP applicable to their operations. Where laws and regulations have requirements more stringent than those found in this publication, they should be followed.

Site Managers should promote employee awareness and conduct training of GEMP that apply to their site. Periodic feedback and suggestions should be solicited from employees on ways to minimize wastes, emissions, discharges and releases. Employees should be recognized for significant ideas that improve environmental performance and reduce the generation of wastes, emissions, discharges and releases.

5 How to use the appendices

The appendices identify GEMP applicable to pollution prevention opportunities at the following types of facilities, processes and operations.

Not every facility or operation has every source, waste, emission, discharge or release listed in each applicable appendix. Site Managers should use the appendices as a library to identify those sources of potential pollution that do apply to their facility and then implement the recommended, applicable GEMP to the extent practical.

Appendix A lists non-process-specific sources of wastes, emission, discharges and releases common to many industrial gas facilities. One or more of the remaining Appendices can apply depending on the specific processes at the site.

- Appendix A - GEMP for all facilities
- Appendix B - GEMP for air separation units (ASU) and helium production facilities
- Appendix C - GEMP for hydrogen/carbon monoxide (HyCO) units
- Appendix D - GEMP for carbon dioxide production and dry ice facilities
- Appendix E - GEMP for truck maintenance and distribution terminals
- Appendix F - GEMP for acetylene manufacturing operations
- Appendix G - GEMP for cylinder fill and cylinder maintenance operations (including specialty gas operations)
- Appendix H - GEMP for customer installations
- Appendix I - GEMP for nitrous oxide manufacturing plants

6 References

Unless otherwise stated, the latest edition shall apply

[1] EIGA Doc 88/14 *Good Environmental Management Practices for the Compressed Gas Industry*, *European Industrial Gases Association,* www.eiga.eu

[2] ISO 14001, *Environmental Management Systems - Requirements with guidance for use,* International Organization for Standardization, www.iso.org

[3] AIGA 012, *Cleaning Equipment for Oxygen Service*, *Asia Industrial Gases Association*,

[4] EIGA Doc 33, *Cleaning Equipment for Oxygen Service, European Industrial Gases Association,* www.eiga.eu

[5] EIGA Doc 85, *Noise Management for the Industrial Gases Industry*, *European Industrial Gases Association*, www.eiga.eu

[6] CGA P-22*, The Responsible Management and Disposition of Compressed Gases and their Cylinders,* Compressed Gas Association, Inc, www.cganet.com

[7] CGA G-1.5, *Carbide Lime: Its Value and Uses*, *Compressed Gas Association, Inc.*, www.cganet.com

[8] EIGA Doc 143 *Guide to Lime Applications, European Industrial Gases Association*, www.eiga.eu

[9] AIGA Doc 083, *Disposal of Gases*, *Asia Industrial Gases Association*, www.asiaiga.org

[10] AIGA Doc 036, *Guidelines for the Management of Waste Acetylene Cylinders*, *Asia Industrial Gases Association*, www.asiaiga.org

APPENDIX A - GEMP for all facilities			
Activity/Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Batteries	Heavy metals	Waste disposal	Segregate and recycle to the extent feasible.
Boilers, hot water heaters, emergency generators (Fossil fuel-fired)	Particulate matter, carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide	Air Energy	Operate in accordance with air permit, where applicable. Operate and maintain equipment to be efficient. Use fuel with low sulphur and solids content.
Boiler blow-down	Wastewater, corrosion inhibitors, acids, caustics, oxygen scavenger	Surface water	Discharge through a permitted outfall or sewer connection. Avoid excessive chemical feed through tight control of water chemistry. Run boiler at optimum concentration cycles to minimize chemical loss, wastewater discharges, and makeup water consumption. Purchase water treatment chemicals in returnable /recyclable containers, where practical.
Boiler water softener regeneration	Wastewater, salts	Surface water	Discharge through a permitted outfall or sewer connection. Reuse wastewater, if feasible.
Building	Heating, lighting, air conditioning	Energy use	Monitor energy use. Set improvement targets. Use energy efficient lighting and equipment. Conduct energy audits. Train employees to conserve energy
Building, floor drains	Solvents, oils, detergents, chemicals	Surface water Soil Groundwater	Keep solvents, oils, and other hazardous materials out of floor drains through proper storage and handling. Use floor drain plugs in areas of high spill potential or seal drains that are not needed. Maintain an adequate supply of spill kits in areas of high spill potential. Avoid hosing down areas. Use dry clean-up techniques.
Building and insulation materials	Asbestos	Air Waste disposal	Notify the appropriate agency in advance, as required, of any asbestos demolition or renovation. Use only qualified asbestos removal contractors when removing or repairing asbestos. Contractors shall remove asbestos materials according to regulatory requirements. Place waste in double-lined plastic bags or in drums with proper labels. Wet down asbestos during removal, handling, and disposal. Dispose of asbestos through an approved disposal contractor.

APPENDIX A - GEMP for all facilities			
Activity/Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Chemical and waste loading/unloading areas	Fuel and fuel additives, heating oil, acetone, lubricating oils, solvents, bleach, sulphuric acid, biocides, ethylene glycol, propylene glycol, water treatment corrosion inhibitors, caustics, used oil, and similar chemical or waste-like materials	Soil Surface water Groundwater Air	Avoid positioning transport vehicles near or over storm drains. Attend loading/unloading activities where safe and practical. Have spill kits, absorbent booms, sewer block mats readily available. Check integrity of transfer hoses, fittings, and connections. Ensure the correct fill lines and containers/tanks are identified before loading/ unloading. Illuminate unloading areas if material transfer occurs at night. Use drip pans and buckets to catch small leaks from transfer hoses and fittings. Prevent overfilling of storage tanks during deliveries through procedural or engineering controls. Report and clean up any spills or leaks immediately. Develop and implement a site emergency/spill plan.

APPENDIX A - GEMP for all facilities			
Activity/Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Chemical and waste storage areas	Fuel and fuel additives, heating oil, acetone, lubricating oils, solvents, bleach, sulphuric acid, biocides, ethylene glycol, propylene glycol, water treatment corrosion inhibitors, used oil, and similar chemical or waste-like materials	Soil Surface water Groundwater Air	Store liquid chemicals in proper containers, preferably on an impervious surface with secondary containment. Periodically check container integrity for signs of deterioration or damage. Document if required. Periodically check containment areas for leaks. Document if required. Keep containment valves closed except to drain uncontaminated rainwater. Keep containers closed when not in use. Prevent exposure to rainfall, use drum rain caps for drums stored outside. Store outdoor containers off the ground (e.g., on pallets) to prevent bottom corrosion, possible leakage, and assist in visual inspection. Minimize and consolidate chemical inventories. Do not buy larger quantities than needed simply to get a lower price. Disposal costs will often exceed savings. Use existing chemical inventories before switching to another supplier. Redistribute excess chemicals for use at another facility. Place drip pans beneath drum dispensing valves. Report and clean up any spills or leaks immediately. Prevent overfilling of storage tanks during deliveries through procedural or engineering controls. Develop and implement a site emergency/spill plan. Designate separate areas for waste storage and chemical storage. Ensure that all chemical and waste containers have proper labels. Do not mix hazardous and non-hazardous wastes. Post signs for designated hazardous waste storage areas.
Demolition and construction debris	Concrete, asphalt, metal, miscellaneous	Waste disposal	Identify and remove any asbestos materials before demolition. Recycle concrete, asphalt, and scrap metal where outlets are available. Dispose of through an approved disposal contractor. Reuse surplus soil to landscape site if feasible and acceptable.

APPENDIX A - GEMP for all facilities			
Activity/Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Drums (empty)	Recyclable materials	Use of natural resource Waste disposal	Purchase chemicals in bulk form or use recyclable/ returnable containers, where practical. Remove chemical residuals to the extent possible. Return empty drums to original supplier or recycle through an approved drum reconditioner.
Equipment and parts cleaning	Solvents and detergents	Soil Surface water Groundwater Air	Advice on cleaning for oxygen service can be found in CGA G-4.1, *Cleaning Equipment for Oxygen Service*, and EIGA Doc 33, *Cleaning equipment for oxygen service* [3,4].[2] Minimize solvent/chemical purchases and use. Do not buy and use more than needed. Ensure that all solvent chemical containers have proper labels. Keep containers and parts cleaners closed when not in use. Use drip pans to collect solvents. Collect spent solvents for recycling or disposal through a licensed vendor. Do not pour solvents down any drains or on the ground. Do not mix spent solvents with used oil or other chemicals. Report and clean up any spills immediately and follow emergency procedures. Determine if spent detergents can be discharged to sanitary sewer.
Fluorescent light fixtures	Mercury, polychlorinated biphenyls (PCB) ballast in older fixtures	Waste disposal	Recycle/dispose lamps and ballast via approved recycling/disposal contractor. Pack suitable for transport to prevent breakage when transporting for recycle/disposal (e.g., Keep original packaging) Replace with energy efficient and mercury-free or low-mercury lamps.

[2] References are shown by bracketed numbers and are listed in order of appearance in the reference section.

APPENDIX A - GEMP for all facilities			
Activity/Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Fuelling island / station	Diesel fuel, gasoline, and additives	Soil Surface water Groundwater Air	Check fuel dispenser sump routinely for leaks and product/water accumulation. Maintain adequate supply of spill absorbent at fuelling station. Where present, periodically check oil/water separator. Check housekeeping. Remove any oil-stained gravel. Avoid topping off vehicle fuel tanks. Avoid unattended filling of vehicles. Avoid hosing down area. Use dry clean-up techniques. Minimize rain/storm water run-on into fuel island area. Install canopy, where practical, to keep rainfall off fuelling island. Report and clean-up spills immediately.
Halon fire suppression systems	Halon	Depletion of ozone layer	Maintain system to avoid leaks. As suitable halon replacements are identified, recover halon and place in halon banks. New systems shall be designed without halon.
Mercury switches and other mercury-containing devices	Mercury	Waste disposal	Recycle or dispose by approved contractor. Have mercury spill kits available.
Oil contaminated soil/debris	Oily rags, leak/spill clean-up materials, oily soils	Soil Surface water Waste disposal	Dispose of through an approved disposal contractor. Recycle through an approved asphalt batching or other appropriate recycling facility plant when available. Clean up oil stained soil/gravel promptly.
Oil/water separators	Oil, oily water, oily sludge	Surface water Soil Groundwater	Minimize solids from going into drains routed to an oil/water separator. Periodically clean out separator to maintain optimum oil removal efficiency. Routinely remove accumulated oil and sludge and recycle through an approved oil recycler. Test sludge for hazardous constituents. Do not mix solvents or other chemicals with used oil. Periodically inspect integrity of separator.

APPENDIX A - GEMP for all facilities			
Activity/Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Painting of buildings and equipment	Paint residue, solvents, abrasive blasting material	Air Soil Surface water Groundwater Waste disposal	Use water-based and low VOC paints to the extent possible. Analyze old paint before removal to determine if toxic metals such as lead, chromium, or cadmium hazard exist. Collect abrasive-blasted wastes. At the end of each day, secure wastes in appropriate containers. Monitor paint contractor's operations, including material storage areas, and have contractor provide temporary spill containment around portable equipment containing diesel or gasoline. Dispose of paint chips, abrasive blasting material, and associated painting supplies (e.g., tarps, brushes, rollers, rags, empty paint cans) as solid or hazardous wastes (depending upon analytical results) using an approved disposal contractor. All residual paint should be dry before disposal. Use brush or roll-on paints instead of aerosol paints, where practical. Dispose of all solvent-based paints and thinners through an approved disposal contractor.
Power supply, transformers, and capacitors	Mineral oil, PCB oil Sulfur hexafluoride$_6$	Soil Surface water Groundwater Waste disposal Greenhouse gas emissions	Periodically check equipment for leaks. Schedule periodic maintenance of equipment. Report and clean up any leaks immediately. Replace or retrofill PCB transformers or PCB capacitors. Always test equipment for presence of PCBs before disposing of oils or equipment. Never assume there are no PCBs. Arrange for disposal of mineral oils or PCBs through an approved disposal contractor.
Product venting, compressors, traffic, etc.	Noise	Community	Design and install compressors, expanders, and other equipment in accordance with local noise requirements. Use appropriate noise-attenuation measures as required (e.g., sound insulation, noise curtains, buildings, walls). Select sites with adequate land and distance to buffer noise. Site equipment in a location that will minimize the noise impact to neighbours. Minimize night-time noise-generating activities. Refer to EIGA Doc 85, *Noise management for the industrial gases industry* [5].

APPENDIX A - GEMP for all facilities			
Activity/Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Sanitary waste (foul) systems	Sewage	Surface water Soil Groundwater	Do not dispose of chemicals down sinks, drains, or toilets. Dispose of sanitary wastes through permitted municipal sanitary sewer, septic system, or onsite treatment. When on-site treatment is used, conduct appropriate preventive maintenance and testing. Keep operator certifications current, where required.
Scrap metal, including cylinder valves, cylinders (except acetylene cylinders), used equipment, etc.	Recyclable materials	Natural resource Waste disposal	Purge any gases from scrap cylinders. Remove any fluids contained in equipment. Check any coatings or insulation on the equipment for asbestos and if present remove before scrapping equipment. Recycle through scrap metal dealer. Refer to CGA P-22, *The Responsible Management and Disposition of Compressed Gases and their Cylinders*.[6]
Storage tanks– aboveground (ASTs)	Heating oil, diesel fuel, acetone, used oil, gasoline, etc.	Soil Groundwater Surface water Air	Provide secondary containment for tank and fill port. Provide overfill protection. Obtain regulatory approvals. Install barriers to protect tank from vehicular traffic. Periodically inspect the tank system. Provide spill kit near tank. Prepare emergency plan to handle accidental discharges.
Storage tanks– underground (USTs)	Heating oil, diesel fuel, acetone, used oil, gasoline, etc.	Soil Groundwater Surface water Air	Install double-walled tanks and lines with release detection systems, spill collars, overfill protection, and cathodic protection for steel tanks and lines. Conduct and document monthly release detection monitoring specified for the site's UST system. Periodically inspect spill collar/fill port. Periodically check spill/overfill devices. Conduct regular inspection of tank and line release detection system using a qualified contractor to ensure proper operation. Periodically inspect cathodic protection systems using a qualified contractor. Report suspected leaks immediately. Report and clean up any spills immediately. Avoid unattended filling of storage tank.

APPENDIX A - GEMP for all facilities			
Activity/Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Transportation–employees	Noise, exhaust fumes, fuel consumption	Air Global warming Community	Set up company transport plans to minimize the need to travel. Use e-mail, voice mail, and videoconferencing. Use car pooling/sharing, public transport. Provide training for vehicle drivers.
Transportation–product	Fuel, oil, grease, antifreeze, product, fuel additives, emissions and spills	Air Water Noise Land use Energy use	Consider best supply option (e.g., on-site production). Minimize transportation distances. Purchase and maintain vehicles to be fuel efficient and minimize air emissions. Avoid truck routes through residential neighbourhoods and minimize night-time transport through residential neighbourhoods. Carry spill kits on vehicles and have an emergency response plan in place.
Trash (plant non-hazardous waste)	Waste, recyclable materials	Use of natural resource Waste disposal	Segregate and recycle materials to the extent feasible (e.g., waste paper, aluminium cans, cardboard, wood pallets, packing materials). Dispose of waste through an approved disposal contractor.

Appendix B—GEMP for air separation units and helium production facilities			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Argon production	Ammonia (if ammonia dissociation method used)	Air emission	Regular maintenance to minimize emissions. Switch to hydrogen supply, where practical.
Cold box insulation	Rock wool, perlite, vermiculite	Waste disposal Energy efficiency	Check for ice spots. Replace insulation on shutdown. Reuse perlite and vermiculite as a soil conditioner, where allowed. Recycle, where possible. Dispose of as solid waste through an approved disposal contractor.
Compressors and vacuum pumps	Lubricating oil	Soil Surface water Waste Disposal Groundwater	Minimize leaks through preventive maintenance. Where present, keep foundation curbing and drains free of debris for effective drainage to oil/water separator. Use absorbents to minimize oil seepage off foundations that are not tied to an oil/water separator. Where practical, install roof over compressors to prevent contaminated storm water. Recycle used oil and, where possible, saturated absorbents through an approved oil recycler. Do not mix solvents or other chemicals with used oil. Used oil contaminated with refrigerants or solvents requires special disposal. Return empty drums to original supplier or recycle through an approved drum reconditioner, where practical.
Compressor–condensate	Low pH (acidic), copper, nickel, lead	Surface water Groundwater	Do not discharge onto the ground. Discharge through a permitted outfall or sewer connection. Reuse as makeup to cooling tower, where feasible. Treat any excessive levels of metals. Neutralize low pH before discharging.
Compressor– vents	Lubricating oil mists	Air Soil Surface water	Install oil demisters to collect oil mist emissions. Recycle the collected oil through an approved oil recycler.
Cooler system–chemical wash	Acids, metals, solids, chelants	Surface water Waste disposal	Dispose of spent chemical cleaning solutions through an approved disposal contractor.

Appendix B—GEMP for air separation units and helium production facilities			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Cooling systems–closed loop	Ethylene glycol, propylene glycol, and similar heat exchange fluids	Soil Surface water Waste disposal Groundwater	Minimize leaks through preventive maintenance. Maintain proper level of corrosion inhibitors to extend life of solutions. Recycle glycols by approved recycler. Dispose of spent solutions through an approved disposal contractor.
Cooling tower–blowdown	Biocides, acids, corrosion inhibitors	Surface water Natural resource	Discharge through a permitted outfall or sewer connection. Avoid use of chromate-based or zinc-based corrosion inhibitors. Avoid excessive chemical feed through tight control of water chemistry. Run cooling tower at optimum concentration cycles to minimize chemical loss, wastewater discharges, and makeup water consumption. Purchase water treatment chemicals in bulk or returnable containers instead of drums, where practical. Return empty drums to original supplier or recycle through an approved drum reconditioner, where practical. Use of existing supplier of chemicals and obtain any necessary permit modifications before switching chemicals.
Cooling tower–mists	Legionella risk	Legionella	Planned maintenance and disinfection of cooling systems. Regular testing of systems for Legionella.
Cooling tower–sidestream filter backwash	Solids	Surface water	Treat if required before discharge through a permitted outfall or sewer connection.
Cooling tower–sludge	Solids, heavy metals (chromium, copper, zinc)	Waste disposal	Test for presence of heavy metals to determine if a hazardous waste. Dispose of through an approved disposal contractor.
Electricity	Indirect	Energy use Air Water Solid waste	Design, purchase, and maintain equipment to operate efficiently and minimize energy use. Conduct energy audits to identify potential opportunities to improve energy efficiency. Train employees to conserve energy.
Fuel-fired vaporizers and temperature swing adsorption units	Particulate matter, carbon monoxide, hydrocarbons, nitrogen oxides, sulfur dioxide	Air Energy	Operate in accordance with air permit, where applicable. Operate and maintain equipment to be efficient. Use fuel with low sulfur and solids content.

Appendix B—GEMP for air separation units and helium production facilities

Source	Environmental Aspect	Potential Impact(s)	Good Environmental Management Practices
Ion mobility analyzers, helium ionization detectors, dewpointers	Radioactive materials	Waste disposal	Return radioactive cells to manufacturer. Do not throw in normal (waste) trash. Report all pending transfers of radioactive materials to and from the site to applicable regulatory agencies. Perform wipe tests for leaks, where required. Maintain all warning labels on analyzers. Obtain appropriate regulatory approvals to own and use radioactive materials.
Prepurification units	Silica gel, molecular sieve, alumina, activated charcoal	Waste disposal	If feasible, recycle, reuse, or regenerate molecular sieves. Dispose of as solid waste through an approved disposal contractor.
Process refrigeration–ammonia systems	Ammonia	Accidental release, fugitive release	Minimize leaks from valves, flanges, etc., through preventive maintenance. Use purging systems designed to minimize refrigerant releases. Recover ammonia to the maximum extent possible during maintenance through receivers. Use water-scrubbing systems to treat major ammonia releases.
Process refrigeration–Refrigerant systems	Refrigerants (CFCs, HCFCs, HFCs, PFCs), ammonia	Ozone depletion Global warming Air	Minimize leaks from valves, flanges, etc., through preventive maintenance. Monitor and document the rate of consumption of refrigerants and ammonia to detect leaks. Repair leaks promptly. Do not vent refrigerants to atmosphere. Evacuate refrigerants to prescribed levels before major maintenance and servicing using certified technicians and approved recovery and recycling equipment. Reuse excess refrigerant inventories at other facilities or recycle through an approved recycling contractor. Where practical, retrofit units with more environmentally friendly refrigerants.
Product storage and transfer	Nitrogen, oxygen, helium, argon	Energy use	Minimize venting of cryogenic gases.

Appendix B—GEMP for air separation units and helium production facilities			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Product venting, compressors, traffic, etc.	Noise	Community	Design and install compressors, expanders, and other equipment in accordance with local noise requirements. Use appropriate noise-attenuation measures as required (e.g., sound insulation, noise curtains, buildings, walls). Select sites with adequate land and distance to buffer noise. Site equipment in a location that will minimize the noise impact to neighbors. Minimize night time noise generating activities. Refer to EIGA Doc 85 [5].
Used filters	Filters with dust deposits	Waste disposal	Change out filters as part of planned maintenance to maintain efficiency. Test for presence of radioactivity, if warranted, or other dust contaminants to determine if a hazardous waste, where appropriate.

Appendix C—GEMP for hydrogen/carbon monoxide units			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Amine adsorption system	Mono-ethanolamine	Surface water Soil	Contain equipment leaks. Discharge through a permitted outfall or sewer connection, if allowed. Dispose of through an approved disposal contractor.
Catalysts, e.g., selective catalytic reduction (SCR), high/low temp shift, reformer, prereformer, hydrotreater)	Various metals (titanium, vanadium, tungsten, iron, chromium, copper, molybdenum, cobalt, nickel)	Waste disposal	Recycle through approved recycling contractor, where feasible. Where not feasible, dispose of through an approved disposal contractor.
Compressors and vacuum pumps	Lubricating oil	Soil Surface water Waste disposal Groundwater	Minimize leaks through preventive maintenance. Where present, keep foundation curbing and drains free of debris for effective drainage to oil/water separator. Use absorbents to minimize oil seepage off foundations that are not tied to an oil/water separator. Where practical, install roof over compressors to prevent contaminated storm water. Recycle used oil and, where possible, saturated absorbents through an approved oil recycler. Do not mix solvents or other chemicals with used oil. Used oil contaminated with refrigerants or solvents requires special disposal. Return empty drums to original supplier or recycle through an approved drum reconditioner, where practical.
Compressor–condensate	Low pH (acidic), copper, nickel, lead	Surface water Groundwater	Do not discharge onto the ground. Discharge through a permitted outfall or sewer connection. Reuse as makeup to cooling tower, where feasible. Treat any excessive levels of metals. Neutralize low pH before discharging.
Compressor–vents	Lubricating oil mists	Air Soil Surface water	Install oil demisters to collect oil mist emissions. Recycle the collected oil through an approved oil recycler.
Cooling tower–blowdown	Biocides, acids, corrosion inhibitors	Surface water Natural resource	Discharge through a permitted outfall or sewer connection. Avoid use of chromate based or zinc based corrosion inhibitors.

Appendix C—GEMP for hydrogen/carbon monoxide units			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
			Avoid excessive chemical feed through tight control of water chemistry. Run cooling tower at optimum concentration cycles to minimize chemical loss, wastewater discharges, and makeup water consumption. Purchase water treatment chemicals in bulk or returnable/recyclable containers instead of drums, where practical. Return empty drums to original supplier or recycle through an approved drum reconditioner, where practical. Use of existing supplier of chemicals and obtain any necessary permit modifications before switching chemicals.
Cooling tower–mists	Legionella risk	Legionella	Planned maintenance and disinfection of cooling systems. Regular testing of systems for Legionella.
Cooling water–sidestream filter backwash	Solids	Surface water	Treat if required before discharge through a permitted outfall or sewer connection.
Cooling tower–sludge	Solids, heavy metals (chromium, copper, zinc)	Waste disposal	Test for presence of heavy metals to determine if a hazardous waste. Dispose of through an approved disposal contractor.
Desulfurization beds	Zinc oxide, zinc sulphide	Soil	Dispose of through an approved disposal contractor.
Flaring	Noise, air emissions	Community	Design and install flares, compressors, expanders, and other “noisy” equipment in accordance with external requirements or internal engineering standards. Use appropriate noise-attenuation measures as required (e.g., sound insulation, noise curtains, buildings, walls). Select sites with adequate land and distance to buffer noise. Install noisy equipment on site in a location that will minimize the noise impact to neighbors. Minimize night time noise generating activities.
Fugitive emissions from compressors, valves, flanges	Hydrocarbons	Air	Where required, implement leak detection and repair program to control fugitive emissions from valves, flanges, compressors. Repair leaking components promptly.

Appendix C—GEMP for hydrogen/carbon monoxide units			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Process boiler–blowdown	Corrosion inhibitors	Surface water Energy Natural resource	Discharge through a permitted outfall or sewer connection. Avoid excessive chemical feed through tight control of water chemistry. Run boiler at optimum concentration cycles to minimize chemical loss, wastewater discharges, makeup water consumption, and energy consumption. Purchase water treatment chemicals in returnable/recyclable containers instead of drums, where practical. Return empty drums to supplier or recycle through an approved drum reconditioner.
Process boiler–feed water pretreatment (e.g., reverse osmosis [RO] reject, softener reject, demineralizer regeneration, filter backwash)	Waste water containing salts, solids.	Surface water	Discharge through a permitted outfall or sewer connection. Reuse wastewater, where feasible.
Process condensate	Waste water, methanol, ammonia, temperature	Surface water Air Energy Natural resource	Reuse as boiler feed water makeup, where feasible. Reuse as cooling tower makeup, where feasible. Control deaerator vent emissions, when used as boiler feed water. Discharge to a permitted outfall or sewer connection.
Pressure swing adsorption system	Silica gel, molecular sieve, alumina, carbon, noise	Waste disposal Community	If available, recycling through original manufacturer. Dispose of through an approved disposal contractor. Use appropriate noise-attenuation measures as required (e.g., sound insulation, noise curtains, buildings, walls). Select sites with adequate land and distance to buffer noise. Install noisy equipment on site in a location that will minimize the noise impact to neighbors. Minimize nighttime noise-generating activities. Refer to EIGA Doc 85 [5].
Pressure swing adsorption purge gas	Hydrogen, carbon monoxide, noise	Air Community	Use as supplemental fuel source in steam methane reformer or customer fuel system. Install silencer.
Steam condensate return, steam traps	Wastewater, corrosion inhibitors, low pH, temperature	Surface water Energy Natural resource	Reuse as boiler feedwater makeup, where feasible. Discharge to a permitted outfall or sewer connection.

Appendix C—GEMP for hydrogen/carbon monoxide units			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Steam methane reformer	Particulate matter, carbon monoxide, hydrocarbons, nitrogen oxides, sulphuric dioxide, methanol, ammonia	Air	Operate in accordance with air permit. Use low nitrogen oxide burners, steam injection, flue gas recirculation, other nitrogen oxide control technology, where required. Where present monitor performance of SCR catalyst/ nitrogen oxide control system. Periodically replace SCR catalyst to maintain nitrogen oxide destruction efficiency.

Appendix D—GEMP for carbon dioxide production and dry ice facilities

Source	Environmental Aspect	Potential Impact(s)	Good Environmental Management Practices
Catalytic oxidation	Used catalysts	Waste disposal	Recycle through approved recycling contractor if feasible Where not feasible dispose of through approved contractor
Compressors and vacuum pumps	Lubricating oil	Soil Surface water Waste disposal Groundwater	Minimize leaks through preventive maintenance. Where present, keep foundations curbing and drains free of debris for effective drainage to oil/water separator. Use absorbents to minimize oil seepage off foundations that are not tied to an oil/water separator. Where practical, install roof over compressors to prevent contaminated storm water. Recycle used oil, and where possible, saturated absorbents through an approved oil recycler. Do not mix solvents or other chemicals with used oil. Used oil contaminated with refrigerants or solvents requires special disposal. Return empty drums to original supplier or recycle through an approved drum reconditioner, where practical. Report and clean up any leaks immediately.
Compressor–condensate	Low pH (acidic), copper, nickel, lead	Surface water Groundwater	Do not discharge onto the ground. Discharge through a permitted outfall or sewer connection. Reuse as makeup to cooling tower, where feasible. Treat any excessive levels of metals. Neutralize low pH before discharging.
Compressor–vents	Lubricating oil mists	Air Soil Surface water	Install oil demisters to collect oil mist emissions. Recycle the collected oil through an approved oil recycler. Report and clean-up any leaks immediately
Cooling tower–blowdown	Biocides, acids, corrosion inhibitors	Surface water Natural resource	Discharge through a permitted outfall or sewer connection. Avoid use of chromate based or zinc based corrosion inhibitors. Avoid excessive chemical feed through tight control of water chemistry. Run cooling tower at optimum concentration cycles to minimize chemical loss, wastewater discharges, and makeup water consumption. Purchase water treatment chemicals in bulk or returnable containers instead of drums, where practical.

Appendix D—GEMP for carbon dioxide production and dry ice facilities			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
			Return empty drums to original supplier or recycle through an approved drum reconditioner, where practical. Obtain any necessary permit modifications before switching chemicals.
Cooling tower–mists	Legionella risk	Legionella	Planned maintenance and disinfection of cooling systems. Regular testing of systems for Legionella.
Cooling tower–sludge	Solids, heavy metals (chromium, copper, zinc, arsenic, etc.)	Waste disposal	Test for presence of heavy metals to determine if a hazardous waste. Dispose of through an approved disposal contractor.
Electricity	Indirect emissions, discharges and wastes	Energy use Air Water Solid waste	Design, purchase, and maintain equipment to operate efficiently and minimize energy use. Conduct energy audits to identify potential opportunities to improve energy efficiency. Train employees to conserve energy.
Fuel	Burning to produce product	Natural resources	Use natural sources of carbon dioxide or by-product streams as feed, where possible.
Process refrigeration–ammonia systems	Ammonia	Accidental release Fugitive release	Minimize leaks from valves, flanges, etc., through preventive maintenance. Use purging systems designed to minimize refrigerant releases. Recover ammonia to the maximum extent possible during maintenance, through receivers. Use water-scrubbing systems to treat major ammonia releases.
Process refrigeration–Refrigerant systems	Refrigerants (CFCs, HCFCs, HFCs, PFCs), ammonia	Ozone depletion Global warming Air	Minimize leaks from valves, flanges, etc., through preventive maintenance. Monitor and document the rate of consumption of refrigerants and ammonia to detect leaks. Repair leaks promptly. Do not vent refrigerants to atmosphere. Evacuate refrigerants to prescribed levels before major maintenance and servicing using certified technicians and approved recovery and recycling equipment. Reuse excess refrigerant inventories at other facilities or recycle through an approved recycling contractor. Where practical, retrofit units with more environmentally friendly refrigerants.
Venting	Carbon dioxide emissions	Air Global warming	Optimize plant efficiency. Avoid venting where possible.

APPENDIX E—GEMP for truck maintenance and distribution terminals			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Brake shoes	Asbestos	Waste Air	Do not use asbestos brake shoes. Replace existing shoes. Dispose of as hazardous waste to authorized contractor .
Cleaners–engine, brake and other specialty maintenance products	Various chemicals, aerosol cans	Soil Air Waste disposal	When using specialty cleaning products, apply product to rag then apply the product - containing rag to surface being cleaned. Minimize overspray, drips, and residues. Use absorbent materials to collect excess. Do not mix spent specialty products with parts washer solvents. Empty aerosol cans (contents no longer under pressure) before discarding into non-hazardous waste(trash), if permitted. Do not clean parts over ground or drain. Use drip pan. Dispose of in accordance with appropriate rules and regulations.
Motor oil changes	Used oil, oil filters	Soil Surface water Waste disposal	Puncture filter dome end and hot drain used oil for 24 hours. Recycle used oil filters, where service is available. Recycle used oil through an approved oil recycler. Do not mix solvents or other chemicals with used oil. Do not pour oil on ground or down drain. Report and clean up any leaks immediately
Motor vehicle air conditioners	Refrigerants (CFCs, HCFCs, HFCs)	Ozone depletion Global warming Air	Minimize leaks through preventive maintenance. Repair leaks promptly. Do not vent refrigerants to atmosphere. Recover refrigerants to the maximum extent possible during maintenance and servicing by certified technicians using approved recovery and recycling equipment. Where practical, retrofit units with less harmful refrigerants that are approved by an environmental representative.
Radiator servicing	Ethylene glycol, Propylene glycol, and similar heat exchange fluids	Soil Surface water Waste disposal	Recycle spent antifreeze via approved recycler. Dispose of spent solutions as a last resort through an approved disposal contractor. Do not pour antifreeze on ground or down drain. Use drip pan to collect. Report and clean up any leaks immediately.

APPENDIX E—GEMP for truck maintenance and distribution terminals

Source	Environmental Aspect	Potential Impact(s)	Good Environmental Management Practices
Truck emissions (fuel economy)	Carbon monoxide, nitrogen oxides, hydrocarbons, particulates (diesel)	Air Energy	Optimize route scheduling and routes. Maintain vehicles to operate efficiently while minimizing emissions. Minimize trips and distances traveled to extent possible by maximizing load volume going out and minimizing load volume returned. Purchase energy-efficient vehicles that meet regulatory emission standards. Use low sulfur fuel and particle traps where feasible. Use different fuels (e.g., LNG, hydrogen, CNG). Measure and monitor fuel consumption and set targets.
Truck batteries	Lead, sulphuric acid	Soil Waste disposal	Return used batteries to dealer when purchasing new batteries. Protect batteries from severe cold to prevent freezing and release of battery acid. Store batteries indoors on impervious surfaces, whenever possible. Store batteries on wooden pallets (one battery high). Do not throw batteries in normal waste (trash) container. Do not try to break open and reclaim lead from batteries on site.
Truck tires	Tires	Waste disposal Fuel use	Recycle used tires back to dealer when purchasing new tires. Use retreaded tires, where appropriate. Maintain proper tire inflation.
Truck breakdowns and accidents	Diesel fuel, antifreeze, motor oil, hydraulic oil	Soil Surface water Waste disposal	Where appropriate, keep spill kits stocked on each truck. Report and clean up spills immediately. Take clean-up debris from small incidents back to home terminal for disposal. Use clean-up contractor for larger spills. Contact an environmental representative for assistance.

APPENDIX E—GEMP for truck maintenance and distribution terminals			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Vehicle washing	Oils, greases, detergents, suspended solids, salts, sludge residual	Surface water Soil	Wash vehicles in wash bays or other designated areas. Discharge through a permitted outfall or sewer connection. Discharging to a storm water drain is prohibited. Remove accumulated solids/sludge from wash bay sump or grit chamber regularly. Wash bay areas that do not have a solid collection sump. Use a fabric drain-filtering device to prevent accumulated solids/sludge from wash bay from entering and accumulating in oil/water separator. Use only nonphosphate, nonemulsifying detergents, and quick oil release detergents. Treat wash water through an oil/water separator before discharge.

APPENDIX F—GEMP for acetylene manufacturing operations			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Acetylene generator	Carbide metal and carbon	Waste disposal	Minimize impurities in purchased carbide. Clean generator regularly. Dispose of residuals to an authorized contractor as nonhazardous waste.
Acetylene generator and lime pit area	Calcium hydroxide (lime) scale/deposits, acid wash water used to remove lime scale buildup	Waste disposal Soil	Dispose of through an approved disposal contractor. Collect acid wash water and reuse as a first rinse wash water the next time acid washing is needed. Combine with lime slurry where possible. Neutralize with lime before discharge. Periodically check integrity of lime pit.
Carbide lime slurry	Calcium hydroxide (lime) solids, water	Surface water Soil Waste disposal	Decant water from solids. Reuse decanted wastewater back in acetylene manufacturing process. Reuse co-product lime as raw material for offsite wastewater treatment, agricultural/soil amendment, etc. Refer to CGA G-1.5, *Carbide Lime: Its Value and Uses* [7] and EIGA Doc 143 *Guide to lime applications* [8].
Compressors and vacuum pumps	Lubricating oil	Soil Surface water Waste disposal Groundwater	Minimize leaks through preventive maintenance. Where present, keep foundation curbing and drains free of debris for effective drainage to oil/water separator. Use absorbents to minimize oil seepage off foundations that are not tied to an oil/water separator. Where practical, install roof over compressors to prevent contaminated storm water. Recycle used oil, and where possible, saturated absorbents through an approved oil recycler. Do not mix solvents or other chemicals with used oil. Used oil contaminated with refrigerants or solvents requires special disposal. Return empty drums to original supplier or recycle through an approved drum reconditioner, where practical. Report and clean up any leaks immediately.
Compressor–condensate	Low pH (acidic), copper, nickel, lead	Surface water Groundwater	Do not discharge onto the ground. Discharge through a permitted outfall or sewer connection. Reuse as makeup to cooling tower, where feasible. Treat any excessive levels of metals. Neutralize low pH before discharging.

APPENDIX F—GEMP for acetylene manufacturing operations			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Compressor–vents	Lubricating oil mists	Air Soil Surface water	Install oil demisters to collect oil mist emissions. Recycle the collected oil through an approved oil recycler. Report and clean up any leaks immediately.
Cooling water	Wastewater	Natural resource Surface water	Reuse as makeup to acetylene generator.
Cylinder painting	Paint, paint thinners, paint cans, aerosol cans, paint rollers and brushes, volatile organic compounds (VOC), paint booth filters	Air Waste disposal Soil	Use water-based paints or paint with low VOC content. Discharge water-based paint rinse water through a permitted sewer connection. Do not pour on ground or in storm sewer. Install paint booth for high volume painting (an air permit may be required). Use aerosol can-puncturing system to release propellant and drain liquid. Do not throw liquids in trash dumpster. Allow empty paint cans, paintbrushes, and rollers to dry before disposing. Collect used paint, paint thinners for disposal through an approved disposal contractor. Do not mix with other wastes or pour on ground. Operate in accordance with all proper rules and regulations.
Cylinders - venting	Acetylene	Air	Vent gas back to generator or gas holder for recovery. Only vent cylinder gases allowed by air permit, air regulations, or air permit exemption. Vent flammable gases to appropriate control device(s). Refer to P-22, *The Responsible Management and Disposition of Compressed Gases and their Containers,* and EIGA Doc 30, *Disposal of gases,* and EIGA Doc 85, *Noise Management for the Industrial Gases Industry* [6, 9, 5].
Cylinders–scrap	Acetone, asbestos	Air Waste disposal	Drain acetylene from cylinder. If an appropriate processing facility is available, consider recovery/recycling of acetone. Recycle/dispose through a permitted contractor/facility. Refer to CGA P-22 and EIGA Doc 05, *Guidelines for the Management of Waste Acetylene Cylinders* [6, 10].
Carbide dust	Nuisance, dust	Air	Minimize by using closed filling system. Return to generator. Dispose of in lime pit.

APPENDIX F—GEMP for acetylene manufacturing operations			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Cylinders–surface preparation	Abrasive blasting media, lead, chromium, cadmium, particulates, silica, paint chips	Air Waste disposal	Conduct surface preparation operations in accordance with air permit or air permit exemption. Control particulate emissions through dust collector. Test waste for toxic metals such as lead, chromium, cadmium, to determine if the waste is a hazardous waste. Dispose of waste through an approved disposal contractor.
Cylinders–valve packing material	Asbestos	Waste disposal	Dispose of through an approved disposal contractor. Keep asbestos materials wet and keep in plastic bags before disposal.
Dryers	Silica gel, calcium chloride	Waste disposal	Optimize dryer operation. Check for contamination before disposal. Dispose of through an approved disposal contractor.
Gas purification media from high purity fill operations	Arsenic, mercury, chromic acid, sulphuric acid, ferric chloride, ferric oxide	Waste disposal	Use to maximum capacity of purification before switching out spent media. Dispose of through an approved disposal contractor. Test for hazardous constituents.
Stabilizers	Acetone, dimethylformamide (DMF)	Air Waste disposal Soil	Recover the stabilizer to the extent possible. Refer to CGA P-22 and EIGA Doc 05, [6, 10]. Report and clean up any leaks immediately

Appendix G—GEMP or cylinder fill and cylinder maintenance operations (including speciality gas operations)			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Compressors and vacuum pumps	Lubricating oil	Soil Surface water Waste disposal Groundwater	Minimize leaks through preventive maintenance. Where present, keep foundation curbing and drains free of debris for effective drainage to oil/water separator. Use absorbents to minimize oil seepage off foundations that are not tied to an oil/water separator. Where practical, install roof over compressors to prevent contaminated storm water. Recycle used oil, and where possible, saturated absorbents through an approved oil recycler. Do not mix solvents or other chemicals with used oil. Used oil contaminated with refrigerants or solvents requires special disposal. Return empty drums to original supplier or recycle through an approved drum reconditioner, where practical. Report and clean up any leaks immediately
Compressor–condensate	Low pH (acidic), copper, nickel, lead	Surface water Groundwater	Do not discharge onto the ground. Discharge through a permitted outfall or sewer connection. Reuse as makeup to cooling tower, where feasible. Treat any excessive levels of metals. Neutralize low pH before discharging.
Compressor–vents	Lubricating oil mists	Air Soil Surface water	Install oil demisters to collect oil mist emissions. Recycle the collected oil through an approved oil recycler. Report and clean-up any leaks immediately
Cylinders–filling	Flammable/toxic gases	Air Odour nuisance	Design and maintain filling equipment to minimize leaks. When filling flammable/toxic gases, provide continuous, periodic monitoring to ensure system integrity. Properly train employees to safely conduct filling and follow filling procedures. Consider suitable treatment before releasing gases containing flammable or toxic materials, in some cases, an air permit is required.

Appendix G—GEMP or cylinder fill and cylinder maintenance operations (including speciality gas operations)			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Cylinders–painting	Paint, paint thinners, paint cans, aerosol cans, paint rollers and brushes, VOC, paint booth filters	Air Waste disposal Soil	Use water-based paints or paint with low VOC content. Discharge water-based paint rinsewater through a permitted sewer connection. Do not pour on ground or in storm sewer. Install paint booth for high volume painting (an air permit may be required). Use aerosol can-puncturing system to release propellant and drain liquid. Do not throw liquids in trash dumpster. Allow empty paint cans, paintbrushes, and rollers to dry before disposing in waste/ trash. Collect used paint, paint thinners for disposal via an approved disposal contractor. Do not mix with other wastes or pour on ground. Operate in accordance with all rules and regulations
Cylinders - venting/ purging	Various inert, atmospheric, flammable, and toxic gases	Air Odour nuisance	Recover the product if technically and economically feasible. Only vent cylinder gases allowed by air permit, air regulations, or air permit exemption. Vent toxic and flammable gases to appropriate control devices. Top fill cylinders whenever possible to minimize cylinder purging emissions. Refer to P-22, *The Responsible Management and Disposition of Compressed Gases and their Container*; EIGA Doc 30, *Disposal of gases*; and EIGA Doc 85, *Noise Management for the Industrial Gases Industry* [6, 9, 5].
Cylinders–requalification	Wastewater	Surface water Waste disposal	Recycle cylinder test water to the extent practical. Discharge through a permitted outfall or sewer connection. Remove and dispose of any residue containing metals or other contaminants. Render rejected cylinders unusable and discard as scrap metal.
Cylinders–surface preparation	Abrasive blasting media, lead, chromium, cadmium, particulates, silica, paint chips	Air Waste disposal	Conduct operations in accordance with air permit or air permit exemption. Control particulate emissions through dust collector. Test waste for metals (lead, chromium, cadmium) to determine if hazardous waste. Dispose of waste through an approved disposal contractor.

Appendix G—GEMP or cylinder fill and cylinder maintenance operations (including speciality gas operations)			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Cylinder preparation	Plastic from packaging, shrink wrap, polytetrafluoroethylene (PTFE) tape	Waste disposal	Send for recycling or recovery. Dispose of waste through an approved disposal contractor.
Cylinders–unserviceable	Various inert, atmospheric, flammable, and toxic gases	Air Waste disposal	Do not accept unknown cylinders and lecture bottles. Keep problem cylinder inventories low by directing cylinders to appropriate locations for processing on an ongoing basis. Atmospherics (argon, nitrogen, and oxygen) may be vented on site, but only after contacting the environmental expert to insure that local/state environmental regulations do not prohibit such venting. Refer to CGA P-22 and EIGA Doc 30 [6, 10].
Ion mobility analyzers, helium ionization detectors, dewpointers	Radioactive materials	Waste disposal	Return radioactive cells to manufacturer or approved disposal contractor. Do not throw in normal nonhazardous waste containers. Document all pending transfers of radioactive materials to and from the site to applicable regulatory agencies. Perform wipe tests for leaks, where required. Maintain all warning labels on analyzers. Obtain appropriate regulatory approvals to own and use radioactive materials.
Process refrigeration–Refrigerant systems	Refrigerants (CFCs, HCFCs HFCs, PFCs, ammonia)	Accidental release Fugitive release Ozone depletion Global warming Air	Monitor and document the rate of consumption of refrigerants to detect leaks. Repair leaks promptly. Do not vent refrigerants to atmosphere. Evacuate refrigerants to prescribed levels before major maintenance and servicing using certified technicians and approved recovery and recycling equipment. Reuse excess refrigerant inventories at other facilities or recycle through an approved recycling contractor. Where practical, retrofit units with more environmentally friendly refrigerants.
Scrap metal	Recyclable materials	Natural resource Waste disposal	Purge any gases from scrap tanks, etc. Remove any fluids contained in equipment. Check any coatings or insulation on the equipment for asbestos and if present remove before scrapping equipment. Recycle through scrap metal dealer. Operate and maintain in accordance with applicable rules and regulations. Report and clean-up any leaks immediately.

Appendix G—GEMP or cylinder fill and cylinder maintenance operations (including speciality gas operations)			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Scrubber effluent and emissions	Toxic emissions, waste alkali, acid, or permanganate scrubbing solutions which could contain metals	Waste disposal Water	Design and run scrubber efficiently to minimize emissions and the use of scrubbing solutions. Design and run scrubbing system to prevent leaks and spills. Treat liquid waste before permitted discharge or dispose of through licensed disposal contractors.

Appendix H—GEMP for customer installations			
Source	**Environmental Aspect**	**Potential impact(s)**	**Good Environmental Management Practices**
Carbon molecular sieve, ceramic molecular sieve and alumina, silica gel	Carbon, alumina	Waste disposal	Plan ahead to arrange for disposal. Adequate lead time is needed. If the customer is responsible for disposal, follow customer's procedures.
Equipment and parts	Spent solvents and detergents	Soil Surface water Groundwater	Purchase pre-cleaned parts. Minimize solvent/chemical purchases. Do not buy more than needed. Keep containers and parts cleaners closed when not in use. Use drip pans to collect solvents. Collect spent solvents for recycling through an approved recycler. Do not pour solvents down any drains or on the ground. Do not mix spent solvents with used oil or other chemicals. Report and clean up any spills immediately. Use biodegradable detergents whenever possible. Determine if spent detergents can be discharged to sanitary sewer.
Process refrigeration systems	Refrigerants (CFCs, HCFCs, HFCs, PFCs), ammonia	Ozone depletion Global warming Air	Minimize leaks from valves, flanges, etc., through preventive maintenance. Monitor and document the rate of consumption of refrigerants and ammonia to detect leaks. Repair leaks promptly. Do not vent refrigerants to atmosphere. Evacuate refrigerants to prescribed levels before major maintenance and servicing using certified technicians and approved recovery and recycling equipment. Reuse excess refrigerant inventories at other facilities or recycle through an approved recycling contractor. Where practical, retrofit units with more environmentally friendly refrigerants.

Appendix I—GEMP for nitrous oxide manufacturing plants			
Source	**Environmental Aspect**	**Potential Impact(s)**	**Good Environmental Management Practices**
Scrubber Effluent	Waste alkali or acid scrubbing solutions which could contain metal ions, permanganate, sulfuric acid	Waste disposal Water	Design and run scrubber efficiently to minimize the use of acid/alkali. Design and run scrubbing system to prevent leaks and spills. Treat liquid waste before landfill disposal. Operate and maintain in accordance with applicable rules and regulations. Report and clean-up any leaks immediately Refer to EIGA Doc 85 [5].
Alumina , Silica gel	Carbon, alumina	Waste disposal	Plan ahead to arrange for disposal. Adequate lead time is needed. Refer to EIGA Doc 85 [5].
Process refrigeration–Refrigerant systems	Refrigerants (CFCs, HCFCs, HFCs, PFCs, ammonia)	Accidental release Fugitive release Ozone depletion Global warming Air	Monitor and document the rate of consumption of refrigerants to detect leaks. Repair leaks promptly. Do not vent refrigerants to atmosphere. Evacuate refrigerants to prescribed levels before major maintenance and servicing using certified technicians and approved recovery and recycling equipment. Reuse excess refrigerant inventories at other facilities or recycle through an approved recycling contractor. Where practical, retrofit units with more environmentally friendly refrigerants. Refer to EIGA Doc 85 [5].
Cylinders–purging	Nitrous Oxide	Air	Recover the product if technically and economically feasible. Only vent cylinder gases allowed by air permit, air regulations, or air permit exemption. Top fill cylinders whenever possible to minimize cylinder purging emissions. Refer to P-22, *The Responsible Management and Disposition of Compressed Gases and their Containers*; EIGA Doc 30, Disposal of Gases; and EIGA Doc 85, *Noise Management for the Industrial Gases Industry* [6, 9, 5].