SAFETY AUDIT GUIDELINES

AIGA 014/05

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SAFETY AUDIT GUIDELINES

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- FORKLIFT
- HAZARD
- HYDROGEN
- INSPECTION
- LIQUID
- NITROGEN
- OXYGEN
- PIPING SYSTEM
- SAFETY
- STORAGE
- TRAINING
- TRANSPORTATION
- WORK PERMIT

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1 Introduction

The fact that we often fail to learn from experience is commonplace. Time after time accidents occur because well established safe procedures and practices have been ignored or forgotten. Investigation will often reveal that the basic cause of an accident has been the steady deterioration of working practices since a plant was installed. It is incredible how quickly a well-constructed plant with clear procedures and safeguards can become unsafe without management or workers being aware. A short cut in procedures becomes accepted practice; a small malfunction of equipment is overcome by the operator and the 'new' procedure adopted as standard. And so it goes on, until the inevitable accident occurs and the manager cannot understand how he came to walk past the problem every day without seeing the hazard.

It is because of this that all responsible management sees the need to promote systematic and regular auditing of their safety procedures and practices.

It is the overall responsibility of management to ensure that operational related activities are adequately controlled. The responsibility covers both the human and physical elements, as accidents are often caused by failure to achieve control in these areas; accidents are not, as is often believed, the result of straightforward failures of technology, but also result from social, organisational and technical problems.

A major part of this responsibility is to make sure that personnel will not be exposed to hazards which they are unaware of or are unable to control.

This implies high technical competence, but on its own it will not ensure a consistently safe place of work. The behaviour of the human being in an advanced technological working place is also of fundamental importance.

Hazards may cause accidents. One definition of hazards is that they are unsafe acts of persons, unsafe mechanical conditions or unsafe environmental conditions.

A safety audit is aimed at the reduction of exposure to all of the aforementioned conditions as part of an overall safety programme.

The adoption of this systematic approach has, in some companies, originated from their concern generated by major accidents, or an internal realisation that safety standards may be falling, often brought about by better accident reporting and investigation.

It therefore becomes possible to publish criteria and lead plant management, with specialist assistance, into more objective analysis of their activity, with resulting improved standards becoming a useful tool for reducing accidents.

2 Scope and Purpose

2.1 Scope

These Safety Audit Guidelines have been prepared by operational experts in the Industrial Gases Business and they not only explain how to set about introducing a comprehensive safety audit system, but also provide audit checklists for a range of activities in the Industrial Gas Business.

This document gives general guidance information for the detection of unsafe conditions, prevention of hazards and accidents.

The specific areas covered are:

- General site matters
- Industrial gas cylinder filling
- Cryogenic liquid bulk storage at a production site
- Industrial gas and liquid plant

- Acetylene plant and cylinder filling
- Hydrogen purification and cylinder filling
- Liquid tanker and distribution of liquid products
- Cryogenic liquid storage at customer's premises
- Cylinder transport and distribution

For each of these areas a questionnaire is provided so that a standard approach can be used opposite each activity, no matter how simple or complex a site may be.

These questionnaires:

do not	-	include design
	-	make recommendations
	-	include local/national regulations
but do	-	cover various company practices
	-	check that:
		safe operating procedures exist
		safe operating procedures are followed
must	-	be as exhaustive as possible
	-	not constitute too large a document.

It should be realised that these guidelines do not incorporate all the requirements of local or national legislation, which will have to be inserted in the document by the reader according to local conditions.

The reader should be aware that in order to enhance the overall standard of safety performance, it is necessary to complement safety audits by safety inspections (see 5.2) and safety walks (see 5.3). As these elements are not part of the scope of this document, they are only described in brief.

2.2 Purpose

The Guidelines are presented with the real hope that all AIGA member companies who have not done so already, will introduce systems of safety audits, safety inspections and safety walks. Such action, together with the development of a correct attitude towards safety, will surely improve the safety record of individual companies - and the Industrial Gas Business as a whole.

It is intended that this document will guide those companies who have not carried out in-depth reviews of their total operation, such that using the information contained, in the way of checklists, questionnaires etc, it will enable them to carry out the necessary procedures.

For those who may have their own system, it will present a basis for comparison and may in certain areas, identify improvements that can be made.

3 Reasons for Safety Audit Practice

Safety audits are intended to promote, improve and then maintain good safety performance.

Safety audits (unlike accident statistics, which only record past accidents) are an instrument for the direct prevention of accidents, as they immediately generate positive actions across the whole business activity.

When accident levels have dropped to levels which are of the order of company, or IGC, targets (e.g. 10/12 accidents per million hours) as a result of the use of a good safety programme, then Safety Audits are a positive means by which performance can be further improved.

They are a structured and effective (review of the total factory which emphasises the need for good housekeeping and planned maintenance) way of preventing accidents and controlling safety hazards.

4 Objectives of Safety Audits

The objective of the safety audit is to evaluate the effectiveness of the company's safety effort and make recommendations which lead to a reduction in accidents and minimisation of loss potential. Safety audits are an important part of a company's control system and these checks ensure that deteriorating standards are detected. Examination of the defects exposed in this review results in hazardous conditions and potential accidents being avoided.

Regular audits should be based on the premise that resources should be made available to identify and eliminate hazards before accidents occur, rather than use the resource of manpower and materials only after injuries and damage to equipment have resulted in human suffering, significant monetary loss which, in certain circumstances, affect the profitability severely.

Mistaken belief that management and sites are operating satisfactorily within the requirements of appropriate legislation/regulations and standards/codes of practice is eradicated, and the direct contact with individual workers has as its aim the resultant change in attitude and commitment to the use of safe working practices, which continual involvement and education generate.

The safety audits will monitor all activities performed on site, and in particular:

- The basic safety policy and organisation of the company.
- Management commitment and example on safety matters.
- Administration and safety activity.
- Accident reporting and investigation.
- Opportunity of injury – and record of every injury.
- Safety committees.
- Working rules and practices for each company location, including visitors and contractors.
- Compliance with statutory regulations and company standards.
- Behaviour and unsafe acts of personnel and their relationship to compliance with safety rules.
- Activity related certification of employees.
- First Aid certified employees.
- Training needs and activities.
- Hazards review of process equipment for either new or existing facilities.
- Operating procedures.
- Safety work permits.
- Emergency procedures.

5 Description of Safety Audit Practice

Safety audit practice subjects each area of a company's activity to a systematic critical examination with the object of minimising human suffering and monetary loss. Every component of the total system is included, e.g. management policy, attitudes training, features of the process, layout and construction of the plant, operating procedures, emergency plans, personal protection standards, accident records, etc. An audit, as in the fields of accountancy, aims to disclose the strengths, the weaknesses and the main areas of vulnerability or risk, and is carried out by appropriately qualified personnel.

It is important to ensure that the attitude of all personnel to safety audit practice is positive. It may need to be pointed out that the reason for the audit is to help the plant management to establish those areas within the plant where additional effort is required to ensure safety at all times. The audit is not there to find fault with the efforts of local manage. The safety audit is an aid to sound, safe, plant management.

Audits will involve plant operatives and review training, work experience, knowledge of procedures, emergency procedures and other plant operating instructions.

A formal report and action plan is subsequently prepared and monitored.

6 Procedures Used in Safety Audit Practice

It is an essential requirement of an audit system that it will originate, like any safety policy or safety programme, with the policy-making executive because of the monetary implications, e.g.:

- Implications of a major disaster.
- Running cost of a safety audit team.
- Cost of recommended alterations.

It is important that line management accepts the objectives and supports the activity; properly assessing the audit findings and ensuring that agreed actions are carried out.

Safety Programmes embody three essential elements:

- Safety Audits
- Safety Inspections
- Safety Walks.

See Appendix A for a Summary of Proposed Characteristics of Safety Audits, Safety Inspections and Safety Walks.

6.1 Safety Audits

6.1.1 Preparation

In view of reaching the aims described, every safety audit should be carefully prepared.

Questionnaires should be established for each activity and plant by the safety audit team and be approved by Company Management. Safety audit questionnaires will also include questions on general organisation, management and training.

Previous audit reports must be studied prior to the next audit to ensure that all actions from the previous audit either have been carried out satisfactorily or are included as an additional item on the current audit report.

6.1.2 Frequency of Safety Audits

As safety audits are by nature in-depth assessments of the safety situation of an activity, a frequency of one every three or four years seems to be appropriate.

The frequency will enable the audit team to better identify technical and personnel changes, evaluate the effectiveness of training at all levels, review the application of codes of practice and recent statutory regulations.

6.1.3 Safety Audit Team

Safety audits should be carried out at general management level and at each plant or site.

The audit team members should be carefully selected for their knowledge and experience in the field of audit, from general management, plant management, and other safety specialists.

For example, at plant level, the team should consist of, as a minimum:

- Site Plant Manager
- Site Plant Foreman
- Safety Specialist.

As safety audits are carried out at a number of levels in a factory, e.g. small department, followed by operating and then general management level, it is essential that a team member at the lowest level is

also incorporated in the next level team, and so on, so as to ensure a common approach, improved ease of reporting and communication.

When safety audits are carried out at a Main Branch satellite works, it is recommended that one of the Safety Audit Team who conducted the audit at the satellite works, participate in the Main Branch Team.

The indications given for frequency, duration, team composition and areas of activity may be adjusted according to plant size.

6.1.4 Safety Audit Report

Local management must be involved in the review of the findings of the audit team before the audit team leaves site.

Following the audits, a report should be issued containing the following:

- A description of all findings relative to items needing a proposal for remedial action.
- A description of any defects detected on equipment and initial proposals for remedial actions.
- The names and job titles of those people who are responsible for initiating remedial actions.
- The need for any revision of operating instructions or company standards.
- Agreed target dates for completion (which realistically allow sufficient time for thorough technical assessment and consequent changes, if necessary).

Copies of the audit report shall be given to the local plant manager and to the company management, who will take decisions and supervise follow-up actions agreed by the safety audit team.

6.1.5 Monitoring and Follow-up

Monitoring of approved safety audit conclusions and recommendations is an important activity to ensure improvement of the safety level of a plant or company.

It is the responsibility of the Plant Manager to see that audit conclusions and recommendations are implemented by the agreed target dates.

6.2 Safety Inspection

A safety inspection is a scheduled inspection of a plant area, conducted by the plant supervisor or plant management member, one of the plant employees and a company safety officer.

Safety inspections will be carried out with a frequency of one year, and may last up to one or two days.

Safety inspections may cover the following subjects:

- Housekeeping
- Unsafe acts or conditions

It will use lists referring to specialised equipment and procedures according to activity.

The result of the safety inspection, provided by the checklists filled in by the visiting team, will be handed over to the plant manager who will be responsible for monitoring all resultant actions and follow-up.

6.3 Safety Walks

A safety walk is a scheduled or non-scheduled inspection of a plant area, conducted by local personnel, e.g. a plant management member assisted by one of the plant employees.

When scheduled, a safety walk of a plant area may be carried out every month and last one hour.

It will cover the following subjects:

- Housekeeping
- Visible unsafe acts and conditions.

The use of a simple aide memoire is of assistance in reminding those involved of the objectives. The result of the safety walk will be recorded and reported to the plant manager who will decide on the follow-up to be given.

The team conducting the safety walk should have received adequate training in observing unsafe acts and conditions.

7 Questionnaires

The object of the questionnaires included in this document is to allow company management to check that the necessary safety procedures have been established, and that they are followed, in order to ensure all plant personnel are conforming to company practices, resulting in a totally safe operation.

These questionnaires do not include any questions relating to plant design, which is supposed to have been suitably established so as to allow the operation of a safe and efficient business. However, the questionnaires do include questions which establish that any modifications to plant and machinery have been duly authorised. In addition, if aspects of poor design are noted, these should be reported to line management for further specialist investigation.

The questionnaires contain numerous references to testing at regular or frequent intervals. These intervals are usually incorporated in the planned maintenance system. In the event that the safety audit team considers any of the company test intervals to be inappropriate, then these should be referred back to specialist for reconsideration.

The questionnaires in this document, which have been compiled by Working Group Members, following a study of their company practices, may need to be complemented/adapted to accommodate equipment or procedures which differ from one company to another. However, to avoid rewording of certain questions, a column ‘Not Applicable’ has been provided and may be used.

The questionnaires incorporated in this document are presented as forms to as to allow immediate use.

Appendix A: Proposed Characteristics of Safety Audits, Safety Inspections and Safety Walks

	Safety Walk	**Safety Inspection**	**Safety Audit**
Frequency	minimum weekly	monthly	3 – 4 years
Duration	1 hour	1 day	3 – 4 days
Aim	• Housekeeping • Unsafe acts/ conditions	• Housekeeping • Unsafe acts/ conditions • Questionnaires Equipment Procedures	• Housekeeping • Unsafe acts/ conditions • Questionnaires Equipment Procedures General
By whom:			
• Staff member	X	X	
• Foreman	X	X	
• Plant Manager		X	X
• Safety Engineer		X	X
Specialist Engineer			X
Monitoring Follow-up	One Management step higher than above		

Appendix B: Safety audit questionnaires

B.1 General Site Matters

1 Management

2 Administration

3 Training

4 Records and registers

5 Safety

6 Emergency control procedures

7 Fire fighting

8 Maintenance

9 Electrical equipment

NB This questionnaire is not exhaustive and may need to be complemented/adapted in order to cover all the procedures, plant and equipment on site.

SAFETY AUDIT QUESTIONNAIRE

B.1 General Site

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
1.0	**Management**								
1.1	Has the Company Safety Policy been issued to personnel								
1.2	Has it been posted on notice boards								
1.3.1	Is there a Management organisation chart								
1.3.2	Is it up-to-date								
1.3.3	Is a Site Safety Action Plan being used as an aid to improve/maintain safety standards								
1.4.1	Does the Plant Manager's job description clearly define he is totally responsible for all safety matters on site								
1.4.2	If not, who is responsible								
1.5.1	Is allocation of safety responsibilities kept up-to-date								
1.5.2	Are the management team totally committed to the attainment of their safety targets								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
1.6.1	Have the people responsible for safety matters received adequate training								
1.6.2	Are individual training records available								
1.7.1	Have Management/Supervision received formalised training in the products for which they are responsible								
1.7.2	Are individual training records available for all employees								
1.8	When new equipment is installed, are proper instructions/operating procedures issued								
1.9	Has each employee had a Safety Training check completed for the type of area in which he now works								
1.10.1	Is monitoring of training requirements being fulfilled								
1.10.2	Is monitoring of training requirements being fulfilled								
1.11	Is there a system for issue and control of Permit to Work forms								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
1.12.1	Does the Plant Manager regularly receive information advising him of accidents/incidents which have occurred in the gas industry								
1.12.2	Does he communicate and discuss this information regularly with his personnel								
1.13	As a result of carrying out Emergency Drills, is action taken to remedy shortcomings								
2.0	**Administration**								
2.1	Are there sufficient trained first aiders available at all times, including shift working								
2.2	Is an up-to-date notice posted giving names and location of first aiders								
2.3	Does first aid equipment meet the stipulated requirements								
2.4.1	When new equipment is installed, is there a system to ensure that adequate drawings, operating instructions and appropriate specifications are available to Management								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
2.4.2	Has a responsible person been appointed for holding and distributing copies of this information								
2.5	Is there a system for the control of contractors and visitors to site								
2.6	Are drawings, specifications and operating instructions for all plant and equipment available in the local language and kept up-to-date								
2.7	Have the necessary authority approvals for any alterations carried out since the last audit been obtained								
2.8	Are all plant valves and pipework etc adequately identified								
2.9	Are all water drains cleaned at the proper intervals								
2.10	Is emergency lighting checked/ tested at regular intervals								
3.0	**Training**								
3.1	Has any hazard or emergency training been given to personnel								
3.2	Have people with specialist jobs been adequately trained/certificated e.g. high voltage equipment, breathing apparatus, fork lift trucks, safety valves, hoists and cranes								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
3.3	Are new employees given special induction training								
3.4	Is refresher training being carried out at regular intervals								
3.5	Are critical procedures posted adjacent to workstations used for training personnel								
3.6.1	Are there training modules for respective jobs								
3.6.2	Are they used								
3.6.3	Are they satisfactory								
3.6.4	Are management and supervision directly involved in the training of personnel								
3.7	Do those who receive fuel, toxic materials and other dangerous materials understand:								
3.7.1	The properties of the materials								
3.7.2	The need to store them in specific areas/places								
3.7.3	That quantities do not exceed amounts covered by licence or agreed with Fire Department								
3.7.4	Appropriate handling methods								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
3.7.5	First aid requirements for these materials								
3.7.6	Fire risk								
3.7.7	Disposal procedure								
3.8	Are all written instructions, operating instructions and training modules up-to-date and used for training of personnel								
4.0	**Records and Registers**								
4.1	Is there a record of fuel, toxic material and other dangerous materials kept on site								
4.2	Are statutory records, factory registers etc kept and maintained								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
4.3	Are the following records available on site: Accident Reports – on plant and at customers' premises Lost Time Accidents Near Misses First Aid Injuries Opportunity for injury (which describes the unsafe acts and conditions witnessed during Safety Walks) Safety Walks Safety Inspections Safety Audits Minutes of Safety Meetings Personal safety records Training records Permit to Work certificates Receipts of fuel and other dangerous materials Inspection of ladders, trestles, scaffolding, mobile platforms, cranes, fork lift trucks etc External inspections, e.g. Lifting equipment Electrical inspections Pressure vessels Radioactive sources Fire Department Maintenance checks on fire extinguishers Weigh scales								
5.0	**Safety**								
5.1.1	Is there a site safety committee								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
5.1.2	Do they meet regularly								
5.1.3	Are safety committee items followed through to a conclusion								
5.2.1	Are safety committee members fully representative of plant personnel								
5.2.2	Have they received formal training								
5.3	Does the general site lighting meet recognised/company standards								
5.4.1	Has the issue of necessary protective clothing/equipment to operatives met the laid down standards								
5.4.2	Is it worn/used								
5.4.3	Is specialist protective clothing/ equipment regularly inspected so as to ensure it is in good condition and fit for use, e.g. rubber gloves for electrical use and aprons for chemical handling								
5.5.1	Are emergency showers tested regularly								
5.5.2	Is eye wash equipment available at the predetermined locations								
5.5.3	Is the eye wash solution changed at stipulated intervals								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
5.6.1	Are up-to-date Works Notices posted, e.g. Safety Committee reports								
5.6.2	Are they displayed in the appropriate places								
5.6.3	Are they clearly legible								
5.7.1	Are all alleyways/access walkways throughout factory kept clear								
5.7.2	Are they clearly marked								
5.8	Are fork lift truck working areas properly marked on the ground and signs posted or, as an alternative, are pedestrian walkways clearly marked								
5.9	Are restricted areas clearly marked and appropriate notices displayed e.g. Non-smoking/non-flame Traffic speed limits Access speed limits Access prohibited Fork lift trucks No parking								
5.10	Do single manned sites have ‘dead man’ protection, e.g. walkie talkie, offsite alarm, closed circuit television set etc								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
5.11.1	Are accidents or near misses fully investigated								
5.11.2	Are accidents or near misses fully documented								
5.11.3	Is implementation of recommendations arising from accidents/near misses formally monitored								
5.12	Are safety distances identified in Statutory or Company Regulations being observed								
6.0	**Emergency Control Procedures**								
6.1.1	Is there any emergency plan for the site								
6.1.2	Is it posted in a conspicuous location								
6.1.3	Is it regularly updated								
6.1.4	Does it cover a major incident								
6.2	Has an Emergency Controller and a deputy been appointed								
6.3.1	Are emergency practice drills carried out at stipulated intervals								
6.3.2	Do they involve Fire Department, Police and Ambulance Service etc								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
6.3.3	Do they include neighbouring businesses								
6.4.1	Are all emergency stop buttons clearly marked on the site plan								
6.4.2	Are they tested at the stipulated intervals								
6.4.3	Is there a rota which covers every emergency stop button being tested within a set period								
6.5	Does the layout of the site allow ease of access of fire tenders in the event of an emergency								
6.6.1	Does the site have to meet any agreement made with Local Authority Emergency Controller or Fire Department								
6.6.2	Is the agreement being fulfilled								
6.7.1	Is there a site plan showing the location of all bulk storage of gaseous, toxic and other hazardous materials on site, and does it also show oil, paint, diesel oil, petrol etc storage places								
6.7.2	Is it updated and readily available in an emergency								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
6.7.3	Is a weatherproof site plan located in a prominent place near the entrance to the factory such that the Fire Department can use it for reference at time of an emergency in the event that the Emergency Controller's office is not available								
6.8	Is a device to indicate wind direction clearly visible adjacent to the entrance to the factory								
6.9	Have telephone numbers been posted for all emergency services and expert advisers with names of contacts where appropriate e.g. Fire Department, Doctor, Hospital, Police, Safety, Electrical, Gases, Chemicals etc								
7.0	Fire Fighting								
7.1.1	Are quantities, type and location of fire alarm points, fire hydrants etc complying with the site plan								
7.1.2	Are they clearly marked so that they are easily seen								
7.1.3	Is all this equipment inspected regularly								
7.2	Is availability of water for fire fighting adequate								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
7.3	Are all fire exits and escape routes clear and free from obstruction								
7.4	Are all fire exit doors operable								
7.5	Are the Local Authorities aware of the nature of the risks at the site								
7.6	Are fire drills held at regular intervals with occasional simulation exercises								
7.7.1	Are the fire alarms regularly tested								
7.7.2	Do you have a rota which covers every alarm point being actuated within a set period								
7.8	Are water deluge and/or gaseous protection systems inspected and tested at regular intervals								
8.0	**Maintenance**								
8.1	Are maintenance workers, whether contractors or company employees, adequately trained/certified for the duties they perform								
8.2	Are all electrically driven tools and hand lamps purchased to approved specifications and are they examined at regular intervals by a competent person								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
8.3.1	Are grinding wheels provided with proper guards								
8.3.2	Are grinding wheels regularly dressed by a competent person								
8.3.3	Are the procedures for purchase, storage and fitting of grinding wheels established, known and followed								
8.4	Are signs ‘face shields or goggles required’ posted nearby grinding tools								
8.5	Are valving machines regularly inspected and checked								
8.6	Do maintenance personnel work to a predetermined work list when carrying out planned preventative maintenance								
8.7	Have maintenance personnel been trained in the use of Permit to Work procedures								
8.8.1	Are Permit to Work forms being issued as necessary e.g. Hot work Cold work Electrical Entry to confined spaces etc								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
8.8.2	Are Permit to Work procedures being followed and properly documented prior to re-commissioning of equipment								
8.8.3	Are the Permit to Work forms properly filed following completion								
8.9.1	Are job request forms used								
8.9.2	When issuing job request forms, has the need for immediate action been duly considered								
8.9.3	Are they properly completed								
8.9.4	Are copies filed								
8.9.5	Is the information obtained analysed								
8.9.6	Is the information acted upon as necessary								
8.10	Are all the boundary fences/walls and gates in good condition								
9.0	**Electrical Equipment**								
9.1	**General**								
9.1.1.1	Are all electrical drawings available								
9.1.1.2	Are they up-to-date								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.1.2.1	Is there a preventative maintenance system in use for regular inspections/testing of all electrical equipment								
9.1.2.2	Does this include verification of the electrical installation by a competent party, e.g. including approved sub-contractors								
9.1.3.1	Is a list on display which identifies the degree of authorisation of personnel to carry out duties on all electrical components								
9.1.3.2	Is the list up-to-date								
9.1.3.3	Have all the above people received adequate training								
9.1.4.1	Are safe working practices established for carrying out work on electrical equipment								
9.1.4.2	Do these practices include the use of total isolation and locking off electrical components in order to carry out inspection/testing/ maintenance work								
9.1.4.3	Are these isolation systems checked regularly to ensure they are all properly applied								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.1.5.1	Are all electrical compounds, HV & LT switch rooms kept locked								
9.1.5.2	Is admission to electrical compounds/switch rooms strictly restricted to authorised personnel								
9.1.5.3	Are all personnel advised of the risks associated with electrical equipment								
9.1.5.4	Are they advised of first aid measures in case of electrical accidents								
9.1.5.5	Are instructions posted concerning first aid measures in case of electrical accidents								
9.1.6.1	Are instructions posted providing information in case of fire in electrical installations								
9.1.6.2	Are approved fire extinguishers available for use with electrical equipment								
9.1.7.1	Are emergency circuit breakers clearly marked								
9.1.7.2	Is the emergency power supply in proper standby condition								
9.1.7.3	Is emergency lighting in good working condition								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.1.7.4	Is emergency equipment energy source tested regularly, e.g. diesel generator sprinkler systems								
9.1.8	Are adequate danger boards available to personnel who carry out work on high voltage equipment and associated machinery								
9.1.9.1	Are DC batteries properly installed with regard to: Ventilation Risks for personnel (e.g. explosion hazard)								
9.1.9.2	Are DC batteries safeguarded against possible overcharging (e.g. limited time for manual operation)								
9.1.10	Are all alarm/trip systems on electrical installations and equipment checked regularly								
9.1.11	Are all components clearly identified with type and service								
9.1.12	Is all electrical equipment adequately protected and enclosures secured to prevent accidental contact with live conductors								
9.1.13.1	Are all electrical consumers (motors/heaters) equipped with lockable isolation switches								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.1.13.2	Are they all clearly identified								
9.1.14.1	Are all motors provided with emergency stop buttons adjacent to the motor								
9.1.14.2	Are they clearly identified								
9.2	**Transformers + Capacitors**								
9.2.1.1	Is warning notice displayed 'Authorised persons only'								
9.2.1.2	Is warning noticed displayed 'Danger – high voltage'								
9.2.2	Has adequate fencing been installed around transformers								
9.2.3	Are indoor transformers properly safeguarded by suitable fir extinguishing equipment								
9.2.4.1	Are there signs of oil leaks on the transformers								
9.2.4.2	Are oil catching basins below oil transformers in good condition								
9.2.4.3	Is the oil level in the transformer satisfactory								
9.2.4.4	Is quality of oil regularly checked								
9.2.4.5	Is Buchholz protection on transformers inspected regularly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.2.4.6	Are pressure relief devices on transformers inspected regularly								
9.2.4.7	Are the transformers regularly checked for signs of overheating								
9.2.5	Is drying equipment on breathing air inlet/outlet on oil transformers in good condition								
9.2.6.1	Are capacitors containing PCB clearly labelled								
9.2.6.2	Are transformers containing PCB clearly labelled								
9.2.6.3	Are procedures established for disposal of PCB – capacitors/ transformers								
9.2.7	Are transformers clearly labelled with circuit identification								
9.2.8	Are adequate interlocks provided to prevent transformers being paralleled when they are not designed to be								
9.2.9	Are all off-load changes clearly identified and, where appropriate, padlocked								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.2.10	Are ducts from transformers compounds into switch rooms adequately sealed to prevent spread of fire								
9.2.11	Are overhead transmission line clearances to earth maintained								
9.3	HV Switch rooms								
9.3.1.1	Is a warning noticed displayed: 'Authorised persons only'								
9.3.1.2	Is a warning noticed displayed: 'Danger – high voltage'								
9.3.2.1	Is a substation log book provided to record entry and switching operation								
9.3.2.2	Are proper written instructions given for the operation of high voltage switchgear								
9.3.2.3	Do these instructions cover emergency isolation in case of automatic system failure								
9.3.2.4	Are operating rules for HV systems displayed								
9.3.2.5	Is main single line HV distribution diagram displayed								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.3.2.6	For switch rooms with CO_2/halogen systems, are instructions displayed ensuring the CO_2/halogen system is defeated and the room ventilated before entry								
9.3.3	Are switch rooms clean and free from obstacles								
9.3.4.1	Is the location of switch rooms adequate with respect to possible flooding								
9.3.4.2	Are ducts free of water								
9.3.5.1	Is there a safety cabinet located at the entrance to substations which contains appropriate safety equipment, for the equipment installed, to meet company regulations								
9.3.5.2	Do all exit doors open outwards								
9.3.5.3	Are these doors equipped with panic bars								
9.3.5.4	Are emergency exits clear and provided with emergency illumination								
9.3.5.5	Is a door key provided in a weak glass enclosure for emergency access								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.3.5.6	Is there a telephone for emergency purposes								
9.3.5.7	Are insulation mats located in front of all of the switchgear/equipment								
9.3.5.8	Are mobile insulated platforms available for use when operating manual high voltage circuit breakers								
9.3.6	Are ventilation openings free from obstruction								
9.3.7	Is general lighting adequate								
9.3.8	Are all panels properly labelled for voltage/equipment service								
9.3.9.1	Is test equipment, particularly high voltage probes, readily available								
9.3.9.2	Is it regularly maintained/tested								
9.3.10	Are all electrical protection relays regularly tested by secondary injection at regular intervals								
9.3.11	Are adequate locks available for locking off shutters etc								
9.4	**LT Switch rooms**								
9.4.1.1	Is a warning notice displayed: ‘Authorised persons only’								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.4.1.2	Is a warning notice displayed: 'Danger – voltage'								
9.4.2.1	Do all exit doors open outwards								
9.4.2.2	Are these doors equipped with panic bars								
9.4.2.3	Are emergency exits clear and provided with emergency illumination								
9.4.3	Are ventilation openings free from obstruction								
9.4.4	Is general lighting adequate								
9.4.5.1	Are all panels properly labelled for voltage/equipment service								
9.4.5.2	Are all sections clearly marked where current feedback can occur								
9.4.5.3	Are all intrinsic safety devices clearly marked								
9.4.5.4	Are off-load isolators clearly labelled								
9.4.6	Are cabinets free from moisture (condensate water)								
9.4.7	Are insulation mats located in front of all the switchgear/equipment								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.4.8.1	Are free exposed parts, which are live, protected against accidental damage								
9.4.8.2	Are all electrical protection systems regularly tested by secondary injection								
9.5	**Cables**								
9.5.1.1	Are all cables clearly labelled								
9.5.1.2	Are earthing cables/wires labelled/colour coded								
9.5.2	Are power cables segregated from other cables								
9.5.3	Are cables checked regularly (e.g. insulation/resistance)								
9.5.4	Are cables adequately electrically protected								
9.5.5	Are ventilation opens in cable ducts free from obstruction								
9.5.6	Is protection of cables against mechanical damage sufficient								
9.5.7	Are there any gaps where cables pass through walls								
9.5.8	Are naked wire ends insulated properly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.5.9.1	Are adequate drawings available showing all buried cable routes on site								
9.5.9.2	Are an adequate number of marker posts present along buried cable routes								
9.5.9.3	Are procedures available (e.g. Safety Work Permits) to control excavation adjacent to cable routes								
9.5.9.4	Do these procedures include testing and isolation of cables								
9.5.10	Are fire break walls in cable ducts kept in good condition								
9.6	**Motors**								
9.6.1	Are motors clearly labelled with volts, amps, watts, pf and isolation class								
9.6.2	Are warnings posted: ‘Be aware of current feedback from capacitors’								
9.6.3	Are instructions posted/followed fore re-starting of main machinery motors								
9.6.4.1	Does preventative maintenance system include all motors								
9.6.4.2	Are ventilation apertures free from obstruction								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								T	C
9.6.4.3	Is insulation of windings regularly checked								
9.6.4.4	Is tightness and efficiency of water coolers regularly checked								
9.6.5	Are rotating parts adequately guarded								
9.6.6	Are motor heaters switched on when main machinery is shut down								

B.2 Industrial Gas Cylinder Filling

1 General precautions

2 Liquid storage

3 Liquid pumps, vaporisers, heaters

4 Gasholders, balloons

5 Compressors

6 Pipes, separators, dryers

7 Filling manifolds and related equipment

8 Handling and storage of cylinders/bundles

9 Cylinder maintenance testing

NB This questionnaire is not exhaustive and may need to be complemented/adapted in order to cover all the procedures, plant and equipment on site.

Also, ensure that this Questionnaire is always used in conjunction with A ‘General Site’ Questionnaire

SAFETY AUDIT QUESTIONNAIRE

B.2 Industrial Gas Cylinder Filling

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.0	**General – Precautions**								
1.1	Are updated layout drawings available								
1.2	Is an up-to-date flow scheme available and does it cover all pipework, pumps and vacuum systems								
1.3	Is it posted and kept legible								
1.4	Are 'No Smoking' signs displayed on oxygen storage docks, cylinder filling areas, oxygen tanks and gasholders								
1.5	Are 'Flammable Gas – No Smoking' displayed on storage docks for flammable gases								
1.6	Are personnel wearing appropriate protective clothing/glasses etc for the safety zone in which they work								
1.7	Are signs 'No admittance for unauthorised persons; displayed at access to filling areas								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.8	Are function tests of machinery and equipment carried out after repair and are they recorded								
1.9	Are safety devices tested at regular intervals and results recorded for: safety valves high pressure shut-off devices emergency stop buttons alarm functions etc								
1.10.1	Are exposed belts, pulley drives/couplings or similar provided with enclosing guards								
1.10.2	Are they adequate								
1.11	Are handrails installed on stairs								
1.12	Is combustible waste stored in self-closing metal bins								
1.13	Is adequate electrical protection provided for electrical tools								
1.14	Is the personal safety equipment mandatory for visitors								
1.15	Is a pressure gauge calibration record maintained								
1.16.1	Are gauges ‘For Oxygen Service’ properly marked								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.16.2	Is there a written specification for the purchase of oxygen pressure gauges and is it followed								
1.17	Is a procedure for testing pressure gauges available and followed								
1.18.1	Are all oxygen spares purchased to written cleanliness specifications								
1.18.2	Are they maintained in this condition until used								
1.19	Are floors in good condition, e.g. where cylinders are stored/filled								
1.20	Are ventilation openings free from obstructions								
1.21	Are stairs kept in good condition								
1.22	Are storage areas/routes of handling equipment clearly marked and kept free from obstructions								
2.0	**Liquid Storage (vacuum insulated tanks)**								
2.1	Is area free from combustible/ flammable material, e.g. oil, grease, tar								
2.2	Are liquid gas transfer procedures in force and posted								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.3	Are precautions taken to avoid kinking of transfer hoses								
2.4	Are transfer hoses protected against the entry of foreign matter								
2.5.1	Are transfer hoses checked/ maintained regularly								
2.5.2	Are adequate records/ identification systems maintained								
2.6	Are tanks protected against mechanical damage by vehicles								
2.7	Are precautions taken to avoid tow-away accidents								
2.8	Is there an emergency shower provided near oxygen tank and kept in good working condition								
2.9	Is tank flowsheet posted, up-to-date and legible								
2.10	Are adequate warning and product identification signs posted								
2.11	Are there established procedures for inspection and overhaul of tank safety devices								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.12	When changeover valves upstream of safety valves are provided, are they checked and maintained regularly								
2.13	Are vent pipes from safety valves kept free from obstruction such as ingress of foreign material, water etc.								
2.14	Do vent pipes lead to a safe area								
2.15	Are supports for safety valves/ vent pipes adequate								
2.16	Is the shut-off valve on tank liquid outlet tested at regular intervals								
2.17	Are liquid level indicators checked/ calibrated at regular intervals								
2.18	Is the vacuum checked at regular intervals if covered by regulations								
2.19	Are thermal relief valves on all live sections where cold gas/liquid product can be trapped checked and maintained at regular intervals								
2.20	Is valve identification maintained in good condition and kept legible								
2.21	Is the automatic tanker pressure control system checked and maintained regularly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.22	Is instrument air system checked and maintained at regular intervals								
2.23	Is the manual vent valve easily accessible								
2.24	Are safety devices for avoiding over-pressure of vacuum space in good condition								
3.0	**Liquid Pumps, Vaporisers, Heaters**								
3.1	Are pump suction filters checked and cleaned regularly								
3.2	Are liquid oxygen centrifugal pumps free from material non-compatible with oxygen, e.g. aluminium alloys (see IGC Document 11/82)								
3.3	Is centrifugal pump cavitation protection maintained in good working condition								
3.4	Is there a special maintenance procedure available for overhauling oxygen pumps in accordance with oxygen cleanliness standards								
3.5	Are manufacturer's and company regulations regarding lubrication strictly observed								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.6	If pumps are installed in confined space, are ventilation openings free from obstructions								
3.7	Are operating instructions posted and strictly followed, particularly for pump cool-down.								
3.8	Is area around liquid oxygen pumps free from combustible/flammable material, e.g. oil, grease, tar etc								
3.9	Do vent pipes lead to a safe area								
3.10	Is the remote emergency stop device for liquid pumps tested regularly								
3.11	Are emergency stop buttons located both in the filling area and adjacent to the pumps								
3.12	Are all liquid lock and high pressure relief valves tested and maintained at stipulated intervals								
3.13	Are low temperature devices on vaporiser outlets regularly checked								
3.14	Are adequate guards around piping and vaporisers near vehicle movement areas in good condition								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.15.1	Is a permit to work system used when carryout out maintenance on pumps								
3.15.2	Within this system are pumps totally isolated, both electrically and physically								
3.16	Is the type of lubrication oil/grease used in accordance with company recommendations								
4.0	**Gasholders, Balloons**								
4.1	Are safety devices regularly tested e.g. alarm min/max level								
4.2	Are level indicators in good working condition								
4.3	Are leak tests regularly carried out								
4.4	Is the water level of gasholders regularly checked								
4.5	In case of gasholders being external to building, are precautions taken to prevent freezing								
4.6	Are guards installed around gasholders near vehicle movement areas in good condition								
4.7	Do vent pipes lead to a safe area								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.8	Are maintenance instructions established and applied								
4.9.1	Are drain pot overflow pipes free from obstruction								
4.9.2	Are they also free from the entry of foreign matter								
5.0	**Compressors**								
5.1	Is the area free of tripping/slipping								
5.2	Is the emergency stop button tested at regular intervals								
5.3	Are operating instructions posted nearby and followed								
5.4	Are inter-cooler/after-cooler vents, drains, safety valve outlets and bursting discs piped to a safe area								
5.5	Is there a preventive maintenance system in use for regular inspection/calibration of: pressure gauges all instrumentation alarm/trip functions temperature indicators major machine components filters and valves electric motor electrical system safety devices etc								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
5.6	Is technical data provided by compressor manufacturer available								
5.7	Does the supervisor record all unusual events								
5.8	Are maximum operating pressures marked on interstage pressure gauges								
5.9	Are temperature gauges marked with alarm/trip levels								
5.10	Are alarm/trip functions provided on compressor suction and discharge lines regularly tested								
5.11	Are inter- and after-cooler vessels, including pipes connecting to compressor, internally inspected/ pressure tested at regular intervals								
5.12	Are drain valves fitted to the bottom of each condenser and water separator operated at regular intervals								
5.13	Is the automatic stop device of water lubricated compressors in case of water failure tested at regular intervals and maintained in good working condition								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
5.14	Is water sued for lubrication purposes quality checked at regular intervals								
5.15	Is cooling water system maintained in good working condition								
5.16	Are types of lubricants used in accordance with company recommendations								
5.17	Are interstage valves checked at regular intervals								
5.18	Are piston clearances checked at regular intervals								
5.19	Are alarm/trip functions on oil/cooling water system checked at regular intervals								
5.20	If one compressor is used for oxygen/nitrogen/compressed air service, is a suitable safety device used to avoid cross connections and keep product integrity								
6.0	**Pipes, Separators, Dryers**								
6.1	Is protection of high pressure pipes against external sources of heat, mechanical damage and excessive vibration adequate								
6.2	Are leak tests regularly carried out								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
6.3.1	Do filter materials conform with company specifications								
6.3.2	Are filters inspected and cleaned regularly								
6.4	Are non-return valves tested at regular intervals								
6.5.1	Do vent valves lead to a safe area								
6.5.2	Are they free from obstruction								
6.6	Are all pipes correctly identified								
6.7	Are operating instructions for separators and dryers posted nearby and followed								
6.8	Are separators drained at regular intervals								
6.9	Does purchase of drying material meet written specifications								
6.10	Are separator and dryer vessels inspected/tested in accordance with legal/company requirements at stipulated intervals								
6.11	Is moisture content downstream of dryers checked at regular intervals								
6.12	Is hot piping of dryers properly insulated								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
6.13	Is the gas temperature downstream of the dryers monitored								
6.14	Is the pressure drop across the dryers checked at regular intervals								
7.0	**Filling Manifolds & Related Equipment**								
7.1	Is each filling manifold pressure gauge and recorder inspected/ tested at regular intervals								
7.2	Is there a cylinder segregation procedure to ensure that lower pressure cylinders are not connected to a higher pressure cylinder filling manifold								
7.3	Are automatic control systems set at correct pressure according to ambient temperature, filling rate etc								
7.4	Are filling procedures corresponding to filling system clearly defined, posted and followed								
7.5	Are copper pigtails (if used) annealed regularly according to company standards								
7.6	Is annealing date marked/recorded								
7.7	Are copper pigtails free of twisting or deformation								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
7.8	Are high pressure hoses in good working condition and inspected, tested/replaced at stipulated intervals								
7.9	Are provisions strictly applied to avoid pigtails and hoses from flapping in case of hose or pigtail rupture								
7.10	Are provisions made to secure pigtails, hoses and fittings not in use								
7.11	Are the couplings/fittings to cylinder/bundle valves in safe working condition								
7.12	Are the filling manifolds allocated to one gas only and identified by product name								
7.13	Is the piping of filling manifolds labelled with flow direction for product, vacuum and venting								
7.14	Are vent pipes free from obstructions and piped to a safe area								
7.15	Is the over-pressure filling rack switch regularly adjusted and tested to follow ambient temperature								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
7.16	Are lubricants used in vacuum pumps for oxygen approved for oxygen service								
7.17	Is vacuum pump protection against over-pressure by mal-operation maintained in safe operating condition								
7.18	Are precautions taken to avoid tow-away accidents in bundle/ trailer filling stations								
7.19	Are instructions given/followed for inspection of cylinders/bundles before filling as: colour code test date physical damage of valves condition of neck ring labels odour test damage to cylinder shell stranger cylinders								
7.20	Are instructions posted/followed on segregation of rejected cylinders								
7.21	When venting cylinders in an enclosed room, are the residual gases vented to a safe area								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
7.22	Is data available for proper control of filling of cylinders, i.e. pressure, temperature, compressibility, mixture etc								
7.23	Are all cylinders checked during filling for temperature differential to ensure admission of product to each cylinder								
7.24	Is a leak test performed on valve packing while there is full pressure on pigtail/hose								
7.25	Is a leak test done at valve outlet and cylinder to valve connection at final pressure								
7.26	Are pressure checks on filled cylinders carried out at regular intervals to verify correct filling pressure at reference temperature (e.g. 15^{o}C)								
7.27	Are oxygen cylinders that may have been used offshore hammer-checked for corrosion before filling								
7.28	Are proper procedures available for inspection/filling of all cylinders/ bundles that have been used offshore								
7.29	Is responsibility for product integrity clearly defined								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
7.30	Are instructions given/followed for method and frequency of tests per product filled								
7.31	Are results recorded								
7.32	Do vent pipes of analysing equipment lead to a safe area								
7.33	Is calibration of instruments made at regular intervals								
7.34	Are chemicals stored according to company/legal requirements								
8.0	**Handling & Storage of Cylinders/ Bundles**								
8.1	Are full and empty cylinder storage areas segregated								
8.2	Are all storage areas identified for the various gases and are they segregated from each other								
8.3	Are cylinders kept away from sources of heat								
8.4	Are storage areas kept clean and tidy								
8.5	Are walkways kept free from cylinders								
8.6	Are provisions made to prevent loose cylinders from falling								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
8.7	Are transport devices (forklift trucks, hand lifts etc) checked and maintained regularly according to company/legal regulations								
8.8.1	Are battery charging stations located in a safe and well-ventilated area								
8.8.2	Is the area clearly marked								
9.0	**Cylinder Maintenance/Testing**								
9.1	Are instructions posted and legible for: residual gas handling e.g. including highly flammable/toxic gases (see IGC Doc 30/04) check procedures before doing maintenance on cylinder valves inspection of cylinders external/ internal frequency of periodic test procedures per type of gas/ cylinder pressure test procedures colour codes labelling valves approved per type of gas scrapping of cylinders removal of inoperable cylinder valves etc								
9.2	Is adequate inspection of new valves and spare parts carried out before issue for use								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
9.3	Are signs posted 'face shields or goggles required' near grinding wheels								
9.4.1	Are valving machines regularly inspected and checked								
9.4.2	Are torque loadings specified for use with valving machines, e.g. for different cylinder materials								
9.4.3	Is there a procedure for the maintenance and fitting of cylinder valves, e.g. sealing medium								
9.5	Is water source properly controlled to prevent entry of oil or foreign matter into cylinders being tested								
9.6	Are pressure gauges on hydrostatic testing equipment calibrated at stipulated intervals and records kept								
9.7	Are guards on hydrostatic test equipment in good condition and in use								
9.8	Are stamping tools in good condition								
9.9	If inert gas for drying of cylinders is used, is ventilation sufficient								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
9.10	Are paint removers, paint materials, paint thinners and chlorinated solvents stored and used according to company/legal requirements								
9.11	Is colour spraying equipment (cabinet) in condition according to company/legal requirements								
9.12	Is compressed air supply system maintained regularly								
9.13	Is paint removing/sandblasting equipment in good condition								
9.14	Does the sandblasting equipment meet the requirements of national legislation								
9.15	Is an approved internal cylinder inspection lamp/lighting system in use								

B.3 Cryogenic Bulk Storage at Production Sites

1 Tanks

2 Cryogenic fill points

NB This questionnaire is not exhaustive and may need to be complemented/adapted in order to cover all the procedures, plant and equipment on site.

Also, ensure that this Questionnaire is always used in conjunction with A ‘General Site’ Questionnaire

SAFETY AUDIT QUESTIONNAIRE

B.3 Cryogenic Bulk Storage Tanks at Production Sites

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.0	**Tanks** **See IGC Documents 21/86 & 25/86**								
1.1	Is the manufacturer's name-plate legible								
1.2	Is there a flow sheet posted								
1.3	Is the remote emergency shut-off valve at the main liquid outlet of the tank in good working condition								
1.4	Can the emergency shut-off valve still be operated under power failure conditions and on instrument failure								
1.5	Are the associated emergency push buttons tested and maintained regularly								
1.6	Are the pressure controlling devices fitted on the annular space of the tank inspected at regular intervals								
1.7.1	Have checks been carried out to ensure that all safety devices on the tank can relieve vapours created by tanker flash-off in the worst possible condition								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.7.2	Are procedures for transfer of liquid into low pressure bulk storage tanks posted								
1.8	Are the safety valves provided checked and maintained at stipulated intervals								
1.9	Prior to inspections, are safety valves submitted to a relief test								
1.10	When changeover valves upstream of safety valves are provided, are they adjusted to the middle position so that both safety valves are in their operating condition								
1.11	Is the automatic tank vent valve checked and maintained regularly								
1.12	Are the exhaust pipes from safety valves and vent valves kept free from any obstruction such as foreign material, ice etc								
1.13	Are there established procedures for the inspection and overhaul of tank safety devices								
1.14	Are provisions made and kept in operation to avoid fall of ice blocks from tank vent outlets (baskets on outlets)								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.15	Is the seal gas flow in the annular space of the tank maintained at a certain rate								
1.16	Is the annular space regularly analysed for other components than present in the seal gas								
1.17	Is the manually operated vent valve of the tank easily accessible								
1.18	Are all alarm/trip functions provided such as: minimum pressure maximum pressure high level etc checked regularly.								
1.19	Is the liquid level indicator provided checked and calibrated at regular intervals								
1.20	Are the liquid level limit switches provided checked at regular intervals								
1.21	Is all valve identification maintained in good condition and kept legible								
1.22	Are all live sections where cold gas/liquid product can be trapped equipped with thermal relief valves								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.23	Are they checked and maintained at regular intervals								
1.24.1	Is the automatic tank pressure build-up control system checked and maintained regularly								
1.24.2	Is the anti-vacuum system on the tank checked and maintained regularly								
1.25	Is the instrument air control system inspected and maintained regularly								
1.26	Is the dew point of the instrument air in stationary lead lines to vital equipment sufficiently low to avoid blockage								
1.27	Are the transfer pumps tripped in the event of instrument air supply failure								
1.28	Is the remote emergency stop for the transfer pump in good working order								
1.29	Are an adequate number of product identification and safety signs posted, e.g. ‘No Smoking’, ‘Safety Glasses’ etc								
1.30	Is an emergency shower provided near to the LOX storage tank and is it kept in good working order								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.31	Are operators trained to deal with the dispersal of large vapour clouds								
1.32	Are warning signs posted at ducts and valve pits pointing out that permit to work procedures are to be followed prior to entering the pit								
1.33	Is the liquid level controller/ recorder of the tank calibrated and checked at stipulated intervals								
2.0	**Cryogenic Fill Points**								
2.1	Is tank gas pressure gauge in view of fill point checked and maintained regularly								
2.2	Are pressure gauges on suction and discharge of transfer pump checked and maintained regularly								
2.3	Is the maximum working pressure marked on the pressure gauges								
2.4	Are the pump safety valves inspected and overhauled at regular intervals								
2.5	Is the remote emergency stop device for the transfer pump regularly tested								
2.6	Are filling procedures for road and rail tankers posted								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.7	Is a flow sheet of the fill point posted								
2.8	Are identification signs of fill point valves legible								
2.9	Are safety distances clearly identified and observed (for recommended safety distances see IGC Doc 21/86 and 25/86)								
2.10	Are the filling hoses pressure tested/inspected and maintained at regular intervals								
2.11	Are filling hose supports in good working condition								
2.12	Are filling hoses kept free from any dirt or other foreign materials								
2.13	Are precautions taken not to kink filling hoses								
2.14	Is the tanker loading area at LOX fill points made of concrete and free from oil, grease and any organic compounds e.g. tar, bitumen etc								
2.15	Are warning signs and/or tow-away devices used to avoid tanker tow-aways								
2.16	Is each fill point clearly identified								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.17	Are transfer pumps protected against cavitation maintained in good working condition, e.g. pressure switch-low current								
2.18	Do the filling procedures clearly identify the responsibility of operating personnel and tanker drivers								
2.19	Are personal safety protection signs posted at each filling point, e.g. safety glasses safety shoes safety gloves								
2.20	Are different couplings used for the various products being filled								
2.21	Is there a procedure to report and remedy cryogenic leaks at the fill point								

B.4 Industrial Gas and Liquid Plant

1 General safety
2 Main air compressor and surrounding area
3 Air refrigeration equipment
4 Air condensate separators/molecular sieves/switch valves
5 Caustic scrubber
6 Cold box and surrounding area
7 ASU
8 Control room
9 Avoidance of hydrocarbon concentration
10 Oxygen pumps
11 Expansion turbines
12 Expansion engines
13 Argon and nitrogen compressors
14 Oxygen compressors
15 Cooling towers
16 Cooling water treatment
17 Emergency equipment/procedures
18 Argon purification plant
19 Hydrogen system
20 Product and disposal vaporisers for liquid nitrogen, oxygen and argon

NB This questionnaire is not exhaustive and may need to be complemented/adapted in order to cover all the procedures, plant and equipment on site.

Also, ensure that this Questionnaire is always used in conjunction with A ‘General Site’ Questionnaire

SAFETY AUDIT QUESTIONNAIRE

B.4 Industrial Gas and Liquid Plant

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.0	**General/Safety**								
1.1	Is the standard of housekeeping adequate								
1.2	Is there safety reference literature available on site on the following material categories: acetylene/acetylides ammonia freon argon chloride/chlorine hydrogen nitrogen oxygen miscellaneous gases (eg NO, NO_2, F, HF, H_2S								
1.3	Is an approved procedure in use for authorising modifications of plant and process control circuits etc								
1.4.1	Are electrical personnel certificated/ authorised to carry out work related to high, medium and low voltage equipment								
1.4.2	Is the list up-to-date								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.5	Is a procedure in force for isolating, affixing warning boards and locking off process equipment prior to inspection, maintenance and other work								
1.6.1	Are numbered danger boards, spades and isolation register in use within the permit to work system								
1.6.2	Are permit to work procedures followed prior to isolating/ re-commissioning equipment								
1.7.1	Are operating procedures issued for all plant and equipment								
1.7.2	Are start/stop procedures posted adjacent to the starter/stop mechanism								
1.7.3	Are all operating procedures kept up-to-date								
1.8.1	Are cleaning specifications and acceptance standards for production plants clearly defined								
1.8.2	Do these cleaning specifications differentiate between the requirements for: gases air liquid air/enriched air oxygen clean etc								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.9	Is an authorised material list available for oxygen service which is used when replacing joints, sealing rings and component parts								
1.10	Are pressure gauges for oxygen service clearly identified								
1.11	Is an operating procedure followed to establish the cause of cold box leaks								
1.12	Are there written emergency procedures relating to a large liquid spill from a tank, tanker or container								
1.13.1	Is a portable oxygen monitor available								
1.13.2	Is it calibrated at regular intervals								
1.14	Are proper instructions for start-up of main motor posted and do they cover frequency permitted, with time intervals etc								
1.15	Are maximum periods between air separation unit thawing operations/ maintenance laid down								
1.16	Are plant pressure systems, condensate separators and carbon steel pipework adequately inspected (for corrosion/erosion etc) and proper records kept								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.17	Is a control system in existence for additions, revisions or modifications to computer hardware/software								
1.18	Are rules established for inspection and pressure testing of relief valves (refer to IGC Doc 24/83)								
1.19.1	Are consolidated rules laid down for inspection and maintenance of gas transmission lines (internal to factory and external to customers)								
1.19.2	Do these rules cover: pipeline surveillance pipeline repairs pipeline reporting periodic checks cathodic protection monitoring								
1.20	Are adequate flow sheet/drawings available for all plant and ancillary services/equipment, e.g. instrument air, seal gas, cooling water etc								
2.0	**Main Air Compressor & Surrounding Area**								
2.1	Is the sign ‘Asphyxiation Danger – Entry Permit Required’ mounted on the air inlet duct inspection door/filter house door								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.2	Is there a proper unobstructed access to the air intake filter house								
2.3	Is the floor grating surrounding the compressor securely mounted on supports								
2.4	Is the area free of tripping/slipping hazards								
2.5	Are appropriate guards fitted over machine couplings								
2.6	Are noise warning signs posted in appropriate areas								
2.7	Is the sign ‘Danger – Do Not Stand in Front of Cabinet While Motor is being Started’ mounted on starter capacitor box								
2.8	Is there adequate lighting around the compressor								
2.9	Is the emergency stop button functionally tested at regular intervals								
2.10	Are operating instructions posted nearby								
2.11	Are intercooler/aftercooler vents, drains and bursting discs piped to a safe location								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.12	Are pressure/temperature gauges marked with alarm/trip levels								
2.13	Are temperature limits marked on lubricating oil indicators in use								
2.14	Is there a preventative maintenance system in use for regular inspection/calibration of: pressure gauges all instrumentation alarm/trip functions temperature indicators major machine components filters and valves electrical motors electrical systems safety devices vibration monitors etc								
2.15	Is technical data provided by compressor manufacturer available								
2.16	Does a daily log sheet record pressure, temperature and flow conditions as well as power consumption figures and are reference points shown on log sheets								
2.17	Does the supervisor carry out a daily check of all record data								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.18	Does the supervisor record all unusual events								
2.19	Are pressure gauges installed on each compressor stage								
2.20	Are maximum operating pressures marked on these gauges								
2.21	Is alarm/trip function provided on compressor discharge regularly tested								
2.22	Is the anti-surge protection of the turbo compressor regularly tested and calibrated								
2.23	Are inter-cooler and after-cooler vessels internally inspected at regular intervals								
2.24	Are drain valves fitted to the bottom of each condenser and water separator operated at regular intervals								
2.25	Are alarm/trip functions provided on the guide vanes at the suction of the compressor checked at regular intervals								
2.26.1	Is pipework connecting main compressor to coolers inspected at regular intervals for presence of oil etc								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.26.2	Are checks carried out at regular intervals so as to ensure that oil residues have not built up beyond the predetermined thickness								
2.27	Is the vibration monitor/shaft indicator in functional order								
2.28.1	Is the type of lubricating oil used in accordance with company recommendations								
2.28.2	Is the procedure for blowing oil separator drains being properly followed								
2.28.3	Are oiling rates for all the compressors clearly identified and in use								
2.29	Are records of approach temperatures to coolers of compressors kept								
2.30	Are piston and ring clearances checked at regular intervals								
2.31	Are alarm/trip functions in working order on oil filter units								
2.32	Are individual compressor alarms/ trips operated by low cooling water flow conditions and/or high air temperatures in working order								
3.0	**Air Refrigeration Equipment**								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.1	Freon								
3.1.1	With freon cycles, are warning signs posted identifying:								
3.1.1.1	Decomposition can occur in the vent of high temperature, leading to the formation of phosgene gas								
3.1.1.2	Hydrochloric acid is formed in the presence of moisture								
3.1.1.3	Halogen gas detection equipment should be used to search for vapour leaks								
3.1.2	Is there a halogen gas detector available on site and is it in working order								
3.1.3	Does the permit to work form highlight the danger of phosgene gas formation when carrying out hot work on, or in the vicinity of, this equipment								
3.1.4	Are operating instructions posted adjacent to this equipment								
3.1.5	Are special procedures available identifying the means of isolating/ replenishing/re-commissioning the fern sections								
3.1.6	Is the compressor oil properly stored to avoid ingress of humidity								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.1.7	Are personnel ware of the danger of leaking fern into the plant process stream								
3.1.8	Have personnel been adequately trained and appreciate the hazards involved with this type of equipment								
3.2	Ammonia								
3.2.1	With ammonia cycles, are warning signs posted forbidding entry in the vent of leakage unless proper procedures have been followed (use of breathing equipment etc)								
3.2.2	Is there an emergency procedure for us in the vent of a major escape of ammonia								
3.2.3	Are operating instructions posted adjacent to this equipment								
3.2.4	Are special procedures available identifying the means of isolating/ replenishing/re-commissioning the ammonia sections								
3.2.5	Are personnel aware of the danger of ammonia leaking into the plant process stream								
3.2.6	Are emergency showers/eye washes sited adjacent to ammonia refrigeration equipment								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.0	**Air Condensate Separators/ Molecular Sieves/Switch Valves**								
4.1	Is the condensate separator drain valve checked regularly for proper operation								
4.2	For totally enclosed rooms: e.g. molecular sieve vessels and/or switch valves:								
4.2.1	Do all exit doors open outward								
4.2.2	Is powered ventilation with louvres in working order								
4.2.3	Is visual alarm tied into oxygen monitor at entrance doors								
4.2.4	Does oxygen monitor give audible/ visible alarm in the event of increase/decrease in oxygen concentration								
4.2.5	Is a sail switch mounted in ventilation discharge duct which ties into the alarm circuit								
4.2.6	Are ‘Danger’ signs posted at all doorways								
4.2.7	Are all nitrogen vent sources piped to a safe outside location								
4.3	Are guards installed over switch valve mechanisms								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.4	Are lubricants applied to the switch valves oxygen compatible								
4.5	Do switch valve lubrication points have fittings to prevent the use of standard hydrocarbon grease								
4.6	Is the high temperature alarm/trip device on the air stream from the molecular sieve to the cold box tested and calibrated at stipulated intervals								
5.0	**Caustic Scrubber**								
5.1.1	Are air inlet and outlet connections to the scrubber checked at stipulated intervals for build-up of caustic								
5.1.2	Are the pipes to the safety valves checked at stipulated intervals for caustic build-up								
5.2	Is the pressure differential across the scrubber provided with an alarm/trip device and is it checked at stipulated periods								
5.3	Are operating procedures established for caustic systems								
5.4	Are loading/unloading procedures posted								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
5.5	Is individual protection equipment available (helmet with face shield, neoprene gloves, wellington boots and apron)								
5.6	Are warning signs properly posted								
5.7	Are emergency showers sited adjacent to the caustic scrubber								
5.8	Are eyewash facilities available adjacent to the caustic scrubber								
6.0	**Cold Box and Surrounding Area**								
6.1	Are coloured caps fitted over the ends of protruding valve spindles								
6.2	Is cold box pressure regularly logged								
6.3	In the event of abnormal ice patches:								
6.3.1	Are gas samples taken from frost spot areas and analysed								
6.3.2	Is appropriate action taken								
6.3.3	Are leaks reported to management and possible consequences evaluated								
6.4.1	Do safety valve exhausts vent to a safe place								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
6.4.2	Are these vents free from obstruction								
6.5	Are cold box foundation temperatures checked at regular intervals								
6.6.1	Do liquid drain lines slop downhill into the disposal header								
6.6.2	Are there any low points where total evaporation of LOX could lead to a dangerous hydrocarbon concentration								
6.7	Following deriming operations, are procedures followed (preferably logged) to ensure that all drain and instrument lines are clear and free from moisture								
6.8	Are signs ‘Possible Asphyxiation/ Enrichment of Atmosphere Beyond this Point’ installed for walkways and platforms in the area of argon, nitrogen and oxygen vents								
6.9.1	Is insulation material used on cold piping in good order and dry								
6.9.2	If not, are atmospheric conditions leading to pipe corrosion								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
6.10	Is there any evidence of valve spindles rubbing on the panel due to column movement caused by temperatures established during operating/thawing								
6.11	Is the area free of tripping/slipping hazards								
6.12	Do ladders, cages, safety gates, handrails and platforms comply with legal/company standards								
6.13.1	Is there the ability to monitor hydrogen levels in the top of the cold box in case of leaks								
6.13.2	Is an alarm fitted								
7.0	**ASU**								
7.1	Are adequate flow sheets and drawings of pipe routes available								
7.2	Are adequate operating instructions available								
7.3	Do they include:								
7.3.1	Start-up procedures								
7.3.2	Normal operation								
7.3.3	Shut-down procedure								
7.3.4	Thawing procedure								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
7.3.5	Emergency shut-down procedure								
7.3.6	Emergency liquid disposal procedure								
7.3.7	Are adequate flow sheets/drawings available for all plant and ancillary services/equipment, e.g. instrument air, seal gas, cooling water etc								
7.4	Is a daily log sheet record concerning pressure, temperature, liquid level and flow conditions, as well as power consumption figures, available								
7.5	Do management check data on log sheet regularly								
7.6	Are all unusual events recorded								
7.7	Are all liquid level indicators, alarms/trips on columns or condensers checked and maintained at stipulated intervals								
7.8	Are purity alarm/trip functions tested regularly – particularly with respect to oxygen content								
8.0	**Control Room**								
8.1	Do doors open outward								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
8.2.1	Are analysers vented to a common vent header and piped outside the building								
8.2.2	Is hydrogen vented through a separate header								
8.3	Are all chemicals used for analyses clearly identified								
8.4	Is oxygen monitoring carried out in the control room in the event of valve actuators being supplied with instrument nitrogen								
8.5	Is the oxygen monitor tied in with an audible alarm								
8.6	Are all cylinders properly secured to prevent them falling								
8.7	Does the use and location of cylinders meet the requirements of company and national regulations								
8.8	Can the wind direction be identified from the control room								
8.9	Are non-smoking areas clearly defined								
8.10	Are suitable fire extinguishers available								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
8.11	Are all instrument lines running into the control room limited on pressure								
8.12	Is the remote product storage tank gas pressure instrument gauge easily read								
9.0	**Avoidance of Hydrocarbon Concentration**								
9.1	Are reactivation procedures established for hydrocarbon/ acetylene adsorbers								
9.2	Is there a constant monitoring of hydrocarbons within the LP column sump/reboiler condenser								
9.3.1	Are hydrocarbon levels above maximum permitted, immediately reported to management								
9.3.2	Are procedures established and followed in case of a significant increase in hydrocarbon level being detected								
9.4	Are acetylene checks within LOX reboilers regularly carried out								
9.5.1	Is minimum liquid level in oxygen condenser bath always maintained at a safe operating level								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
9.5.2	Is a LOX purge being maintained from oxygen/enriched bottom column that is sufficient to ensure hydrocarbon concentration does not exceed safe levels								
9.6	Are LOX batch samples taken from column for full analysis periodically								
9.7	Is the adsorber material condition checked at stipulated intervals and replaced as necessary								
10.0	**Oxygen Pumps**								
10.1	Are operating instructions posted nearby								
10.2	Is seal gas provided								
10.3	Is control equipment for seal gas checked and maintained regularly, e.g. regulators, valves etc								
10.4	Is there a preventive maintenance system for inspection/calibration of:								
10.4.1	Vibration monitoring devices								
10.4.2	Mechanical pump components (labyrinth, filters etc)								
10.4.3	Alarm/trip functions								
10.4.4	Safety devices, e.g. under-current/ over-current etc								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
10.4.5	Electric motors								
10.4.6	Electrical systems								
10.5	Is there a special maintenance procedure available for overhauling the pump in accordance with oxygen cleanliness standards								
10.6	Are the manufacturers' and company regulations regarding lubrication of pumps and motors strictly observed								
10.7	Are pump suction filters checked and cleaned at regular intervals								
10.8	Are centrifugal pumps free from materials non-compatible with LOX, e.g. aluminium alloy – see IGC Doc 11/82								
10.9	Is centrifugal pump cavitation protection maintained in good condition, e.g. pressure switches, low current trip								
10.10	If pumps are installed in confined spaces, are ventilation openings free from obstruction								
10.11	Is the area around the pumps free from combustible material, e.g. oil, grease, tar etc								
11.0	**Expansion Turbines**								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
11.1	Is manufacturer's data on these machines available								
11.2	Are operating instructions posted nearby								
11.3.1	Are all applicable pressure, temperatures and power figures being monitored and logged								
11.3.2	Are pressure and temperature conditions at the turbine exhaust controlled so as to avoid any possibility of liquid formation in turbines								
11.3.3	Are all the indicators appropriately marked with the limits, e.g. pressure, temperature, power rpm								
11.4.1	Are the alarm/trip functions of the brake generator tested at regular intervals								
11.4.2	Is alarm/trip system of the vibration monitor regularly tested								
11.4.3	Are alarm/trip functions provided for oil temperature, oil pressure and oil tank level tested regularly								
11.5	Are alarm/trip functions for seal gas pressure tested regularly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
11.6	Is the overspeed trip device tested regularly								
11.7	When carrying out maintenance of turbines, are cleanliness standards strictly observed								
12.0	**Expansion Engines**								
12.1	Is the overspeed trip tested regularly								
12.2	Is oil lubrication properly controlled when applicable								
12.3	Is the oil separator of an oil lubricated engine blown at regular intervals								
12.4	Are the oil filters and adsorber regularly inspected and maintained								
12.5	Are temperature and pressure conditions at expansion engine exhaust controlled so as to avoid any possibility of liquid formation in expansion engine								
12.6	Are all expansion engine component parts purchased to approved specifications								
13.0	**Argon & Nitrogen Compressors**								
13.1	For machinery enclosures:								
13.1.1	Do all exit doors open outward								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
13.1.2	Is powered ventilation with louvres provided								
13.1.3	Is visual alarm tied into oxygen monitor at entrance doors								
13.1.4	Does oxygen monitor give an audible/visual alarm in the event of reduced oxygen concentration								
13.1.5	Is a sail switch mounted in the ventilation discharge duct which ties into the alarm circuit								
13.1.6	Are danger signs posted outside all entrances to this enclosure: 'Caution Oxygen Deficiency Possible'								
13.1.7	Are all argon and nitrogen vents piped to a safe outside location								
13.2	Is the grating around the compressor area securely mounted								
13.3	Is sign 'Danger – do not Stand in Front of Cabinet While Motor is being Started' mounted on starter capacitor box								
13.4	Are bursting disc and relief valve discharges piped to a safe area								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
13.5	Is emergency stop button functionally tested at regular intervals								
13.6	Are operating instructions posted nearby								
13.7	Is hot piping/intercoolers guarded such that personnel cannot come into contact with it								
13.8	Are pressure/temperature gauges marked with alarm/trip levels								
13.9	Are temperature limits marked for lubrication oil in use								
13.10	Is compressor manufacturer's technical data available								
13.11	Is a daily log sheet record concerning pressure, temperature and flow conditions, as well as power consumption figures available, and are reference points shown on the log sheet								
13.12	Does the supervisor carry out a daily check of all recorded data								
13.13	Does the supervisor record all unusual events								
13.14	Are pressure gauges installed on each stage of compressors								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
13.15	Are maximum operating pressures marked on these gauges								
13.16	Are suction pressure alarm/trip functions available								
13.17	Is alarm/trip system provided on compressor discharge tested regularly								
13.18	Is the anti-surge protection of the turbo compressor regularly tested and calibrated								
13.19	Are cooler purging procedures posted near to the compressor								
13.20	Are alarm/trip functions on oil filter units in working order								
13.21	Are individual compressors fitted with alarm/trips operated by low cooling water flow conditions and/or high gas temperature in working order								
13.22	In the event of compressors being capable of being run on either oxygen or nitrogen service, are detailed operating procedures posted adjacent to the compressor								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
13.23	Are the compressors being regularly maintained in accordance with the preventative maintenance system								
14.0	**Oxygen Compressors See IGC Docs 10/81 & 27/01**								
14.1.1	Is entry to an oxygen compressor machinery space forbidden whilst the compressor is in oxygen service								
14.1.2	Can all necessary instrument readings be taken from a safe place								
14.1.3	Can these readings be taken without entering a restricted area during normal operation								
14.2	Do entrance and exits to restricted areas have appropriate warning signs								
14.3	Are specific operating procedures available and fully understood by all authorised personnel								
14.4.1	Are local and remote emergency stop buttons available								
14.4.2	Are they tested at regular intervals on a rota basis								
14.5.1	Are all vent, drain and relief valves etc piped to external safe locations								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
14.5.2	Is the position of the oil vapour vent at a safe distance from all the above oxygen vents								
14.6	Is the sign 'Danger – Do not Stand in Front of Cabinet while Motor is being Started' mounted on starter capacitor box								
14.7	Does the immediate area around the compressor conform with company standards								
14.8	Is the area frequently checked for oil spillage and cleanliness								
14.9	Is the piston rod checked regularly for any sign of oil contamination (e.g. ultra violet light)								
14.10.1	Are operating procedures (normal and emergency) posted nearby								
14.10.2	Do they allow for the machine being 'run up' and 'shut down' on inert gas								
14.11	Are alarm and trip values clearly marked on all pressure gauges/ temperature indicators								
14.12	Is compressor manufacturer's technical data available								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
14.13	Is a daily log sheet record concerning pressure, temperature and flow conditions, as well as power consumption figures, available and are reference points shown on the log sheet								
14.14	Does the supervisor carry out a daily check of all recorded data								
14.15	Does the supervisor record all unusual events								
14.16	If a machine is shut down under abnormal conditions, is management permission needed before machine re-start								
14.17	Have procedures been established for the inspection and maintenance of oxygen machinery and do they cover:								
14.17.1	Compressor isolation/purging								
14.17.2	The use of oxygen compatible materials								
14.17.3	Oxygen cleanliness standards and ultra violet light inspection								
14.17.4	Purchase of oxygen spares to written cleanliness specifications								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
14.17.5	Maintaining spare parts in this clean condition until used								
14.17.6	The wearing of white, lint-free gloves conforming to company standards, when handling oxygen clean parts								
14.17.7	The wearing of clean overalls conforming to company standards								
14.17.8	Carrying out pre-filter and non-return valve inspection whenever compressor inspections are done								
14.17.9	In the event of repairs to the compressor (e.g. valve repair), is a laid down procedures followed to establish all parts have been located and removed before re-start of compressor								
14.17.10	Do these procedures cover the need to account for all tools and materials at start and completion of the work on the internals of the compressor								
14.18	Are non-return valves installed in oxygen compressor discharge pipelines								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
14.19	Are manually operated oxygen valves provided with special protection shield in order to protect personnel in the event of an ignition during valve operation.								
14.20	Is start up of turbo compressor linked to the availability of a 'failsafe' seal gas control system								
14.21	Are safety signs and fire fighting equipment installed in accordance with the site emergency plan								
14.22.1	Are personnel provided with protective clothing and equipment for their full range of activities								
14.22.2	Is it used								
14.23	Is there a planned preventive maintenance system in existence for the frequent inspection/ calibration of pressure gauges, temperature indicators, vibration monitoring equipment, major machine components, all instrumentation, filters, valves, relief valves, alarms, trips, electric motors, electrical systems, safety devices including seal gas equipment								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
14.24	Is the discharge/recycle line of the compressor provided with a dewpoint meter and associated alarm/trip for corrosion prevention								
14.25	Has consideration been given tot he fitting of temperature monitoring of all valves on the compressor (rather than one per stage) in order to assist in the early detection of faults								
14.26	In the event of a trip, is a 'first flag' indication available to simplify fault diagnosis								
14.27	Are individual compressors fitted with alarms/trips operated by low cooling water flow conditions and/or high gas temperatures								
14.28	In the event of compressors being capable of being run on either oxygen or nitrogen service, are detailed operating procedures posted adjacent to the compressor								
15.0	**Cooling Towers & Pumps**								
15.1	Are there guards installed over motor shaft couplings								
15.2	Is the necessary lifting tackle etc available for removal of filter screens before the pump suction								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
15.3	Is there adequate protection to prevent personnel falling into cooling tower ponds								
15.4	Is the cooling tower pond fitted with a low level alarm								
15.5	Is make-up water to cooling tower ponds provided by means of open discharge pipes above the pond								
15.6	Is the cooling tower deck equipped with kick-boards and non-slip surfaces								
15.7	Are handrails and ladders smooth and free of splinters on wooden towers and free of sharp edges on metal towers								
15.8.1	When working on gearboxes, vee-belt drives etc on cooling towers, is a ‘safe system of work’ established for normal operation, inspection and maintenance								
15.8.2	Does this take account of the need to secure the fan blade whilst carrying out maintenance in this area								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
15.9	Is a failsafe sprinkler system installed on wooden towers (being connected to the circulating water pumps such that shutdown, or trip, automatically starts the system)								
15.10.1	Are fire extinguishers available on the top deck								
15.10.2	Is an escape route from the top deck available and free from obstruction								
15.11	Are there emergency stop buttons located on top of the tower								
15.12	Notwithstanding the use of Permit to Work system when carrying out maintenance, in the event of burning/hot work, then are precautions taken to prevent any sparks/hot metal coming into contact with wooden/combustible materials of construction								
15.13	Are protective devices fitted to the fan and gearbox to protect against excessive vibration and temperature respectively								
16.0	**Cooling Water Treatment**								
16.1	Are operating procedures established for use of sulphuric acid/caustic/chlorine/other chemicals								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
16.2	Is an unloading procedure posted								
16.3.1	Is individual protection made available helmet faceshield neoprene gloves boots protective clothing								
16.3.2	Is it worn								
16.4	Are warning signs properly posted								
16.5	Are the chemical tank storage vents located close to ground level and do they spill in a safe area								
16.6	Are there emergency showers and eye-wash stations located within the appropriate safety zones								
16.7	Are dosing pumps equipped with plexiglass shields								
16.8	Are cylinders/drums located in safe areas								
16.9.1	Are employees aware of the hazardous nature of all materials used in chemical water treatment								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
16.9.2	Have adequate facilities/equipment been provided to deal with emergencies relating to use of these chemicals								
16.10	Do testing procedures ensure that damage to plant cannot occur due to excessive deviations of water quality								
16.11	Is there a procedure for checking the state of effluent so as to ensure disposal of same meets the requirements of local/national regulations								
17.0	**Emergency Equipment/ Procedures**								
17.1.1	Are the breathing gas cylinders regularly checked for content								
17.1.2	Are the breathing gas cylinders full								
17.1.3	Are all component parts of the breathing equipment in good condition								
17.2	Is the inspection of equipment logged								
17.3	Is the equipment regularly tested								
17.4	Are cylinders still within approved test period								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
17.5	Stretchers/fire fighting suits/ fire blankets: is all the equipment regularly inspected/logged								
17.6	Eye washers/showers: is all the equipment regularly inspected/ logged								
17.7	Emergency lighting: is all equipment regularly tested/logged								
17.8	Portable analysers: is all equipment regularly tested/logged								
17.9	First aid kits: is there a check system to ensure the kits are stocked with the necessary items								
17.10	Are emergency procedures available and up-to-date for shutting down all items of plant								
18.0	**Argon Purification Plant**								
18.1	Are there heat protective shields around de-oxo units								
18.2	Is there insulation on hot lines which personnel can come in contact with								
18.3	Is the area free of tripping/slipping hazards								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
18.4	Do ladders, cages, safety gates, handrails and platforms comply with the national/company standards								
18.5	Is the automatic protection device on high oxygen content in the feed to the de-oxo unit regularly checked								
18.6	Is the high temperature protection device, installed in the de-oxo unit bed, regularly checked								
18.7	Are hydrogen/hydrocarbon analysers sensing the cold box for leaks of flammable gases, checked at regular intervals								
18.8	Do sample stream discharges/vents from product analysers vent to a safe area outside the building								
18.9	Is the forced draft ventilation in analyser rooms checked at regular intervals								
18.10	Is the permanent hydrogen gas monitoring device calibrated/logged at stipulated intervals								
18.11	Are all equipment earthing readings verified at stipulated intervals								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
18.12	Are condensate traps on condensate separators checked against blowing hydrogen and are they regularly inspected								
18.13	Can all valves for manual operation easily be reached								
18.14	Are the low flow shutdown devices on all process heaters checked/ maintained at regular intervals								
19.0	**Hydrogen System**								
19.1	Is a flowsheet description of the hydrogen system posted and kept legible								
19.2	Are safety distances clearly identified and observed as company regulations								
19.3	Is the hydrogen storage area clearly identified as non-smoking/ non open flame zone								
19.4	Are adequate guards installed around piping and fill connections near vehicle movement areas effective								
19.5	Are vent lines and safety device outlets free from obstruction and piped to a safe height								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
19.6	Is the ventilation of the hydrogen pressure reduction cabinet adequate								
19.7	Are tools that may be used of an approved type								
19.8	Are hydrogen trailers properly earthed prior to connecting								
19.9	Are earthing resistance readings regularly taken of equipment and systems								
19.10	Is the area around and under the hydrogen installation kept free from weeds, bush and combustible material								
19.11	Are all operating personnel trained on properties of hydrogen gas								
19.12	Are all operating personnel trained in handling hydrogen fires								
19.13	Are operating procedures posted nearby and kept legible								
19.14	Are transfer hoses replaced at regular intervals								
19.15	Are anti-towaway procedures for hydrogen trailers/bundles in force								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
19.16	Are filters cleaned at regular intervals								
19.17	Are maintenance procedures established to allow for purging of the system sot hat air cannot enter the storage system before commencing repair work								
20.0	**Product & Disposal Vaporisers for Liquid Nitrogen, Oxygen & Argon**								
20.1	Are low temperature trip devices on product outlets regularly checked								
20.2	Are all alarm/trip devices regularly submitted to functional test								
20.3	Is warm water/steam ejection from vaporiser discharged to a safe location in case of coil rupture								
20.4	Are all operating instructions locally posted								
20.5	Is an up-to-date flowsheet available								
20.6	Are all hot water/steam lines insulated for personnel protection								
20.7	Are operating personnel obliged to wear protective gloves in the area were steam is being used								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
20.8	Is cold piping shielded to protect personnel								

B.5 Acetylene Plant and Cylinder Filling

1 General precautions
2 Storage and handling of carbide
3 Acetylene generator
4 Acetylene drying and purification
5 Acetylene compressors
6 HP driers
7 Flame arrestors
8 Filling racks/charging
9 Acetone equipment
10 DMF equipment
11 Maintenance
12 Emergency procedures
13 Acetylene cylinder construction, internal inspection, maintenance and disposal

NB This questionnaire is not exhaustive and may need to be complemented/adapted in order to cover all the procedures, plant and equipment on site.

Also, ensure that this Questionnaire is always used in conjunction with A ‘General Site’ Questionnaire

SAFETY AUDIT QUESTIONNAIRE

B.5 Acetylene Plant and Cylinder Filling

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.0	**General Precautions**								
1.1	Is the standard of housekeeping adequate								
1.2	Is a purging procedure issued for all major equipment								
1.3	Are all parts of rotating machinery/ equipment, shafts etc, properly guarded								
1.4	Can the plant be operated with the alarm ‘main switch’ in the ‘OFF’ position								
1.5	Is the acetylene system protected against the effect of freezing conditions								
1.6.1	Are personnel provided with the necessary protective clothing and equipment for the full range of plant								
1.6.2	Is this clothing/equipment used								
1.7	Are metal/anti-static plastic buckets used under drain valves for operation and maintenance purposes								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.8	Are components, valves, pipework, flexible hoses etc correctly specified at the time of replacement								
1.9.1	Are personnel who work on acetylene systems adequately trained and aware of the hazards associated with acetylene and this type of plant								
1.9.2	Are personnel aware of the dangers of using certain materials and metals for equipment in contact with acetylene								
1.10	Are all metal constructions/ equipment adequately earthed								
1.11	Are all floors, walls, beams, roof trusses, window ledges etc kept free from carbide dust								
1.12	Is a safe method of disposing of carbide dust in use								
1.13	Are safety signs prominently displayed around the acetylene factory, eg ‘No smoking’, ‘Unauthorised Personnel Prohibited’.								
1.14	Are ventilation openings at high and low level kept free from obstruction								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.15	Are all vent pipes (from relief valves etc) discharging outside the building, kept free from obstructions								
1.16.1	Do all fork lift trucks meet the requirements of company/ national legislation								
1.16.2	Are they regularly inspected/ maintained								
2.0	**Storage & Handling of Carbide**								
2.1	Are carbide drums/containers inspected after receipt on site								
2.2	Are operators trained to deal with damaged or hot drums/ containers								
2.3	Are other materials stored in this area								
2.4	Is a notice posted warning one not to extinguish a carbide fire with water								
2.5	Are the emergency exits properly identified and kept free from obstruction								
2.6	Is it possible to have an ingress of water into the carbide store								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.7	Are all construction materials and storage areas kept in accordance with legal requirements, eg floor, roof, walls, doors, windows, platform, ventilation, lifting devices								
2.8	Is the store adequately ventilated								
2.9.1	Do all fork lift trucks used in this area meet the requirement of company/national legislation								
2.9.2	Are they regularly inspected/ maintained								
2.10	Are unloading conditions for carbide drums and containers properly controlled, eg in event of heavy rain, rough handling etc								
2.11	Are container analysis instruments (used in connection with purging etc) calibrated regularly								
2.12	Are tools that may be used in the carbide store of an approved type								
2.13	Are carbide drums/containers kept sealed until required for use								
2.14	Is maximum carbide quantity stored kept within licensed figure								
2.15	Is carbide usage based on a ‘first in’, ‘first out’ rota								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.0	**Acetylene Generator**								
3.1	Are adequate and legible operating instructions posted								
3.2	Are clear instructions posted on how to deal with: a blocked charging skip a blocked hopper an overheated hopper a blocked feed system generator body an overheated generator blockage at the agitator a blocked lime water outlet a blocked sludge outlet								
3.3	Is the Supervisor advised and a record kept of any unusual event								
3.4	Is adequate instrumentation available and in good working condition, eg pressure gauge, water level, temperature indicators								
3.5	Is all instrumentation and control equipment regularly inspected and calibrated								
3.6	Are all safety devices regularly tested and inspected								
3.7	Are all company recommended safety devices installed								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.8	Are devices to prevent over-pressure, eg water seals, regularly tested								
3.9	Has the generator outlet a free flow of lime water without any sign of obstruction								
3.10	Are nitrogen purges provided to generator/hopper and skip								
3.10.1	Is the nitrogen purge used at every refill								
3.10.2	Is equipment fitted to the nitrogen purge line to control flow in good working condition								
3.10.3	Is the low content alarm for supply of nitrogen purge gas checked regularly								
3.11	Is the generator internal assembly cleaned at stipulated intervals								
3.12.1	Are clear procedures followed when cleaning or maintaining a generator								
3.12.2	Do these procedures include adequate purging								
3.13	If the water supply in use fails, will an alarm be activated								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.14.1	Is carbide feed stopped in the event of the generator temperature level reaching an alarm point								
3.14.2	Is carbide feed stopped in the event of the generator water level reaching the alarm point								
3.15	Is all lifting/hoisting equipment in the generator house examined regularly								
3.16	Is the sludge drain valve checked regularly for leakage								
3.17	Hydraulic back pressure valve								
3.17.1	Is the hydraulic back pressure valve maintained at regular intervals								
3.17.2	Is the water from the overflow constantly trickling								
3.18	Static water seals								
3.18.1	Are water seals regularly checked for correct operation, eg by checking water level								
3.18.2	Are water seals protected against freezing								
3.19	Gasholder								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.19.1	Are the bell and the guides regularly inspected for free movement								
3.19.2	Are limit switches regularly inspected/tested								
3.19.3	Are ropes/chains regularly inspected/tested								
3.19.4	Are gasholders inspected at stipulated intervals								
3.19.5	Is gasholder overflow system checked at regular intervals (it needs to operate when gasholder is full and the trip does not work)								
3.20	Disposal of sludge								
3.20.1	Are guard rails and walkway across sludge/water pond maintained in a safe condition								
3.20.2	Does sludge disposal comply with the requirements of local environmental regulations								
3.21	Are personnel wearing appropriate protective clothing								
3.22	Are personnel aware that carbide sludge contains dissolved acetylene, which may create a hazardous condition								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.0	**Acetylene Drying and Purification**								
4.1	Low pressure driers								
4.1.1	Are the vessel purging procedures applied before and after shutdown, prior to reconnection to the live system								
4.1.2	Are drain lines regularly checked to be free from dissolved calcium chloride/obstruction								
4.1.3	Are drier vessels internally inspected at stipulated intervals								
4.2	Low pressure purifiers (dry)								
4.2.1	Is there a provision to purge the vessel from C_2H_2 gas								
4.2.2.1	Are gas samples regularly tested downstream of purifiers								
4.2.2.2	Are procedures followed to avoid exhaustion of purifier material								
4.2.3	Can on-line purifier vessel be completely isolated from off-line vessel by block and bleed system, or similar								
4.2.4	Are drain valves on purifiers regularly operated and checked								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.2.5	Is the regeneration procedure strictly followed								
4.2.6	Are adequate procedures followed when disposing of exhausted purifier material, or recharging same								
4.2.7	Is temperature indication of gas stream available when regenerating purifier bed								
4.3	Low pressure purifiers (wet)								
4.3.1	Is the quality/density of the sulphuric acid in circulation monitored								
4.3.2	Is the scrubber operating temperature adequately controlled								
4.3.3	Is the quality/density of circulating caustic solution checked regularly								
4.3.4	Are tests done regularly to determine the effectiveness of the purification process								
4.3.5	Are adequate procedures followed when disposing of exhausted sulphuric acid or caustic soda, or recharging same								
4.3.6	Is pressure drop across the acid scrubber adequately controlled								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.4	Sulphuric acid/chromic acid tank								
4.4.1	Are adequate operating procedures established for the acid system								
4.4.2	Are loading/unloading procedures from the tanker/drum posted								
4.4.3	Is individual protection made available (helmet, protection screen, neoprene gloves, boots, protective clothing etc)								
4.4.4	Are warning signs properly posted								
4.4.5	Are adjacent emergency showers available								
4.4.6	Is the tank inspected regularly for corrosion								
4.4.7	Is the bund around the tank kept in good condition								
4.4.8	Is the bunded area free from rubbish								
4.5	Caustic tank								
4.5.1	Are adequate operating procedures established for the Na0H system								
4.5.2	Are loading/unloading procedures from tanker/drum posted								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.5.3	Is individual protection made available 'helmet, protection screen, neoprene gloves, boots, protective clothing)								
4.5.4	Are warning signs properly posted								
4.5.5	Are adjacent emergency showers available								
5.0	**Acetylene Compressors**								
5.1	Are low pressure alarm and trip tested regularly								
5.2	Is discharge alarm/trip device tested regularly								
5.3	Are suction filters regularly checked for pressure drop								
5.4	Are operating instructions properly posted								
5.5.1	Are there emergency stop buttons placed remote from the compressor								
5.5.2	Are they tested regularly								
5.6.1	Are visible/audible alarms provided								
5.6.2	Are they tested regularly								
5.7	Are water drains from compressor kept free from obstruction								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
5.8	Is water temperature, oil pressure, gas temperature checked regularly								
5.9	HP oil/water separation								
5.9.1	Are the high pressure oil/water separators drained regularly								
5.9.2	Are these separators pressure tested at stipulated intervals								
5.10	Plant piping								
5.10.1	Are plant piping relief device outlets free from obstruction and in good order								
5.10.2	Is all piping regularly leak tested as per requirements								
6.0	**HP Driers**								
6.1	Are drain lines checked regularly to ensure they are free from dissolved calcium chloride/obstruction								
6.2	Is drier material inspected at regular intervals and replaced as necessary								
6.3	Are vessels inspected and tested at stipulated intervals								
6.4	Are vessels cleaned regularly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
6.5	Are procedures for operation of drier drain valve established and followed								
6.6	Are the vessel purging procedures applied before and after shutdown, prior to reconnection to the live system								
7.0	**Flame Arrestors**								
7.1	Are efficient flame arrestors in use (see IGC Doc 19/84)								
7.2	Are they regularly inspected for pressure drop								
7.3	Are flame arrestors changed on excessive pressure drop								
7.4	Are flame arrestors taken out when cleaning the filling lines								
7.5	Do flame arrestor locations meet company requirements								
8.0	**Filling Racks/Charging**								
8.1.1	Is each filling rack independently purged at plant start-up								
8.1.2	Is gas analysed to determine air content before commencing cylinder filling								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
8.2	Is each filling rack pressure gauge and recorder inspected/tested at regular intervals								
8.3	Is every manifold and cylinder fill connection shut-off valve opened slowly								
8.4	Is each charging hose/pigtail non-return valve checked at stipulated intervals								
8.5	Is each charging hose/pigtail filter checked at stipulated intervals								
8.6	Are cylinders kept cool in hot weather by use of water spray								
8.7	Are charging hoses/pigtails regularly inspected and replaced								
8.8	Are operating instructions properly posted								
8.9	Is the emergency deluge system (if fitted) tested regularly								
8.10	Do any dead ended pipe sections exist								
8.11	Are all manifolds properly earthed								
8.12	Are manifolds cleaned at stipulated intervals								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
8.13	Are filling racks inspected/leak tested at stipulated intervals								
8.14	Are cylinder connections leak tested at connection to filling rack and intermediate pressures whilst filling								
8.15.1	Is the cylinder charging procedure posted and followed								
8.15.2	Are cylinder specifications/charts available for all types of cylinders filled								
8.15.3	Are stranger cylinder handling/ filling procedures available and followed								
8.15.4	Are cylinders overdue statutory inspection withdrawn prior to filling								
8.15.5	Are procedures in use for rejection of cylinders affected by dents/cuts, corrosion, exposure to heat and damage to valves								
8.15.6	Is there a record which shows details of all cylinders rejected for filling								
8.16	Is the pressure gauge downstream of the main inlet valve regularly observed								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
8.17	Is the residual gas content established before adding solvent and connecting the cylinder to the charging rack								
8.18	Is there a blowdown procedure for cylinders/bundles with high residual pressure								
8.19	Is a check carried out at the end of the charging cycle to verify that gas content of cylinders is correct								
8.20	Is the weighing machine checked regularly by the use of test weights								
8.21	Are scales regularly calibrated/ tested according to national legislation								
8.22	Is cleanliness maintained under the weighing machine platform								
8.23	Is the solvent replenishing procedure posted adjacent to the solvent machine								
8.24	Are personnel aware of the consequences of an excess, or lack, of solvent in a cylinder/bundle/ trailer								
8.25	Are clear instructions given on how to deal with cylinders containing an excess of solvent								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
8.26	Are operators aware of the risks involved in the use of solvents								
8.27	Are operators aware of first aid actions which should be taken in the event of solvent coming into contact with the skin or the eyes etc								
8.28	Have precise instructions been given in the method of dealing with depressurised cylinders which exceed tare weight								
8.29	Are cylinder valves checked for leaks after filling and disconnection from the filling rack								
8.30	Are fusible plugs checked for leaks after filling								
8.31	Are cylinders stored in locations remote from sources of heat								
8.32	Is cylinder storage area always kept free of gasoline, oil and other combustible materials								
8.33	Is an approved procedure posted for charging and replenishing solvent in bundles/trailers								
8.34	Is the procedure being properly followed – see IGC Doc 18/82								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
8.35	Are warning signs and/or towaway devices used to avoid hoses connected to bundles/trailers being ruptured								
9.0	**Acetone Equipment**								
9.1	Are piping, valves, dispensers, tanks and pumps regularly checked for leaks								
9.2	Are crash barriers installed to prevent damage to equipment								
9.3	Are earthing checks of the system carried out at stipulated intervals								
9.4	Are the operators following procedure for earthing the tanker/ drum when transferring acetone to the storage tank								
9.5	Are tanker unloading instructions properly posted								
9.6	Are means of purging being used when carrying out maintenance of equipment								
9.7	Is acetone only stored in approved areas – outside filling area								
10.0	**DMF Equipment**								
10.1	Are piping, valves, dispensers, tanks and pumps regularly checked for leaks								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
10.2	Are crash barriers installed to prevent damage to equipment								
10.3	Are earthing checks of the system carried out at stipulated intervals								
10.4	Are the operators following procedure for earthing the tanker/ drum when transferring solvent to the storage tank								
10.5	Are tanker unloading instructions properly posted								
10.6	Are means of purging being used when carrying out maintenance of equipment								
10.7	Has a programme for monitoring DMF level in atmosphere adjacent to cylinder examiner, whilst carrying out his duties, been performed to establish procedures in use are adequate								
10.8	Is DMF only stored in approved areas – outside filling area								
11.0	**Maintenance**								
11.1	Is a planned maintenance system in use								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
11.2.1	When planned maintenance work is not completed as originally programmed and is re-scheduled at a later date, does inspection of the records make this clear								
11.2.2	If it does, is the nature of the work reviewed to ensure no hazard can arise from this action								
11.3	Within this system are the safety valves and relief equipment tested and overhauled at stipulated intervals								
11.4	Are personnel who carry out maintenance work on acetylene systems adequately trained and aware of the hazards associated with acetylene and this type of plant								
11.5	When pressure gauges are replaced, is there a procedure that ensures that only approved gauges are fitted, eg having less than 70% copper								
11.6	Is the electrical continuity of every component in the system regularly checked								
11.7	Is all electrical equipment in conformity with national legislation								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
11.8	Is a regular inspection of stuffing boxes/glands carried out between the electrical motor room and acetylene compressor areas in the way of cables/drive shafts etc to ensure gas leakage cannot occur								
11.9	Are personnel instructed about the danger of using portable electrical equipment in safety zones								
12.0	**Emergency Procedures**								
12.1	Are employees aware of the emergency procedures in case of:								
12.1.1	a hot cylinder a leaking cylinder with flame propagation a leaking cylinder without flame a cylinder rupture (eg begin total shutdown/isolation)								
12.1.2	flame on ruptured pigtail/hose or piping ruptured pigtail/hose without fire cessation of water supply								
12.1.3	a hot generator a hot carbide drum/container carbide blockage between the container/skip and the hopper carbide blockage between the hopper and the generator body blocked generator drain/pump								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
12.2	Are adequate instructions available for shutting down plant in emergency cases: Electrically equipment isolation nitrogen purging								
12.3	In the event of problems is the Supervisor/Manager advised								
12.4	Are approved flameproof torches readily available for use in emergency situation								
12.5	Is the remote controlled emergency inert gas supply system in good working order								
12.6	Is it tested at regular intervals								
13.0	**Acetylene Cylinder Construction, Internal Inspection, Maintenance and Disposal**								
13.1	Are all cylinder information charts/ drawings/data available								
13.2	Are all details of acetylene cylinder valves available								
13.3	Are cylinders weighed off after depressurisation to ensure no residual acetylene is trapped								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
13.4	Are procedures in use for the removal of damaged acetylene cylinder valves where the cylinder contains gas under pressure								
13.5	Is an inspection programme designed to eliminate cylinders that have: voids in the mass excessive tophead to filler clearance excessive side wall clearance								
13.6	Is there a procedure available covering: preparation valve and fuse plug removal airing and purging cylinder disposal handling and disposal of pieces record keeping								
13.7	Do cylinders under vacuum have their vacuum broken by slowly bleeding acetylene into them								
13.8	Are new cylinders whose weight is less than its tare segregated for further evaluation								

C.6 Hydrogen Compression, Purification and Cylinder Filling

1 General

2 Hydrogen Compressors

3 Hydrogen Purification

4 Hydrogen Filling Racks

5 Maintenance

6 Emergency Procedures

NB This questionnaire is not exhaustive and may need to be complemented/adapted in order to cover all the procedures, plant and equipment on site.

Also, ensure that this Questionnaire is always used in conjunction with A ‘General Site’ Questionnaire

SAFETY AUDIT QUESTIONNAIRE

C.6 Hydrogen Compression, Purification and Cylinder Filling

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.0	**General** See IGC Doc 15/96								
1.1	Are personnel aware of the properties of hydrogen, both physical and chemical, eg flammability range, explosion limits, low energy requirement for ignition, heating effect of expansion								
1.2.1	Is a purging procedure issued for all major equipment								
1.2.2	Is it strictly followed								
1.3	Is the nitrogen purge distribution system in good working condition								
1.4.1	Is the plant regularly monitored for hydrogen leaks								
1.4.2	In the event of a leak being found that could lead to a dangerous situation/exceeding company standard leak rate, is immediate action taken								
1.5	Have all sources of ignition been eliminated								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.6.1	Is there an adequate number of escape doors and is there free access								
1.6.2	Do all doors open outwards								
1.6.3	Are escape routes adequately signed								
1.7.1	Are personnel provided with the necessary protective clothing and equipment, eg anti static footwear								
1.7.2	Is the protective clothing/equipment used								
1.8	Are personnel aware of the need to use approved tools when working on hydrogen equipment								
1.9	Is the installation and operation of electrical systems in accordance with the regulations, standards and codes of practice								
1.10.1	Are lightning conductors provided								
1.10.2	Are they checked at the stipulated intervals by a competent person								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.11.1	Are all systems bonded and effectively earthed to give protection against hazards of stray electrical currents and static electricity in accordance with National Codes/Regulations								
1.11.2	Are they checked at stipulated intervals								
1.12	Are personnel instructed of the danger of using portable electrical equipment in safety zones								
1.13	Are the safety zones indicated by permanent notices, particularly at access points								
1.14	Are notices posted at appropriate locations ‘Hydrogen – Flammable Gas – No Smoking – No Naked Flames’								
1.15	Is all work other than directly connected with plant operation covered by a ‘safety work permit’ system								
1.16.1	Is natural/forced draught ventilation free from obstruction and in good working condition								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.16.2	Do hydrogen monitors give an audible/visual alarm outdoors in the event of hydrogen enrichment in the building								
1.16.3	Are hydrogen monitors tested and calibrated at stipulated intervals								
1.17.1	Is there adequate lighting in the hydrogen plant area								
1.17.2	Is there also adequate emergency lighting available								
1.17.3	Is the emergency lighting checked at regular intervals								
1.18.1	Are plant and machinery functions checked/monitored and logged								
1.18.2	Is this information reviewed by the appropriate supervisor on a daily basis								
1.19	Are all vents, drains and safe valve exhaust lines leading to external safe locations free from obstruction								
1.20	Are pressure indicators tested/ calibrated regularly								
1.21	Is all analysing equipment tested/ calibrated at regular intervals								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.22	Are all safety valves tested/re-set at stipulated intervals								
1.23	Do all failsafe control valves receive regular checks								
1.24	Are all alarm/trip functions tested and calibrated at stipulated intervals								
1.25	Is a company code issued for purchase of materials to be used on hydrogen systems eg high pressure piping low pressure piping high pressure fittings etc								
1.26	When disposing of chemicals and/or process materials (eg drier/ purifier/de-oxo) is care taken to ensure regulations are being complied with								
1.27.1	Do all fork lift trucks meet the requirements of company/national legislation								
1.27.2	Are they regularly inspected/ maintained								
2.0	**Hydrogen Compressors**								
2.1.1	Are operating instructions properly posted adjacent to the compressor								
2.1.2	Are they up-to-date and legible								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.2.1	Is a flowsheet of the system available								
2.2.2	Is it up-to-date								
2.3	Are compressor main shut-off valves maintained regularly								
2.4	Are regular checks made to ensure hydrogen cannot leak back into the nitrogen purge system								
2.5	Are the high and low pressure alarm and trip settings of the compressor tested at stipulated intervals								
2.6	Is an oxygen analyser provided to test the process gas at the earliest point possible on the compressor								
2.7	Are alarm/trip functions at pre-set oxygen levels tested at stipulated intervals								
2.8.1	Are temperature limits for each stage clearly identified								
2.8.2	Are temperature indicators/ recorders tested regularly								
2.8.3	Are high temperature alarms/trips at the discharge of compressor stages tested regularly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.9	Are pressure limits for each stage clearly identified								
2.10.1	Are the compressor remote emergency stop buttons tested at regular intervals								
2.10.2	Do signs clearly indicate their position								
2.11	Are the automatic drain valves of the condensate drain vessels checked and maintained at regular intervals								
2.12	Are the high and low level alarms/ trips of the condensate level gauges checked at regular intervals								
2.13	Are water drain lines kept free from obstruction								
2.14	Are all compressor safety valves tested/re-set at stipulated intervals								
2.15	Are the alarm/trip functions of individual compressors for water temperature and pressure, oil pressure and motor overload checked on a regular basis								
2.16	Are inlet temperatures of compressor inter and after coolers checked regularly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.17.1	Are safety devices fitted to water side of all coolers checked at stipulated intervals								
2.17.2	Are vents leading from safety devices to a safe area checked regularly to ensure they are free from obstruction								
2.18.1	Is the safety valve of the compressor crankcase (pressurised by hydrogen or nitrogen) checked and maintained at stipulated intervals								
2.18.2	Are the alarm and trip functions on the crankcase purge gas for low pressure/flow conditions checked regularly								
2.18.3	Is the sample valve at the purging line downstream of the compressor crankcase checked and maintained as necessary								
2.18.4	Are gas samples taken at purging outlets from compressor crankcase before allowing maintenance to commence								
2.19.1	Are working procedures available for compressor start-up following erection or maintenance work								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
2.19.2	Do these procedures include the use of a nitrogen purge								
2.19.3	Do these procedures include for analysis of the nitrogen purge (including interstage bypass lines etc) to ensure the compressor internals are full of inert gas prior to start-up								
2.19.4	Are re-start and shut-down procedures of compressor available								
2.19.5	If the compressor is shut down under abnormal conditions, is management permission needed before one may re-start the unit								
2.20	Are all suction drum and interstage separators internally checked, cleaned and tested at stipulated intervals								
2.21	Are wall thicknesses regularly checked at fixed points in pipework/ condensate pot systems so as to determine the corrosion rate								
2.22	Are appropriate guards fitted, eg over couplings and flywheels etc								
3.0	**Hydrogen Purification**								
3.1	Are detailed operating instructions of the purification system available								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.2.1	Are all valves and control equipment numbered								
3.2.2	Is a flow-sheet posted adjacent to the purifiers which clearly identifies valves and control equipment								
3.3	Are the isolating valves between the HP and LP part of the purifier secured against wrong operation								
3.4	Are valve operating instructions posted to ensure slow valve-wheel movements								
3.5	Are oil/water separators, filter and pressure vessels internally checked and tested at stipulated intervals								
3.6	Are the dust filters inspected and cleaned regularly								
3.7.1	Are all temperature control devices in the purification system tested/ calibrated at regular intervals								
3.7.2	Are the alarm/trip functions of these temperature controllers checked at regular intervals								
3.7.3	Is the analysing equipment monitoring the purified gas calibrated at regular intervals								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.7.4	Are purifier/drier/deoxidiser materials checked at regular intervals and replaced as necessary								
3.8	Is the back pressure valve fitted to avoid fluidisation checked and tested at regular intervals								
3.9.1	Are working procedures for purifier startup/shutdown available								
3.9.2	Do these procedures also cover startup/shutdown at the time of carrying out maintenance work								
3.10	Are vessels and pipeline nitrogen purging procedures applied before and after maintenance shutdown, prior to re-connection to the live system								
3.11	Are the automatic quick-acting hydrogen shutoff valves before inlet purifier unit tested and maintained regularly								
3.12	Is the adjustment of the purge outlet valve controlled by high pressure and high temperature at the molesieve section tested and calibrated regularly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.13	Is the liquid nitrogen liquid level controller of the purifier unit tested and calibrated at stipulated intervals								
4.0	**Hydrogen Filling Racks**								
4.1	Is the automatic emergency stop valve before the main feeder system checked and maintained at stipulated intervals								
4.2	Are the remote emergency stop buttons placed on each filling rack tested regularly								
4.3	Are filling rack blowdown/purge valves independently purged at plant startup								
4.4	Is each manifold and fill connection shutoff valve opened slowly								
4.5	Are pigtails/filling hoses inspected/ tested/replaced at stipulated intervals								
4.6	Has it been verified that dead-ended pipe sections are vented regularly								
4.7.1	Are manifolds properly earthed								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.7.2	Is special care exercised to ensure satisfactory earth bonding of cylinders/bundles/trailers being filled								
4.8	Are filling racks inspected/tested at stipulated intervals								
4.9.1	Are cylinder connections leak tested at connection to filling rack whilst filling								
4.9.2	Are cylinder/bundles/trailer valves leak tested at valve spindle/gland								
4.9.3	Are warning signs and/or anti-towaway devices used to avoid hoses connected to bundles/trailers from being ruptured								
4.9.4	Are cylinder/bundles/trailer valves checked for leaks after filling								
4.9.5	Are mechanical joints on the filling system and cylinders/trailers leak tested regularly								
4.10	Is the cylinder charging procedure posted and strictly followed								
4.11	Is the non-return valve of each individual manifold checked regularly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.12.1	Are cylinders overdue statutory test totally segregated from cylinders to be filled								
4.12.2	Are procedures in use for rejection of cylinders affected by dents/cuts, corrosion, exposure to heat and damage to valve								
4.13	Is the vacuum system for evacuation of cylinders in good working condition								
4.14	Is the safety valve installed in the vacuum system to protect the system for cylinder back-pressure, in the event of maloperation, checked regularly								
4.15	Is the automatic shut-off valve installed to exclude any backfeed of oil from the vacuum pump into the manifold, checked regularly								
4.16	Are the non-return valves provided at the hose connection to prevent backflow from the bundle/trailer being filled, in the event of a hose rupture, checked regularly								
4.17	Are the pressure reducing valves used to reduce charging pressure down to an acceptable instrument system pressure checked and maintained regularly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.18	Are analytical instruments and systems for hydrogen service checked and maintained at stipulated intervals								
5.0	**Maintenance**								
5.1	Are maintenance procedures for hydrogen systems available								
5.2.1	Are personnel instructed that prior to slowly depressurising and purging hydrogen systems, or undertaking work on them, a safety work permit needs to be issued								
5.2.2	Does the safety work permit require that a final sample analysis has to be taken before reconnection of any equipment to a live system								
5.3	Is all portable hydrogen monitoring equipment tested and calibrated at stipulated intervals								
5.4	Are maintenance personnel who work on hydrogen systems adequately trained and aware of the particular safety precautions associated with this type of plant								
5.5	Are personnel instructed to use approved tools in hydrogen safety zone								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
6.0	**Emergency Procedures**								
6.1	Are adequate instructions available for shutting down plant in emergency situations: electrical isolation equipment isolation nitrogen purging								
6.2	Are personnel aware of the action to be taken in the event of fire, eg actuate the emergency stop button raise the alarm summon help and fire fighting services close valves to cut off the sources of hydrogen supply evacuate all persons from the danger area except those necessary to deal with the emergency always approach any fire from the windward direction								
6.3	Are personnel aware that hydrogen flames are very difficult to see in daylight								
6.4	Are operators instructed to wear gloves when they manipulate valves/control systems etc in the course of their work								
6.5	Are approved flameproof torches readily available for use in emergency situations								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
6.6.1	Is remote controlled emergency inert gas supply in good working order								
6.6.2	Is it checked at regular intervals								

B.7 Liquid Tanker and Distribution of Liquid Products

1 General

2 Sub-contractors for Liquid Tankers

3 Driver Training

4 Emergency Measures

5 Vehicle Equipment

6 Liquid Delivery to Customer Installation

7 Liquid Tanker Operation

8 Maintenance of Vehicles

NB	This questionnaire is not exhaustive and may need to be complemented/adapted in order to cover all the procedures, plant and equipment on site. Also, ensure that this Questionnaire is always used in conjunction with A 'General Site' Questionnaire

SAFETY AUDIT QUESTIONNAIRE

B.7 Liquid Tanker and Distribution of Liquid Products

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.0	**General**								
1.1	Are vehicles equipped with a Tachograph								
1.2	Are Tachograph discs checked on a frequent basis								
1.3	Are charts/records kept for the mandatory period								
1.4	Are all violations recorded on charts brought to the attention of the drivers								
1.5	Have any modifications been carried out on the vehicles								
1.6	Were these modifications duly authorised								
1.7	Are frequent checks carried out to verify if following items are carried on board vehicles: transport licence gas data sheet emergency cards ADR signs loading sheets operating instructions etc								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.8	Is following information clearly visible on vehicle product name company name and telephone number								
2.0	**Sub-contractors for Liquid Tankers**								
2.1	Prior to the appointment of transport contractors for the carriage of gases, are they supplied with:								
2.1.1	All appropriate training literature								
2.1.2	A copy of all appropriate safety rules								
2.1.3	A copy of the relevant section of the Safety Audit Questionnaire								
2.2	Are the same rules applied to the loading/offloading of contractor's vehicles that are applied to company vehicles								
3.0	**Driver Training**								
3.1	Have all drivers received safety training								
3.2	Have drivers attended sessions on the following subjects:								
3.2.1	Gas and cryogenic liquid properties								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.2.2	National regulations								
3.2.3	European road regulations (ADR)								
3.2.4	Liquid tanker design and safety								
3.2.5	Pump technology and operation								
3.2.6	Influence of liquid movement on tanker stability								
3.2.7	Emergency procedures in case of accident								
3.2.8	Firefighting								
3.2.9	Dangers of vapour clouds and precautions to be taken								
3.2.10	Transfer of liquid into low pressure storage tanks								
3.2.11	The safe parking of tankers								
3.3	Is refresher training given at regular intervals								
3.4	Have drivers been instructed to report:								
3.4.1	Defects: of truck of pump of tanker equipment of faults at customer installations								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.4.2	Incidents and accidents to tanker and personnel								
3.5	Is there evidence of drivers not reporting defects/incidents and accidents relating to tankers and customer installations								
3.6	Have drivers been given instructions to:								
3.6.1	Practice a daily check of their vehicle – according to checklist eg lighting, tyres, brakes								
3.6.2	Check whether anti-towaway device is in working order								
3.6.3	Adhere strictly to road regulations								
3.6.4	Never overload tanker								
3.6.5	Use protective clothing and equipment: gloves, glasses, safety shoes etc								
3.7	Do contract drivers receive the same training								
4.0	**Emergency Measures**								
4.1	Have drivers had an explanation of the dangers of: oxygen enriched atmosphere oxygen deficiency								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.2	Have drivers been instructed as to the measures they should take in the event of: road accident liquid spill tanker/pump fire tyre fire								
4.3	Do drivers know what to do in case of cryogenic burns								
5.0	**Vehicle Equipment**								
5.1	Is a regular check carried out to verify if following items are carried on board:								
5.1.1	Wheel chocks								
5.1.2	Emergency warning lights								
5.1.3	A portable tray (if necessary)								
5.1.4	Fire extinguishers of correct type and size								
5.1.5	Safety signs: 'No Smoking' 'Do Not Move Vehicle' (if no anti-towaway device fitted) road triangles								
5.1.6	First aid kits								
5.2	Is a regular check carried out on operation of anti-towaway devices								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
5.3	Are regulatory cargo (eg ADR) plates fitted to vehicle								
5.4.1	Are company procedures available to control the conversion of a tanker from one gas to another								
5.4.2	Are such procedures followed in full								
5.5	Are the emergency telephone numbers on the tanker legible and up-to-date								
5.6	Are flexible hoses and couplings checked at regular intervals								
5.7.1	Are fire extinguishers regularly inspected and labelled								
5.7.2	Are records kept								
6.0	**Liquid Delivery to Customer**								
6.1	Has a procedure for the transfer of cryogenic liquid been established								
6.2	Have drivers had an explanation of rules governing position of tanker during delivery								
6.3	Have drivers been told to report any deviation of these rules at particular customers								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
6.4	Have drivers been told to report customer installations that: have been modified are not in good condition lack operating instructions or are illegible								
6.5	Do drivers report to the customer on arrival at site and do they follow the customer special site rules								
7.0	**Liquid Tanker Operation**								
7.1	Have drivers/operators been instructed to ensure prior to tanker delivery that product confusion does not occur								
7.1.1	Ensure that couplings correspond to the gas name posted on the tanker and tank to be filled								
7.1.2	Avoid joining flexible hoses end to end								
7.1.3	Pay attention to strict control of tank pressure during delivery								
7.1.4	Stay in proximity of tanker during filling and delivery								
7.1.5	Shutdown any oxygen pump which shows sign of malfunction								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
7.1.6	Report immediately any malfunctioning of oxygen pump during transfer								
8.0	**Maintenance of Vehicle**								
8.1	Is there a planned preventive maintenance system								
8.2	Does it cover: Engine chassis and bodywork transmission gear box brakes steering mechanism electrical and lighting equipment tyres, condition and pressure wheels fire extinguishers								
8.3	Are inspection programmes up-to-date								
8.4	Have any major services been missed for any vehicle								
8.5	Does detailed examination of a number of vehicles show that maintenance standards are unsatisfactory								
8.6	Does this examination substantiate the accuracy of the records								

B.8 Cryogenic Liquid Storage At Customer Premises

1 General

2 Safety and Warning Notices

3 Maintenance of Tank and Associated Equipment

4 Electrics (when applicable)

NB This questionnaire is not exhaustive and may need to be complemented/adapted in order to cover all the procedures, plant and equipment on site.

Also, ensure that this Questionnaire is always used in conjunction with A ‘General Site’ Questionnaire

SAFETY AUDIT QUESTIONNAIRE

B.8 Cryogenic Liquid Storage at Customer Premises

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.0	**General** See IGC Docs 16/85 & 17/85								
1.1	Are safety distances in compliance with legal/company regulations								
1.2.1	Is the storage area external to buildings and well ventilated								
1.2.2	If not, is it installed to a safe standard								
1.3.1	Is there clear access for tankers								
1.3.2	Does the tanker unloading position permit rapid evacuation of tanker in event of an emergency								
1.3.3	Is the tanker unloading area of suitable material for the discharge of oxygen (when applicable)								
1.4	Are the tank controls easily accessible during product transfer								
1.5	Are unauthorised persons prohibited from the installation area								
1.6	Are all product vent lines routed to a safe location								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.7	Is the area fenced and properly maintained								
1.8	Is there an emergency exit from the installation compound – when fenced								
1.9	Is a tank data plate provided and kept legible								
1.10	Is adequate lighting provided to ensure good visibility during product transfer								
1.11	Is the installation protected from mechanical damage by tankers/ vehicles								
1.12	Is an installation dossier maintained for the installation test certificates for vessel and pressure systems maintenance records repair records modifications								
1.13.1	Is fire fighting equipment installed in immediate vicinity of the oxygen storage area								
1.13.2	Are fire extinguishers regularly inspected and labelled								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.14	Are fire fighting equipment locations clearly identified (ie in dark weather conditions)								
1.15	Is the installation area kept clean and free from obstacles								
2.0	**Safety and Warning Notices**								
2.1	Is a notice 'No Parking' posted near transfer area								
2.2	Are following notices (as applicable) posted and kept legible: No Smoking, No Naked Flame/ No Combustible Material Liquid Oxygen/Nitrogen/Argon Explosion Danger when Oil/ Grease are Brought in Contact with Oxygen								
2.3.1	Is a flowsheet and emergency shut-down instruction displayed adjacent to the control panel								
2.3.2	Is it up-to-date and legible								
2.3.3	Are emergency telephone numbers clearly posted								
2.4	Is gas supplier's address and telephone number clearly posted and kept up-to-date								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.0	**Maintenance of Tank Conditions and Associated Equipment**								
3.1	Is the tank and associated equipment regularly inspected as part of the preventative maintenance programme								
3.1.1	eg paintwork, corrosion, filling connection, frost spots, tank supports, leaks etc								
3.1.2	eg pressure regulators, liquid level indicators, temperature controllers, in-line filters, pressure gauges, alarms, trips								
3.1.3	When the above checks are carried out, is the installation examined for the presence of unauthorised modifications								
3.2	Is the area kept free from combustible/flammable material, eg oil, grease, tar								
3.2.1	Is a customer installation defect reporting system in use								
3.2.2	Are repairs notified as being required carried out within an appropriate time period								
3.3	Is tightness of tank/vaporiser holding down bolts checked regularly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.4	Is tank foundation in good condition, eg cracking, settlement								
3.5	Is tanker unloading area suffering from any defects or damage								
3.6	Are tank ladders and platforms well maintained (handrails, toeboards)								
3.7	Are established procedures available for inspection/overhaul of tank safety devices See IGC Doc 24/83								
3.8	Are tank safety valves inspected/ retested/maintained at regular intervals								
3.9	Are records of safety valve inspections kept								
3.10	Are all safety valves properly tagged (ie test date, set pressure, duty, serial number, type)								
3.11	Are all safety valves secured against reaction forces								
3.12	Is safety valve/bursting disc kept free from obstruction								
3.13	Are changeover valves upstream of safety valves checked regularly								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.14	Are safety cut-out devices inspected/checked at stipulated intervals (temperature switches/ pressure switches								
3.15	Is access to the manual vent valve clear from obstruction								
3.16	Are all pipework, valves and controls clearly identified in accordance with the flowsheet								
3.17	Are dust caps provided at each fill point								
3.18.1	Do company technicians adhere to customer/company 'Safety Work Permit' procedures when carrying out repair work								
3.18.2	Do the above procedures include the use of a safety checklist which contains: eg isolation of equipment purging of pipework cold work hot work electrical isolation								
4.0	**Electrics (when applicable)**								
4.1.1	Is the entire installation earthed								
4.1.2	Are earth readings regularly taken and recorded								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.2	Is the electric power supply socket clearly identified								
4.3	Are power sockets provided in full accordance with company specifications								

B.9 Transport of Gas Cylinders

1 General

2 Sub-contractors for cylinder transport

3 Driver training

4 Vehicle crane and tailgate lift

5 Securing loads

6 Maintenance of vehicle

7 Emergency measures

NB This questionnaire is not exhaustive and may need to be complemented/adapted in order to cover all the procedures, plant and equipment on site.

Also, ensure that this Questionnaire is always used in conjunction with A ‘General Site’ Questionnaire

SAFETY AUDIT QUESTIONNAIRE

B.9 Transport of Gas Cylinders

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.0	**General**								
1.1	Are vehicles equipped with a Tachograph								
1.2	Are Tachograph discs checked on a regular basis								
1.3	Are charts/records kept for the mandatory period								
1.4	Are all violations recorded on charts brought to the attention of the drivers								
1.5	Have any modifications been carried out on the vehicles								
1.6	Were these modifications duly authorised								
1.7	Are frequent checks carried out to verify if following items are carried on board vehicles: transport licence gas data sheet emergency cards ADR signs loading/delivery sheets operating instructions								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
1.8	Is the company name and telephone number clearly visible on the vehicle								
2.0	**Sub-contractors for Cylinder Transport**								
2.1	Prior to the appointment of transport contractors for the carriage of gases, are they supplied with:								
2.1.1	All appropriate training literature								
2.1.2	A copy of all appropriate safety rules								
2.1.3	A copy of the relevant section of the Safety Audit Questionnaire								
2.2	Are the same rules applied to the loading/offloading of contractors' vehicles that are applied to company vehicles								
3.0	**Driver Training**								
3.1	Have all drivers received safety training								
3.2	Have drivers attended sessions on following subjects:								
3.2.1	Gas properties								
3.2.2	National regulations								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.2.3	Emergency procedures in case of accident								
3.2.4	Firefighting								
3.3	Is refresher training given at regular intervals								
3.4	Have drivers been instructed to report:								
3.4.1	Any defect on truck, engine and equipment (brakes, lighting etc)								
3.4.2	Incidents and accidents to vehicle, cylinders and personnel								
3.5	Is there evidence of drivers reporting defects, incidents and accidents								
3.6	Have drivers been given instructions to:								
3.6.1	Practice a daily check of their vehicle according to checklist, eg lighting, tyres, valves								
3.6.2	Adhere strictly to road regulations								
3.6.3	Never overload vehicle								
3.6.4	Ensure the load is properly secured, ie by use of chocks, restraining straps etc								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
3.6.5	Avoid rough handling of cylinders, eg when unloading								
3.6.6	To check all cylinders/valves for defects and signs of improper use								
3.6.7	To label all cylinders found to be defective								
3.6.8	Use protective clothing and equipment: gloves safety shoes breathing apparatus (in the case of vehicles delivering toxic gases								
4.0	**Vehicle Crane and Tailgate Lift**								
4.1	Are regular checks carried out on: mechanical components and structure hydraulic system electrical equipment load testing pneumatic systems wire ropes, chains and fittings								
4.2	The instructions as to the use of the crane marked on lifting device								
4.3	Are these instructions followed (safe working load)								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
4.4	Are drivers aware of the weight of the various loads that have to be handled (pallets, bundles, containers etc)								
4.5	Are instructions concerning the use of tailgate lifts and crane outriggers strictly followed								
4.6	Are warning signs attached to the crane/vehicle to forbid walking under loads								
4.7	Are drivers instructed not to operate cranes under electrical power lines								
4.8	Have drivers been instructed to report defects on: tailgate lift crane								
4.9	Are reported defects promptly remedied								
5.0	**Securing of Loads**								
5.1	Are regular checks carried out on load securing items: cable tensioners levers, pins cables and straps brackets etc								
5.2	Have drivers been instructed to report defects on above equipment								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
5.3	Is load properly secured according to instructions								
5.4.1	Is all necessary equipment for securing and safe carriage of loads available								
5.4.2	Is it checked at regular intervals								
6.0	**Maintenance of Vehicle**								
6.1	Is there a planned preventative maintenance system								
6.2	Does it cover: Engine chassis and bodywork transmission gear box steering mechanism electrical and lighting equipment tyres, condition and pressure wheels fire extinguishers brakes load securing equipment cranes/tailgate lifts including all electrical components								
6.3	Are inspection programmes up-to-date								
6.4	Have any major services been missed for any vehicle								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Completion
6.5	Does detailed examination of a number of vehicles show that maintenance standards are satisfactory								
6.6	Does this examination satisfy one as to the accuracy of the records								
7.0	**Emergency Measures**								
7.1	Have drivers been made aware of properties and dangers of: gases under pressure oxygen combustible gases (H_2, C_2H_2 etc) toxic gases								
7.2	Have drivers been instructed as to the measures they should take in the event of: road accident truck fire cylinder leak/fire tyre fire toxic and/or combustible gas leak/fire								