ABU DHABI OIL REFINING COMPANY (TAKREER)

RUWAIS REFINERY EXPANSION (RRE) PROJECT

PROJECT NO. 5578 / AGREEMENT NO. 09-5578-E-4

EPC PACKAGE - 4 : TANKAGE AND ASSOCIATED INTERCONNECTING PIPING

DOCUMENT / DRAWING COMMENTS SHEET

COMMENTS TO BE RETURNED TO:
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1. REJECTED : REVISE AND SUBMIT ☐
2. COMMENTS AS NOTED : WORK MAY PROCEED SUBJECT TO COMPLIANCE WITH AND INCORPORATION OF COMMENTS ☐
3. NO COMMENTS : WORK MAY PROCEED ☐
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COMPRESSED GAS AND AIR PROCEDURE

AGREEMENT NO.	**:**	**09-5578-E-4**
PROJECT NAME	**:**	**Ruwais Refinery Expansion Project EPC-4: Tankage & Associated Interconnecting Piping**
COMPANY	**:**	**Abu Dhabi Oil Refining Company (TAKREER)**
PMC	**:**	**Mott MacDonald Ltd.**
CONTRACTOR	**:**	**Daewoo Engineering & Construction Co., Ltd.**

This page is a record of all revisions of this document. All previous issues are hereby superseded and are to be destroyed.

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SIGNED (Initials)							

NOTES:

(a) Revisions are denoted by a vertical line placed in the right-hand margin against the revised text.

(b) PREP = Prepared by, CHKD = Checked by, REVD = Reviewed by, APP'D = Approved by.

(c) In case of conflict between any requirements stipulated in this document with the contractual requirements, the contractual requirements shall prevail.

REVISION INDEX DETAILS

Rev	Location of Change	Brief Description of Change

CONTENTS

1. INTRODUCTION

1.1 Purpose

The purpose of this procedure is to ensure all work involving the use of compressed air and gas are undertaken in a manner, which will prevent injury to personnel and/or damage to property.

The purpose of this procedure is to ensure that all personnel involved in the storage, handling and use of compressed gases and related equipment are aware of the potential dangers, and that they are instructed in the safe use of these items.

This procedure, in general, encompasses the gasses in general use on a site such as; oxygen, acetylene, propane, nitrogen, freon, etc.

1.2 Scope

This procedure will apply to all work associated with the use of compressed air and gases during construction and commissioning of the Ruwais Refinery Expansion Project.

The procedure is relevant to all personnel on a construction site who may be engaged in the use of compressed gases during the course of their work.

1.3 Objectives

The main objective of the Compressed Gas and Air Procedure is to establish the safe working methods when handling and working with compressed gas or air. This procedure will identify immediate hazards and mandatory control measures.

2. DEFINITIONS

Company	Abu Dhabi Oil Refining Company (TAKREER)
Contractor	Daewoo Engineering and Construction Company Ltd.
PMC	Mott Macdonald

3. INSPECTION OF EQUIPMENT

All compressed air equipment that is to be utilized on the project shall be inspected and approved for use by a competent Equipment Inspector assigned by CONTRACTOR and the Client prior to such equipment being allowed to operate on any CONTRACTOR project. Equipment will be subject to spot checks by the Equipment Inspector.

Inspection certificates shall be attached to all equipment, to ensure that the approval of such equipment for use is readily identifiable.

4. RESPONSIBILITIES

4.1 Project Manager

- Has the final responsibility to ensuring that the use of Compressed Gas and Air Procedure to be implemented on the project as per mentioned herein this HSE management system document.

4.2 HSE Manager

- Ensure that the use of compressed gas and oxygen shall be performed by competent person.
- Scheme and perform HSE training for competent personnel.
- Ensure that the inspection schedule and procedure is being followed.

4.3 Section Managers

- Assign the competent person to carry out compressed gas and oxygen operations.
- Apply for HSE training of competent personnel and ensure that the person attends the training.
- Ensure that only inspected equipment/tools will be used at site.

5. RISK ASSESSMENT

For any activity involving close proximity to a potential gas hazard, whether it is inert, pressurized, cryogenic or liquefied, a risk assessment shall be carried out.

When carrying out a risk assessment:

- Identify the hazards;
- Decide who might be harmed, and how;
- Evaluate the risks arising from the hazard and decide whether existing TAKREER precautions are adequate or more shall be taken; and,
- Review your assessment from time to time and revise it if necessary.

6. RISK MANAGEMENT

CONTRACTOR shall utilize the findings of all risk assessments as the basis to prioritize and manage significant HSE risks from inert, pressurized, cryogenic and liquefied gas hazards according to the requirements of COMPANY.

Risk management strategies and plans shall be developed in order to eliminate, prevent and control risk management hierarchy as required by ADNOC and international best practice.

7. USE OF EQUIPMENT

- All hoses to compressor, hose to hose and hose to pneumatic tool connections shall be positively secured to prevent hoses "whipping out" in an uncontrolled manner, if they become disconnected under pressure. Use whip-checks and Chicago pins to secure both ends of couplings to prevent it from whip-off.
- Hoses shall be maintained in a serviceable condition to prevent them rupturing under pressure. All hoses shall be of a pressure rating that is equivalent to the maximum operational capacity of the compressor. A tag with the safe operating pressure shall be attached on each hose if it is not mentioned by the manufacturer.

All personnel operating pneumatic tools shall be issued with and instructed to wear the following personal protective equipment:

- Safety helmet
- Safety spectacles / glasses
- Hearing protection
- Face protection (Face shield)
- Working gloves
- Safety shoes
- Respiratory protection (if required)
- Personnel shall be instructed in the correct use of all such personal protective equipment.
- All air receivers and compressors shall be in good condition and properly maintained.
- Air compressor shall be individually identified and marked with their safe working pressure.
- Air compressors and related relief valves shall be accompanied by a valid test certificate, which shall be kept on site by CONTRACTOR and shown to the Client representative before bringing the vessel onto site.
- All air compressors must be fitted with a properly set pressure relief valve.
- Air compressors shall be examined and the pressure relief valve tested by an independent examiner at annual intervals.
- A register shall be maintained by CONTRACTOR for all compressors containing the following information;
- Individual identification numbers
- Dates of independent inspections
- Name and signature of independent examiner
- Rates of safe working pressure

- All compressed air fittings shall be fitted with whip checks and wired and/or restrained to prevent them from whipping, should the coupling break during use.
- Only hose clamps designed for compressed air service shall be used. Worm drive (Jubilee) clips are not acceptable.
- All compressors shall be color coded according the quarterly inspection procedure to ensure that the compressors remain in a safe suitable condition for operation. Any compressor found on site that has an expired color coding or has not received any color coding, will be removed from site.

COMPRESSED AIR MUST NEVER BE USED FOR CLEANING CLOTHES OR POINTED DIRECTLY INTO A PERSON

8. COMPRESSED GAS AND OXYGEN

8.1 General Safety Precautions

- Where CONTRACTOR or its Subcontractor brings their own equipment onto the Project, such equipment must comply with approved standards. Cylinders shall comply with KOSHA or equivalent International standards.
- Be in good condition and not suffering from corrosion.
- Be properly color coded (e.g. Black: Oxygen, Maroon: Acetylene, Red: LPG, Blue: Argon etc.)
- Be individually identified.
- Hoses shall be properly color coded to the internationally recognized standard for the gas being used, in good condition and fitted with hose connectors attached by permanent clips e.g. Use red hose for acetylene and other combustible gases, and be careful to see that they are never interchanged with other colors. Use hoses of equal length and do not coil any surplus hose around regulators or cylinders.
- Check valves and flashback arresters must be used on both hoses at all times (at valve as well as at the torch end).
- The equipment used on site must be properly maintained.
- Suspected leaks may be confirmed by a soap solution.
- If the leak cannot be cured the equipment must be withdrawn.
- Users shall check the equipment for perished, damaged hoses, regulators, and pressure gauges, etc. Defects must be reported to their supervisors in order to remove the substandard equipment.
- Gas cylinders must not be left lying around.
- Arrangements should be made to store cylinders in an open mesh fenced compound. Cylinders shall be secured to prevent any accidental damage or release due to falling over.

8.1 General Safety Precautions

- CONTRACTOR will obtain permission from the Client before constructing any temporary gas compound or using an existing gas storage area.
- CONTRACTOR will provide suitable facilities to minimize manual handling of cylinders.
- Cylinders must be in trolleys, or racks, or tied off by chain when on site.
- Oxygen and fuel gas cylinders shall be kept separate with a minimum separation distance of 6 meters or can be stored by constructing in between a 1.5 meter high non-combustible barrier with a fire resistance of 1 hour and 30 minutes.
- Cylinders must never be stored or used in a horizontal position but must be secured in an upright position tied with a non-combustible material (e.g. chain).
- Empty cylinders must also be separated from full cylinders.
- All gas cylinders must be handled with care and they must not be misused or abused.
- They must be properly shut off when not in use and steel safety caps must be fitted when being moved if shrouds are not provided.
- Great care must be taken to ensure that gas equipment, including hoses, are not allowed to cause obstruction of roadways, walkways, manholes, ladders or other means of access where they can cause hazards or be damaged.
- Hoses not in use should be coiled up and put in a safe place.
- Hoses should whenever possible be supported off the ground.
- Where any operation involves the use of gas and oxygen welding or cutting equipment in enclosed or semi-enclosed spaces, supervision must carry out frequent checks to ensure these procedures are complied with.
- During meal breaks and at stopping times, hoses and torches must be removed from confined spaces.
- Oxygen or gas cylinders shall not be taken into confined spaces for use or storage.
- No modification to tanks or drums which have contained flammable liquid shall be undertaken at the site.
- The torch shall only be lit using a flint spark lighter (flint gun) designed for this purpose.
- Hoses will be routed to avoid trip hazards or damage.
- All the materials, equipment and tools shall be suitable for negative temperature in winter season.
- Do not use odd bits of tubing. Copper or high copper content alloy must not be used in acetylene hose or other parts in contact with Acetylene.
- Use a proper adapter.

- Observe carefully the manufacturer's instructions for lighting and using blowpipes, and follow the makers operating instructions
- Do not use pressure in excess of that recommended or heavy-duty delivery regulators where only low pressures are required.
- Never attempt to light a blowpipe until sufficient time has elapsed after opening the blowpipe valve for the gas in the hose to normalize at the correct working pressure and all air to be blown from the hose.

8.2 Storage

Storage areas must be well-ventilated top and bottom.

Cylinders stored in the open must be protected in cold weather from accumulation of ice and snow, and in hot weather from the direct rays of the sun. Tarpaulins or any other cover must not be used in direct contact with the cylinders.

Cylinders must be protected from rusting and corrosive conditions.

Direct space heating in desert conditions must not be allowed in stores where compressed gas cylinders are kept.

Lighting for stores containing acetylene or other combustible gas cylinders should either be:

- Approved explosion proof type.

or

- Outside the building, so that the interior is lit through fire-resistant windows. Electric switches must be explosion proof or placed outside the storeroom.

Storage areas and foundations must be of a fire-resistant construction and so designed and situated that in the event of fire the cylinders are easily removable.

8.3 Layout

Full and empty cylinders must be separated and FULL and EMPTY notices displayed to prevent confusion and mistakes.

Oxygen and combustible gases such as Acetylene and propane shall be kept separate with a minimum separation distance of 6 meters or can be stored by constructing in between a 1.5 meter high non-combustible barrier with a fire resistance of 1 hour and 30 minutes

Acetylene and propane cylinders must always be stored in an upright position. Cylinders being supplied to site must not be accepted without protective valve covers.

When storing cylinders upright, they must be secured so they will not fall. They must not be propped against a wall or bench; a suitable cylinder stand must be used.

If cylinders are stacked horizontally, large wedges must be used at each end of the stack. Large cylinders must be at the bottom and the stack must not be more than four high.

Cylinder protective caps must be installed on stored cylinders.

8.4 Handling and Use of Cylinders

Cylinders should always be considered as being full, and handled with corresponding care.

Because of their shape, smooth surface, and weight, cylinders are difficult to carry by hand. Cylinders may be rolled on bottom edge (Not in lying down position) but never dragged.

Cylinders must not be used as rollers, work supports or jacks.

If a cylinder is exposed to heat, the cylinder wall may be weakened and at the same time the gas content will increase in pressure. This may result in violent rupture of the cylinder. If the contents are combustible the resulting fire will be serious.

8.5 Oil, Grease and Other Contaminants

Oil or grease ignites violently in the presence of high pressure Oxygen and an explosion may occur. Cylinders and fittings must be kept away from all sources of contamination such as oil barrels, overhead shafting, cranes, or drive belts.

Personnel must not smoke, wear oily clothes, or have any exposed naked light in any place where compressed gases are stored.

Measures must be taken to prevent grit, dirt of any sort, oil, grease or water from entering cylinder valves. They must be stored well clear of all sources of corrosion such as battery charging areas.

8.6 Handling and Transport

Cylinders should be transported to and from the site area in the special racks provided.

When cylinders are to be returned to a supplier empty, they shall be clearly marked empty. The valves should be closed and the protective caps fitted.

Gas cylinders must not have any visible defects. This means that they should be checked for corrosion and other faults. Cylinders, which are not approved, shall, irrespective of the number of years since the last control, be dispatched for a new inspection.

Cylinders must not be:

- Subjected to undue strain by blows or mechanical damage.
- Allowed dropping or coming into violent contact with each other.
- Transported with the regulators and hose attached, unless a proper trolley or carrier is used. When transporting by a trolley the cylinder valve must be shut before the cylinder is moved from place to place.

8.7 Care of Cylinders in Use

Personnel must not handle Oxygen cylinders, valves or any other fittings with greasy hands, gloves or rags.

Cylinders and valves must be kept clean. Grit, dirt, oil and dirty water must not be allowed to enter the cylinder valve sockets; otherwise it will be impossible to prevent equipment from leaking

Loose dirt must be cleared by 'sniffing' some gas through, i.e. by opening and closing the cylinder valve momentarily before attaching regulators and fittings. Stand clear of cylinder valves before clearing outlet sockets.

Only the Supplier's standard keys may be used for operating cylinder valves. The leverage of keys must not be increased and long leverage spanners or badly worn keys must not be used. A cylinder with a broken spindle must not be used, otherwise valves may be damaged and the cylinder rendered useless.

Faulty apparatus must not be attached to the cylinder or allowed to remain if it is damaged after attachment.

Personnel must not lubricate any valve or fitting, and must not use any white or red lead or any other jointing compound.

Cylinders must be kept away from sparks, flames or slag from welding or cutting operations.

Cylinder valves must be shut when work has to be stopped for more than a few minutes, or when the cylinder is empty.

8.8 Leaks

Care must be taken to avoid gas escape from the cylinder valve or apparatus attached to it with the associated hazard of a gas accumulation in a confined space.

Soapy water and a brush must be used to locate leaks. NEVER USE A NAKED FLAME.

8.9 Excessive Heat (desert conditions)

Cylinders must not be subjected to heat which causes increased pressure and weakening of the cylinder wall.

Should a cylinder become accidentally overheated or damaged, the Supplier must be notified immediately and the cylinder must be taken out of service.

Damaged cylinders should, where possible, be isolated from undamaged cylinders. They should be clearly marked 'Damaged - Do Not Touch'.

If an Acetylene or propane cylinder is heated accidentally or by a backfire from the use of faulty equipment, it must be dealt with promptly as follows:

- Shut the valve.
- Detach the regulator and other fittings.
- Take the cylinder into the open air and well away from any sources of ignition at once.
- Immerse in, or apply, water copiously to cool.

Open the valve fully and keep cool with water until the cylinder is empty. As this may take several hours, immediate contact should be made with Suppliers for further advice

8.10 Reactions

Acetylene

Acetylene can form explosive compounds in contact with certain metals or alloys, in particular those of copper and silver. Joint fittings or piping made of copper must not be used, Acetylene must never be allowed to come into contact with copper or any alloy containing more than 70% copper.

In a confined space a small amount of Acetylene, Oxygen or Propane may create a dangerous condition which will cause explosion or fire from a spark or naked light.

Oxygen

Oxygen has no smell and whilst it does not burn, it supports and accelerates combustion. Care must be taken to avoid the risk of clothing or other flammable materials such as oil being ignited; they will burn fiercely in Oxygen or where the atmosphere has been enriched with Oxygen.

Precautions against Oxygen Enrichment

Oxygen should not be used to ventilate or 'sweeten' any space.

Oxygen should not be used to power pneumatic machinery or portable tools.

Steps should be taken to prevent the accidental leakage of Oxygen from lines, pipes and cylinders, manifolds and other equipment.

Lines, pipes and cylinders, manifolds and other equipment containing Oxygen should be removed from any space when not required for further use for any substantial period of time.

When not in continuous use, all cylinders, torches, and manifolds should be turned off.

8.11 Ancillary Equipment Valve Operation

The cylinder valve must always be opened slowly. Cylinder valve spindles always have right handed threads irrespective of whether the cylinder contains a fuel gas or non-combustible gas.

The cylinder valve must be closed sufficiently to shut off the gas. Excessive force must not be used.

Regulators and Flashback Arrestors

Welding or cutting apparatus must not be used unless automatic pressure regulators are fitted to the Oxygen and fuel gas cylinder, and flashback arrestors are fitted.

When using Acetylene from a generator, a hydraulic backpressure valve must be used.

It is unsafe to rely entirely on the use of a needle valve as this does not prevent a reverse flow of gases towards the cylinders. Moreover the use of a needle valve in place of a regulator may cause the bursting of the hose if the gases are cut off at the blowpipe, as the hose will be subjected to cylinder pressure.

Before a regulator is put on to a full cylinder, the adjusting screw for regulating the pressure of output must be released otherwise there is a risk of damage to the regulator.

The threads on regulators and other auxiliary equipment must be the same as those on cylinder valve outlets. The outlets of industrial gas cylinder valves are screwed 5/8" BSP threads.

- Right hand for Oxygen and non-combustible gases.

- Left hand for Acetylene, Hydrogen and combustible gases. Connections that do not fit must not be forced.

Manifolds and Headers

Where cylinders are connected to manifolds or headers, such manifolds must be of proper design and equipped with one or more pressure regulators, and proper flashback arrestors.

Matching Equipment and Gases

Equipment must not be used for gases other than those for which it is intended. Coal gas, Hydrogen, and Acetylene/Propane regulators are all fitted with left hand threads of the same size, but Acetylene or Propane regulators must not be used on Coal gas or Hydrogen cylinders which are filled to a higher pressure than is suitable for them.

Hose

Only best quality hoses are to be used. Inferior hoses tend to harden, crack and leak and may fire internally when Oxygen passes through it (weathering).

The hose must be firmly attached to the blowpipe and other connections by crimped clips (never by jubilee clips). Lengths of hose are supplied with the ends firmly attached to nipples having screwed unions suitable for connecting to standard regulator outlets and blowpipe inlets. These should be used in preference to any other hose.

Frequent accidents occur due to leakages or due to the supply hoses becoming loose or being blown off. Hose connections must be frequently examined.

Lengths of hose must be joined by means of suitable connecting fittings when more than the standard length is required. Unnecessarily long lengths of hose shall not be used.

8.12 Light Up Procedure

It is important that an adequate flow of fuel gas is issuing from the nozzle of the blowpipe or other apparatus before lighting up.

User must follow the following procedure:

- Set the regulators to the recommended working pressure.
- Keep the blowpipe nozzle away from any source of ignition (pilot light, smoldering tow, etc.) until the fuel gas is flowing freely from the nozzle.
- The use of a spark lighter is recommended for lighting blowpipes.

If the blowpipe flashes back on lighting up it is because:

The regulators are not set to the correct pressures

Or

A light has been applied before the flow of fuel gas is properly established.

If flame snaps out when the blowpipe is in use, it is because:

- The regulator pressure and/or gas flow is incorrect either too high or too low.
- The nozzle has been obstructed.
- The nozzle is held too close to the work.

The nozzle has become overheated. Completely shut both blowpipe valves. Plunge the nozzle and blowpipe head in water. Make sure that the nozzle is tight before re-lighting the blowpipe. Check the regulator setting and cylinder pressures and re-lights in accordance with the procedure given above.