

**Fitness for Purpose Report for the
Caroline Gas Plant in South Australia**

11^h July 2001

**Report Prepared by:
Air Liquide Australia Limited**

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APPENDIX 1, FITNESS FOR PURPOSE STUDY

INTRODUCTION

In accordance with Regulation 30 of the Petroleum Regulations 2000, Air Liquide Australia Limited (AL) has conducted a fitness-for-purpose assessment of its facilities near Mount Gambier in the south east of South Australia. The purpose of this report is to summarise the findings of this assessment.

Fitness-for-purpose assessments, as described in Regulation 30(2), serve two key objectives.

- 1) To assess the risks imposed by facilities operated under licences granted under the Petroleum Act 2000 on:
 - a) public health and safety; and
 - b) the environment, in the natural, social and economic context; and
 - c) where relevant, the security of natural gas production or supply.
- 2) To review the physical condition and the management systems of the facilities in so far as their adequacy in managing the risks to an acceptable level.

Scope of Assessment

The assessment which this report covers was undertaken between March and May 2001 and addresses the fitness-for-purpose of the equipment which makes up the Caroline Carbon Dioxide facility ('the Plant') from the Well, up to and including the truck loading station. More specifically, this includes:

- Caroline 1 down hole assembly;
- Flow line;
- Pipework within the plant;
- Pressure vessels;
- Effluent concrete tank;
- Waste water concrete tank;
- Waste water sprinkler system;
- Septic tank;
- Loading dock;
- Dangerous goods storage containers;

- Refrigeration units.

Basis of Assessment

AL has undertaken this assessment on the basis of the following:

- 1) An in house risk assessment workshop conducted on the 24th April 2001 at the Melbourne Head Office of AL. The workshop was attended by key AL personnel, Mick Field (Manager - Tonnage Operations), Joseph Febbraio (Manager - Safety and Environment), Mark Bennett (Primary Production Manager - Southern Region) and Tyrone Mustey (Plant Manager - Mt. Gambier). Michael Malavazos (Manager Engineering Regulation from the Office of Minerals and Energy Resources, South Australia) was invited to attend to provide advice on any regulatory issues regarding this assessment and guidance on the format and content of the report required.

The objective of this workshop was to:

- a) Identify actual and potential threats to the Caroline well and plant;
 - b) Assess the current condition of the plant equipment;
 - c) Identify the potential consequences of the threats identified; and
 - d) Identify the existing control measures in place to control these threats.
- 2) A review of consultants' reports and internal investigations undertaken by AL on its Mount Gambier operations including reports prepared for regulatory purposes.
 - 3) A review of existing procedures and systems in place at the Mount Gambier facility.

A summary of the risk assessment is provided in Appendix #1.

AIR LIQUIDE OPERATIONS

A brief description of the facility is given below. A detailed description of the facility appears in the Environmental Impact Report.

Location and Land Tenure

The Carbon Dioxide Purification Plant is located on Carba Road, approximately 12 kilometres southeast of Mt. Gambier, and occupies an area of almost 2 hectares. All access to the site is via Carba Road, which is an all-weather public road maintained

by the District Council of Grant. The Plant is situated within Petroleum Production Licence 21, which overlies the Caroline Forest Reserve, managed by Forestry SA.

Carbon Dioxide Purification Process

Raw CO₂ is supplied from a single well to the purification plant via a 70 metre flowline. The plant runs continuously to process the raw CO₂ into pure liquid CO₂. The impurities removed from the raw CO₂ include sulphur compounds, nitrogen, hydrocarbons and water. In addition, some free water is also contained within the raw liquid.

The process steps to purify the raw material are described in the following sections.

Carbon Dioxide Vapourisation

Initially, water sourced from a licensed bore located on site is used to heat the raw CO₂ and convert it to a gas in the vapouriser. This water is dosed with inhibitor and sulphuric acid to prevent corrosion, control calcium build-up and maintain the pH. When the CO₂ vapour exits the vapouriser, some hydrocarbon and some waste-water is separated out and disposed of. The waste hydrocarbon and water is stored in a bunded tank. Waste-water is later removed from this tank and pumped to the effluent storage tank.

Main Purification Train

The main purification process step involves passing the gas through adsorption media. The first absorption step removes sulphur compounds and hydrocarbons. The remaining moisture is then removed, again using an adsorption process.

Liquefaction

After drying, the CO₂ flows through a dust filter and then is liquefied via refrigeration.

Distillation and Storage

CO₂ liquid is then distilled to remove the remaining impurities including nitrogen and methane. The purified liquid CO₂ is then stored in refrigerated and insulated vessels.

Loading and Transport

Road tankers load liquid CO₂ on-site and transport it to customers in South Australia and Victoria.

Waste Management

All general waste (including solid waste, paper and domestic scraps) is collected in a hopper for later removal to a licensed disposal facility.

All sewage is stored in a concrete effluent pit near the western boundary of the site. A licensed waste disposal contractor pumps out the pits periodically and transports the waste to a licensed sewage treatment plant.

Chemical waste, including spent adsorbing media is collected by a licensed waste disposal contractor for disposal off-site. Empty chemical drums are returned to the bunded workshop storage area for subsequent collection and off-site disposal.

CO₂ gas is vented during the distillation process.

All rainwater runoff in the immediate vicinity of the plant is collected in concrete drainage channels and temporarily stored in a settling pit before being pumped to the effluent storage tank.

Produced formation water is also stored in the storage tank. After a settling period all water from the effluent tank is pumped to an adjacent tank and aerated before being disposed of through irrigation of grassed areas within the plant boundaries. Irrigation takes place via a single sprinkler that is moved throughout the site. There are no natural drainage lines located either within the site or in the immediate surrounding environment.

Background

The source of the CO₂ (and produced formation water) is the Caroline-1 well, which was spudded in September 1966 and reached a total depth of approx. 3300m. The well was completed in February 1967 and began producing CO₂. The deepest formation penetrated is the Eumeralla Formation of the Otway Group. Apart from intermittent production during 1968, the well has produced CO₂ almost continuously to the present.

SUMMARY

On the basis of the risk assessment (Appendix #1), AL has concluded that the physical condition of the facilities and the management systems in place at the Mt Gambier Plant are fit for the purpose of managing the risks to public health and safety and the environment to an acceptable level. "Acceptable" is defined as the attainment of the objectives and assessment criteria outlined in the AL Statement of Environmental Objectives (ECOS, 2000).

As required by the Petroleum Regulations, this fitness for purpose assessment will be repeated within 5 years of the date of this report.

PHYSICAL CONDITION OF FACILITIES

Summarised below are the relevant conclusions drawn from consultants' reports that refer to the physical condition of the Caroline well and CO2 plant.

- 1) Jones Tonkin Consulting Engineers conducted a soil sampling programme to determine the effect of past and present wastewater disposal activities on site. The report concludes, "petroleum type hydrocarbons are not an issue in the site soils associated with the former soakage pits. Furthermore, the hydrocarbons do not represent a human health or environmental risk in this area on the Air Liquide site, and it is highly unlikely due to the sampling regime undertaken that any underlying soils or groundwater would be impacted."
- 2) AL has logs of data, which date back to 1967 when the well originally started production. The data collected includes CO2 and water production rates, pressures and production losses. This data is analysed monthly and provides an extensive history of operation on which to monitor trends. Air Liquide uses the services of Questa Australia who are consultants with expertise in the petroleum industry to analyse this data. This history, combined with regular analysis, demonstrates the suitability of the maintenance and operating procedures at the facility.
- 3) AL carries out bi-annual down hole wireline testing to confirm the integrity of the Caroline 1 well bore and to investigate corrosion. The most recent survey was conducted in May 2000. Data from the testing was analysed by AL with the assistance of Questa. The analysis concluded that no obstructions were present and there were no substantial deviations from previous surveys demonstrating that the well condition is sound and repair or other works are not required to address scale or corrosion issues.
- 4) Schlumberger Oilfield Australia Pty. Ltd. produced an Investigative Logging, Diagnosis and Recommendation report following a site investigation in March 2001. This work included measurements of the well casing and its surrounding cement bond. The conclusion of the report was that the casing cement bond is in sound condition and repair or replacement was not recommended.

EFFECTIVENESS OF MANAGEMENT SYSTEMS

AL has control systems in place to ensure the safe and reliable operation of the plant. The following is a summary:

1. Monthly safety meetings and plant safety inspections, are documented, published and sent to the Safety Department in Melbourne. This system allows for routine hazard identification and tracking of corrective actions.

2. The facility is subject to annual internal safety and environment audit by senior management. Reports are generated detailing corrective actions and completion is tracked through the site safety management system. In addition, the company has a program of technical audits that are conducted by senior technical managers from other AL sites. Reports are generated and actions identified and tracked. The above-mentioned audits combine to enhance safe and reliable operation of the facility.
3. Written Plant operating procedures, specific technical and safety manuals in line with Australian Standards and other state legislative requirements are in place to ensure the plant is operated safely and efficiently. Examples of these are the:
 - AL Safety Training Manual
 - AL Gas Operations Manual and Engineering Standards Manual
 - Australian Standards related to the industrial gas industry
 - Australian Dangerous Goods Code and other state legislative requirements

These are contained within the ISO 9000 Management System framework. This system is subject to routine internal and external audits

4. An Environmental Impact Report and a Statement of Environmental Objectives have been prepared for the Caroline 1 Well and plant. The purpose of these reports is to outline the environmental objectives that the facility must meet in order to satisfy the requirements of Section 6 of the Petroleum Act 2000. The objectives have been set using measurable criteria.

SECURITY OF GAS SUPPLY

The Caroline well produces carbon dioxide. The plant does not produce natural gas and accordingly the security of natural gas supply is not relevant.

POTENTIAL FOR SERIOUS INCIDENTS

Any potential incidents, which are defined as serious in section 85 of the Petroleum Act 2000, are indicated as such in Appendix #1. Furthermore, these potential incidents have each been assessed as to their likelihood of occurrence. A low risk of occurrence was concluded in every case.

AREAS WITH LACK OF RELEVANT INFORMATION

With reference to Regulation 30(8)c, AL is unaware of any matter to which there is a significant lack of relevant information or a significant degree of uncertainty.

REFERENCES

ECOS Consulting (Aust) Pty Ltd, *Air Liquide Australia Ltd, Caroline Carbon Dioxide Plant, Statement of Environmental Objectives*, June 2001

ECOS Consulting (Aust) Pty Ltd, *Air Liquide Australia Ltd, Caroline Carbon Dioxide Plant, Environmental Impact Report*, June 2001

Jones Tonkin Consulting Engineers, *Air Liquide Caroline Well Soil Investigation*, 29 March 2001

Schlumberger Oilfield Australia Pty. Ltd, *Report for Air Liquide on Caroline-1, Investigative Logging, Diagnosis and Recommendations*, April 2001.

Summary of Threats, Consequences and Control Measures

Plant Section	Threat - Actual Potential	Current Condition	Consequences	SI	Pot.	Control Measures - References
Down Hole assembly	Corrosion	Extent of corrosion within acceptable limits, refer to Questa Australia report	Casing Failure Tubing Failure Diesel Loss Cross Flow Contamination	Yes	Low	Diesel Level is monitored daily, Daily Logs of well pressure, flow and other parameters Standard Operating Procedures are used Annual Wireline Survey Specialist Consultant Reviews, operations and monitoring data
Flowlines/Pipework	Corrosion, Erosion, Third party interference, Over Pressurisation	Extent of corrosion within acceptable limits – based on a sample piece of piping which indicates negligible internal corrosion	Pipework Failure, CO2 release Plant shutdown & loss of production/income	No	NA	External corrosion protection for piping (denso tape) External Painting of above ground sections of piping Internal Inspection of piping at every maintenance interval Operating experience and the advice of experts (Questa) is that natural scaling preserves pipe integrity. The site is fenced, is in a relatively remote location has 24hr supervision & restricted 3rd party access Control measures to prevent over-pressurisation are described below Refer to 'pressure vessels' for controls on over pressurisation.
Pressure Vessels/Process	Corrosion, embrittlement, Over pressurisation	All Vessels comply with the requirements of AS3768. Refer to pressure vessel inspection reports	Failure, CO2 release, Risk to Personnel,	No	NA	Vessels are designed to AS1210 and operated in accordance with AS3768. Inspections are conducted as required by



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Plant Section	Threat - Actual Potential	Current Condition	Consequences	SI	Pot.	Control Measures - References
			Plant shutdown & loss of production/income			the standard Pressure is controlled by automatic controllers and valves, Ultimate pressure protection is provided by Pressure Relief valves Pressure & temperature cycling loads of vessels are such that embrittlement is not a factor in the design or operation of the equipment, refer to vessel design approvals.
Waste Handling - effluent (concrete) tank, waste water (concrete) tank, wastewater sprinkler system, bunding and septic tank.	Excess Production, corrosion/erosion, utilities failure	Concrete tanks and bunds have adequate integrity based on daily visual inspections	Soil contamination Ground Water contamination	Yes	Low	Service agreements are in place (Cleanaway) for solid and liquid waste removal. Daily monitoring of plant & equipment Pumps protected from elements by covers and shelters Refer Jones Tonkin consultants report on soil sampling March 29/01. Three monthly testing of waste water discharge to ANZEC specification
Waste Handling - Gas and Fugitive Emissions		Current Emissions are approximately 25% of production Site objectives and company policy is to reduce emissions, target is 5% by end of 2001	Pollution Green House Gas Emissions	No	NA	Operation of plant to established procedures.
Total Site	Third Party interference Public road usage by Forestry vehicles (including logging trucks) equips.	No 3rd. Party issues have been experienced in the past or are anticipated. Road is unsealed but is maintained by the District Council,	Vandalism - damage to Plant. Production loss. Operator safety.	No	NA	Fenced Perimeter. Air Liquide personnel present 24hrs/day. Security Service provided Signage on main gate Authorised personnel only on site,



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Plant Section	Threat - Actual Potential	Current Condition	Consequences	SI	Pot.	Control Measures - References
	General public traffic Bush Fire Lightning	has relatively low usage and is considered to be in a serviceable condition Infrequent use by general public Plant and surrounds clean and tidy				controlled via visitors book, site inductions etc Internal audits conducted by AL to schedule Emergency Procedures via. SEO. Emergency procedures include general emergencies eg Lightning and specific emergencies eg bushfires.
Transportation	Vehicle Accident Failure of filling hoses. Pressure and Temp.of product causes road tanker equipment failure Operator negligence	Nil incidence for ALA Mt. Gambier	Personnel injury Vehicle damage Loss of Containment Public liability. Loss of containment	No	NA	Contract agreement / Duty of care. Annual training of tanker drivers by AL Driver accreditation and licensing. Brakes are interlocked at filling points while loading and unloading. Fill hoses are fitted with breakaway couplings, which automatically close if broken.
Dangerous goods stored on site	3rd party interference Plant failure - dosing lines-acid or biocide	Bunding in good condition. Containment to A.S.	Personal injury Loss of containment Contamination of soil and ground water	No	NA	M.S.D.S. Register on site. Bunding to Australian Standards. Daily monitoring and regular maintenance. Internal Audits conducted to schedule. S.O.P, s in place for all dangerous goods handling and processing.
Refrigeration	Mechanical Failure-cracks in pipework. Seal failures on ammonia refrigeration units eg crank case seals.	Normal operating conditions	Loss of refrigerant containment. Plant shutdown. Production losses. Personnel exposure & injury.	No	NA	Regular Maintenance program conducted by qualified refrigeration mechanic, maintenance contract in place (Gordon Brothers) Internal Technical Audits conducted to schedule. Daily inspection by Plant Operator.



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Notes:

The column headed 'SI' indicates whether or not an item is a 'Serious Incident' as defined in section 85 of the Petroleum Act 2000. The column headed 'Pot.' indicates the potential or assessed likelihood of the serious incident occurring, ranked low, medium or high

Definitions:

AS3873	Australian Standard, Boilers and Pressure Vessels – Operation and Maintenance.
AS1210	Australian Standard, Unfired Pressure Vessels
ANZEC	Australia New Zealand Environmental Code
AL	Air Liquide Australia Limited
SEO	Statement of Environmental Objectives, Report prepared by Ecos Consulting Aust Pty Ltd, June 2001
MSDS	Material Safety Data Sheet
SOP	Standard Operating Procedure
Questa	Questa Australia Pty Ltd