Fitness-For-Purpose Report

PETROLEUM PRODUCTION LICENCES 62 & 168

(KATNOOK AND LADBROKE GROVE GAS PLANTS & PRODUCTION SYSTEM)

Report completed: 23 November 2001

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1 Introduction

Under the SA Petroleum Act 2000 and Petroleum Regulations 2000, the licencee under a prescribed licence is required to carry out periodic fitness-for-purpose assessments of facilities operated on land within the area of the licence in order to assess risks imposed by the facilities.

Origin Energy Resources Ltd as Operator (Origin) on behalf of the holders of Petroleum Production Licences (PPL) 62 and 168 has conducted a fitness-for-purpose assessment of the Katnook and Ladbroke Grove Gas Plants and production system.

In accordance with the Petroleum Regulations 2000 Part 6 Division 4, this report assesses risks imposed by the PPL62 and 168 facilities on:

a) the environment, and
b) public health and safety; and
c) security of production or supply of natural gas (so far as this may be relevant)

In coming to its conclusion, Origin has used internal review processes and external consultants to consider:

a) the physical condition of the facility, and
b) the effectiveness of management systems for the operation and maintenance of the facility; and
c) the potential for the environment to effect the safe and effective operation of the facilities; and
d) the potential for serious incidents to occur at the facilities including the potential for hazardous materials or substances stored at or near the facility to affect the safe or effective operation of the facility; and
e) the adequacy of and reliability of the utilities in order to enable the effective operation of the facility (so far as this may be relevant).

In particular the most recent hazard and risk assessment of PPL62 and 168 facilities was conducted over the period March 2001 to July 2001. This included a field based workshop attended by key Origin personnel, a contracted risk consultant and PIRSA personnel as observers.

2 Licence Areas

This fitness-for-purpose assessment covers PPL's 62 and 168.

Origin Energy Resources Ltd is Operator of the licence areas for and on behalf of the licence holders as indicated below:

Licence	Licence Holders
PPL62	Origin Energy Resources Ltd Omega Oil NL
PPL168	Origin Energy Resources Ltd Omega Oil NL

3 Summary of Operations

The PPL62 and 168 facilities comprise petroleum producing wells, natural gas pipeline gathering systems and two gas processing facilities namely the Katnook Gas Plant and the Ladbroke Grove Gas Plant that are located at the one site approximately 8 km south west of Penola in the South Eastern area of South Australia.

Natural gas is produced and gathered for processing at the respective gas plants. Processing of the natural gas occurs in order to provide sales quality gas to customers in accordance with the specifications required under the relevant contractural agreements. Delivery and transfer of processed gas to customers occurs at the outlet flange of the respective gas plant. Associated gas liquids are separately transported for sale.

4 Risk Assessment

The following risk groups were identified:

- fire and explosion
- loss of containment of hydrocarbon gas
- loss of liquid containment/spills
- loss of containment of flowline inventories
- failure to meet peak demand
- equipment damage or failure
- access
- utilities
- gas supply interruption
- soil contamination
- environmental hazards
- corrosion
- harmful exposure
- transport

Attachment 1 discusses the hazards and risks identified within each group and the preventative actions, management systems and mitigation processes that are in place to manage each risk.

5 Fitness-For-Purpose

Based on

- the hazard identification and risk assessment of the Katnook and Ladbroke Grove surface facilities as detailed in attachment 1,

and

- the management systems in place and the physical condition of key components of the surface facilities as summarised in attachment 2

and

- the management systems in place and the physical condition of the downhole facilities as summarised in attachment 3.

Origin concludes that the fitness for purpose of the Katnook and Ladbroke Grove gas facilities is appropriate to manage the risks imposed by those facilities on:

a) the environment; and
b) public health and safety; and
c) the security of production or supply of natural gas (so far as this may be relevant)

Over the period of the next five years when a subsequent Fitness-For-Purpose assessment is required under the Petroleum Regulations 2000 there have been a number of actions identified within this report that are suggested be investigated to maintain the facilities in a fit-for-purpose state.

ATTACHMENT 1 – Fitness-For-Purpose Assessment – Surface Facilities

FITNESS-FOR-PURPOSE ASSESSMENT
FOR
ORIGIN ENERGY RESOURCES LIMITED
PENOLA, SOUTH AUSTRALIA.

Prepared by: ***Myrna Hepburn***
Date: ***April 2001***
Document No.: ***A002-08-01***

Fitness-For-Purpose Assessment Report
For
Origin Energy Resources Limited,
Penola, South Australia.

Disclaimer

This report was prepared by Myrna Hepburn Pty Ltd (MHPL) as an account of work for Origin Energy Resources Limited (OERL). The material in it reflects MHPL's best judgement in the light of the information available to it at the time of preparation. However, as MHPL cannot control the conditions under which this report may be used, MHPL will not be responsible for damages of any nature resulting from use of or reliance upon this report. MHPL's responsibility for advice given is subject to the terms of engagement with OERL.

Acknowledgment

The author wishes to acknowledge the contribution and active participation of all the team members involved in the Fitness-For-Purpose Assessment.

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Rev	Date	Status	Reviewed by	Authorised by
Draft	04/04/01	Draft for comment	Peter Gayen	
A	25/04/01	Issued for Review	Ian Cook	
B	18/07/01	Audit of Hazard Registers	Ian Cook	
0	19/07/01	Approved for Distribution	Ian Cook	John Rodda

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- HAZOP Studies
- Vulnerability Studies

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- ✓ Halliburton, Bechtel, Beca Simons, Egis, GHD, Kilpatrick Green, Fluor, Kvaerner, Transfield, Worley
- ✓ VWA, RMIT, Dept of Defence, Urban Land Authority

within the risk consulting business.

Selected accomplishments include:

- Safety Case Outline / Safety Case for Orica MHF
- QRA for ICI Yarraville Chlorine plant
- Vulnerability Study of WMC Olympic Dam operations
- HAZOP Studies for WMC $2b OEP expansion
- Demolition Hazard Studies for ICI Propathene plant, Solvents plant, Phosphoric Acid plant

Senior Risk Consultant 1995 - 2000

ORICA LTD (formerly ICI Australia)
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Selected accomplishments include:

- Successful completion of site Quantitative Risk Assessment (QRA) for Major Hazard Facility at Yarraville Chlorine Plant (Orica) which led to the decision to change manufacturing methodology an at a new location and closure of Yarraville site
- Vulnerability Study 2000 of WMC Olympic Dam operations, South Australia which determined the risk profile for the site, both mine and surface facilities, based on technical safety, health and environment issues as well as human and organisational factors and provided recommendations to reduce the risk to ALARP and resulted in inputs to Annual Budgets and Planning
- HAZOP Study Leadership on WMC $2b Olympic Dam expansion (OEP) project including Mine Smelter, Hydromet, Concentrator, Refinery, Auxiliaries, Infrastructure
- Several Evidentiary Risk Assessment reports tabled in Court e.g. where Licenses have been breached, Near fatal Incident Investigations
- Safety Case Consulting including Safety Management Systems, Emergency Planning, Liaison with Regulators
- Risk Assessment for Orica Adhesives & Resins Plant, New Zealand
- HAZIDs, Rapid Risk Ranking (RRR) for Pulp and Paper plants at Burnie (Tas), Maryvale (Vic)
- Fire Safety Studies for Orica eg. Specialty Chemicals, Initiating Explosives, Adhesives & Resins to provide Statutory bodies formal assessment of compliance
- Risk Management training presentations to improve safety e.g. Placer Dome, Porgera site in PNG and for WMC
- Qualitative Risk Assessments for Telstra
- Consequence Analysis for Hydrogen, Methanol, Ammonia etc Installations
- Development and presentation of training courses in HAZOP, HAZOP Leaders, HAZAN, Incident Investigation
- Demolition HAZOPs for ICI plants such as Propathene, Phosphoric Acid, Solvents

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Project Engineer 1987 – 1989

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Responsible for major Projects, including various upgrades to Plastics and Pharmaceutical plants and Silicones

IBM Programmer/Analyst 1983 – 1985

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IBM COBOL/CICS programming for in-house applications as well as training for staff in the use of packages developed and Help Desk Support

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Began career as Process Engineer providing plant technical support for Phenol, Aspirin, Rubber Chemical manufacturing processes (Monsanto Australia)
Tutoring undergraduates within Chemical Engineering Department, Melbourne University and Research Assistant on Loy Yang Brown Coal project, Melbourne University.

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B.E. (Chem.), University of Melbourne

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REFEREES: Available on request

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EXECUTIVE SUMMARY

Origin Energy has a facility approximately 8 kms southwest of Penola in South Australia for the processing of natural gas. These are the Katnook and Ladbroke Grove Gas Plants which are currently undergoing review by Primary Industries and Resources SA (PIRSA) to assess compliance with the new Petroleum Act and Regulations 2000. A Fitness-For-Purpose Assessment is part of this review. The facility has achieved acceptance of its Interim Statement of Environmental Objectives, and has also achieved Low Supervision status under the new Act.

Key elements of a Fitness-For-Purpose Assessment is the assessment and subsequent management of identified safety, health and environment risks, both on-site and off-site, which the facility may impose on the public, the community in which it operates and which could impact upon the security of supply to its customers.

A Fitness-For-Purpose Assessment was carried out on the Katnook Gas Plant and Ladbroke Grove Gas Plant during a 2-day workshop conducted on 5th and 6th March 2001. Additional auditing of the findings was conducted on 12th and 13th July 2001.

Risk Assessment Summary

The Katnook and Ladbroke Grove Gas Plants have undergone a process of hazard identification and assessment which is ongoing to date. Based upon outcomes of these activities and knowledge of the current state of the plant and management systems, the Fitness-for-Purpose Assessment workshop focussed upon understanding the following potential hazardous events and assessing the risks associated with each.

Fire and Explosion

- Fire caused externally such as a grassfire
- Fire caused by Origin activity on-site
- Fire at condensate tanker loadout bay and at the condensate tanks
- Fire at the Glycol Reboiler
- Fire in the buildings

Loss of Containment of Hydrocarbon Gas

- Loss of equipment integrity at wellyards

Loss of Liquid Containment / Spills

- Methanol spill in plant
- Methanol spill at Ladbroke Grove wellyards
- Liquid hydrocarbon Spills
- Glycol spills
- Corrosion inhibitor spillage
- Spillage during pumping condensate residue from pond

Loss of containment of flowline inventories

- Mechanical damage during harvest time of pine trees
- Corrosion / erosion of flowlines

Failure to meet peak demand

- Plant unavailability
- Wellhead deliverability constraints given falling well pressures

Equipment damage or failure

- The continuous vent failure
- Thermal cycling of Katnook Gas Plant vessels
- Ladbroke Grove Plant failure or rupture

Access

- ElectraNet helicopter access above plant near vent stacks
- Public able to access site if personnel are occupied in the plant
- Vehicle/train collision
- Vehicle incident on busy arterial road

Utilities

- Loss of Power
- Loss of Instrument Air
- PLC failure
- Loss of hot water circulation system

Gas Supply Interruption

- Power station gas supply interruption / failure
- Hydrate formation in the heat exchanger, piping, vessels, flowlines and GRU stack
- Reduced capability of Katnook gas /slugcatcher / $CaCl_2$ tower to provide redundant processing capacity
- Accidental ESD events causing plant shutdown

Soil Contamination

- Mercury levels in soil

Environmental Hazards

- Corrosion inhibitor causing condensate residue collection on evaporation pond as a result of emulsion formation
- Glycol feed tank vent gas containing Hydrogen sulphide

Corrosion

- Corrosion in the $CaCl_2$ Tower

Harmful Exposure

- Exposure to contaminated Sludge and Filters (Prescribed Waste)
- Corrosion inhibitor exposure
- Exposure to Ladbroke Grove Power Station emissions

Transport

- Transport Spill of Condensate
- Spill of Dangerous Goods whilst in transit

Statement of Current Fitness-For-Purpose

At Origin Energy's Katnook and Ladbroke Grove Gas Plants, there is a safety awareness which has the philosophy of placing public health and safety and environmental protection first over production. Notwithstanding this, production and security of supply is strategically important.

This Statement of Fitness for Purpose is based on information from plant personnel, Operations senior management and relevant plant documentation.

The Katnook and Ladbroke Grove Gas Plants have been assessed for fitness-for-purpose and generally meets acceptable industry standards. Pipelines have been designed to AS2885 "Gas and Liquid Petroleum Pipelines", and the gas plants designed to B31.3 standards current at that time.

The Katnook and Ladbroke Grove Gas Plants are deemed to be fit-for-purpose given the engineering hardware and management systems in place. There is commitment from plant personnel and senior management to public health and safety, protecting the environment and ensuring a secure supply of natural gas to customers.

The major risks associated with these facilities along with the necessary prevention and mitigation strategies are summarised in the Hazard Registers. However, there are some aspects of the operation which need continued attention from senior management in order to maintain the safe, environmentally sound and reliable operation of these facilities.

Key findings which demonstrate fitness-for-purpose are:

Culture

There is safety awareness at the Origin Energy site and a hierarchy of protective systems to minimise the risks imposed by the facilities. However, it is important that organisational changes are implemented to ensure better communication between on-site personnel and support functions in city locations such as Adelaide and Brisbane.

Public Health and Safety

The major risks imposed by the Katnook and Ladbroke Grove Gas facilities on Public Health and Safety are fire and explosion. The inherent safe design of the wellheads and gas conditioning skids including safe separation distances from public boundaries together with operator awareness of the risks, and sound management practices such as routine inspections and maintenance, reduce the risk of fire.

Signage and adequate padlocked fencing at the wells warn the public of the potential hazards.

The risk imposed by fire originating onsite is managed by procedural control and inherent safety design. Primary detection of fire is a fail-safe Fusible Loop network within each facility which automatically alarms and shuts all inlets and discharges and blows down the gas inventory to the high pressure vents. Individual equipment is protected by thermal relief, pressure relief and bursting discs. A fire occurring on-site may have knock-on effects such as heat radiation causing property damage. However, the plant is located away from residential areas but close to farmland, rail and roads. The plant personnel are fit and have refresher training in hazard identification and management, and emergency procedures. Potential losses of containment such as spills have been identified and bunding provided as appropriate.

Control of ignition sources is ongoing under the Permit-to-Work System. Electrical Hazardous Areas are clearly defined and equipment installed to relevant Australian Standards. Instrumentation is intrinsically safe.

There are prevention, detection and mitigation procedures in place together with a good working relationship with the local emergency services.

The Katnook Gas Plant although ten years old, is sound in its maintenance and run by experienced staff who have been at the plant for the life of the plant.

The Ladbroke Grove Gas Plant is only 18 months old and has been designed to current Australian Standards. Plant integrity is maintained and procedures followed by experienced and trained plant personnel. A major uncontrolled gas release at the Ladbroke Grove Gas Plant will contain carbon dioxide and methane. Evacuation procedures are in place and will be initiated.

Turbine personnel are exposed to risks associated with Gas Plant operation, because of the close geographical proximity of the gas turbines to the Ladbroke Grove Gas Plant. These risks are identified, managed and mitigated by the safety management systems used to ensure the safety of Gas Plant personnel.

Condensate tanker drivers are exposed to hazard during the loading of road tankers. This activity is controlled via operating procedure. Any vehicle accident resulting in a spill onto public roads etc is covered by the company's Safety Management System and Emergency Response Plan.

Aerial surveillance helicopters periodically fly low over the blowdown vent at the gas turbines and may be exposed to a release from the vents. Discussions with ElectraNet will be undertaken.

Environmental Protection

The risks imposed by the Katnook and Ladbroke Grove Gas Plants on the environment are:

The flowlines cross public roads, rail, farmland and pine forests. They may impose a risk to power lines, fibre optic lines etc. Procedures are in place to prevent and mitigate the consequences. Loss of containment of the flowlines due to corrosion is an identified hazard and is addressed by an ongoing program of corrosion inhibition, ultrasonic thickness testing, corrosion coupon monitoring, iron level testing and routine inspections.

Internal corrosion by microorganism attack (sulphate reducing bacteria) has not occurred at the Katnook operation. Operating practice, in particular the practice of producing high flows from individual wells in order to warm the flowlines and minimise the likelihood of hydrate formation, also mitigates against the likelihood of micro-organism attack, because stagnant pools of water are swept from the flowlines rather than allowed to collect at low points.

The flowlines are designed to cope with seismic survey activity in the area. Vibrating trucks are not allowed to operate within 40 m of flowlines during seismic surveys.

As Mercury sulphide, mercury is present in the sludge removed during maintenance and any contaminated articles such as filters or disposable overalls used during vessel inspections are taken away as prescribed waste. Water is checked for mercury levels from test holes located at the perimeter of the plant i.e. at the boundary fence. Results are in the order of <0.0005mg/L.

Regular testing for Mercury in the Katnook sales gas and Ladbroke Grove gas, wells and condensate show that the concentration of mercury is below that which is of concern.

Mercury levels in the soil are monitored and measures taken for future rehabilitation of the site. Samples have been taken from beneath the liner of the Evaporation Pond following a liner replacement.

Hydrogen Sulphide gas may accumulate in sumps and other low points. Operator exposure is minimised by Permit to Work procedures and PPE as per the relevant MSDS. Hydrogen sulphide levels are also regularly tested and monitored.

Water contaminated with methanol and corrosion inhibitor is piped to a lined evaporation pond located within the boundaries of the Katnook Gas Plant. A leak detection sampling program on the Evaporation Pond monitors possible contamination of the freshwater aquifers. Bunding at storage tanks confine possible loss of containment.

Liquids from the process such as bleeds or from sight glasses are collected via a tundish system which reports to an underground double walled steel fibreglass lined tank. A similar underground tank, the interceptor pit, collects pressurised drains.

Transport incidents involving glycol for example, could lead to a spill on the road potentially causing contamination of the neighbouring farmland and surface water. Methanol and liquid hydrocarbon drums are also trucked on adjacent roads. Driver awareness and training, and securing the load reduce the risk.

A transport incident could lead to a spill of the corrosion inhibitor onto adjacent roads and possibly onto the surrounding swamps. The amine in the inhibitor is very surface active and may impose a risk. This is a major concern and trialling is underway of alternative emulsifiers.

Weathering of the condensate tanks occur which vents off the light ends from the tanks before transfer to road tankers.

Initiation and propagation of fire from the gas plants are prevented by design to Standards and Codes, and management systems in place.

Noise is not a concern from either Katnook or Ladbroke Grove Gas Plants and the odour level is minimal. No operation procedures which may increase noise levels are carried out at night.

The visual impact of the gas plants on the surrounding landscape has been minimised with screening trees, which are regularly trimmed to reduce combustible fire hazard, planted along the boundary fence line.

Security of Supply

The Katnook Gas Plant supplies off-site customers. The Katnook Gas Processing train has been in operation for 10 years without any supply shortfall events occurring. The Katnook Gas Plant effectively has a redundant gas supply train in the $CaCl_2$ Tower, even though it is undersized to current peak demand. This is managed by prioritised flow scheduling to key customers.

The Ladbroke Gas Plant has a gas with high carbon dioxide content which is not commercial. It is therefore a secure supply to the turbines at the Ladbroke Grove power station.

Origin Energy has recognised the need for having more wells in service to ensure security supply of natural gas, as reservoir pressures continue to decline. To this end, a program of reinstatement of surface equipment at the wellyard facilities on all producing but out-of-service wellyards is planned to be completed.

Formation of hydrates has the potential to restrict flow through flowlines and vessels, and thus impact upon production. This is managed through careful monitoring, the use of Methanol injection and wellhead, flowline and processing train redundancy.

Equipment failure on the Katnook and Ladbroke Grove Gas Plants is prevented by inherent safe design such as the use of compatible materials of construction and is managed by a maintenance program. Buried equipment is cathodically protected and monitored. Thermal cycling and brittle stress fracture are logged as per the pressure vessel Code AS1210.

Physical Condition of Katnook and Ladbroke Grove Gas Plants

The Katnook Gas Plant is ten years old and was built to the standards and best practice applicable at the time. A Maintenance Management System exists but needs to be upgraded. Specifically, there are valves in the Low Temperature Separator area that require maintenance. The Katnook Gas plant requires a fresh coat of paint in parts to protect against corrosion.

The Ladbroke Grove gas plant is eighteen months old and built to current standards. A documented Maintenance Management system is being developed.

Generally, the plants appear in sound physical condition. Maintenance is done on both plants with a system in place but has in recent times deteriorated and needs reinvigorating. Maintenance has become reactive rather than preventative. Documentation follow-up needs to be reintroduced.

Housekeeping should be noted as an important part of plant safety.

Effectiveness of Management Systems

As part of Process Safety Management, tools such as Hazard and Operability Studies (HAZOP), Job Safety Analysis (JSA) and systems such as plant Modification procedures are carried out.

Ladbroke Grove Gas Plant has a good record of development to ensure compliance with relevant Standard, Regulations and Codes.

The following specific Management initiatives have been undertaken:

- Origin Energy policy is that all major plant modifications are HAZOPed. The entire Ladbroke Grove Gas Plant was HAZOPed through 2H99. Stratex also conducted a Heavy Gas and CO_2 Hazards Review in December 1999.
- Through 2H97 three HAZOPs were undertaken for the Katnook Upgrade and Haselgrove Development project.
- Going back to the early 1990s a complete HAZOP was undertaken of the original Katnook operation.
- The Katnook and Ladbroke Grove operations have been covered by submission and audit activities associated with Origin achieving self-insurer status with WorkCover. A further audit activity has recently been carried out, in July 2001.
- A draft Site Environment Management Plan has been developed for the Katnook and Ladbroke Grove operations, and is currently under review by the EPA as part of EPA License renewal activities
- An internal environmental audit was conducted in November 2000.
- An external OH&S Management Systems Audit was undertaken in May 2000.
- An internal Safety, Process Safety, Risk (insurance) and Environment Audit was conducted in 1996 and is due to be repeated.

The effectiveness of the Safety Management System could not be fully measured. The guidelines and procedures have been written but have not yet been implemented.

The Katnook Gas Plant has been fairly well maintained and documented until 18 months ago when the Ladbroke Grove gas plant came on line. At this time plant personnel and organizational changes occurred, the workload on-site increased and the system became stretched. In particular, the Maintenance Management system's effectiveness slipped. Senior

management has recognized the deficiencies and are implementing systems and addressing workload / manning issues.

Site supervision and interaction with Head Office located in Adelaide appears to be inadequate. Poor plant morale indicates a dissatisfaction with the leadership on site and by senior management. Communications for better management of the site needs to be addressed. OERL has advertised for an on-site Plant Superintendent and in the interim has appointed and installed a Contract Superintendent of 30 years experience.

Relatively recent management systems such as the Waste Management Plan, Safety Plan, Chemical Management Plan and the draft Environmental Management Plan have been developed with a commitment by Origin Energy to fully implement them in the near future.

Impact of the Environment on the Gas Plants

Grass fires and bushfires pose the biggest risk on the safe and effective operation of the facility. This is managed by clearings and firebreaks around the plants and at the wellyards. Grass is kept short and trees are clipped. There is a close liaison with the local CFS and the company has a well-defined Emergency Response Plan, with plant personnel trained in Fire Management.

The rainfall in the area is high leaving paddocks waterlogged. The area is subject to seasonal flooding with poor draining soils. Pipelines are anchored as per AS2885 "Gas and Liquid Petroleum Pipelines". The road to the Gas plants are all-weather roads and are not prone to flooding. Production areas are built up to prevent flooding.

The incidence of electrical storms and lightning strikes is infrequent. The plant does not have any lightning rods, dynospheres or suchlike but does have lightning suppression on electricals.

There is potential for damage to flowlines during harvesting and planting of vines or seismic survey activity. The pipeline management plan as per AS 2885, liaison with loggers and the "One Call" system reduce the risk.

Serious Incidents at the Gas Plants

The potential for serious incidents to occur at the Katnook Gas Plant exists but is generally low.

A major release of high pressure gas due to corrosion occurring at the wellyards and finding an ignition source is a rare event. Inspections and ultrasonic testing to AS2885 "Gas and Liquid Petroleum Pipelines" plus the control of static electricity in the area together with Emergency Shutdowns on high and low pressure signals reduce the likelihood of it occurring.

Corrosion of the flowlines is monitored by Ultrasonic surveys taken on a regular basis and a Corrosion Management program which was audited in Jan 2001. Overpressure of the flowlines is prevented by PSVs and emergency shutdowns at nominated high and low pressures.

A methanol fire at the Katnook Gas plant will be confined to the plant, as the inventory is limited to two 200 litre drums. Methanol injection which is an intermittent activity is confined to a defined Hazardous Area where ignition sources are eliminated. Any vehicles entering the area are fitted with spark arresters and /or under a Hot Work Permit.

The Katnook Gas plant has a continuous vent which is fitted with flame arresters. The potential for these to block is prevented by regular maintenance.

The potential for flashback to occur from the reboiler to the flowlines is prevented by pressure reducing valves and check valves. Motors on all pumps are explosion proof and similarly there are explosion proof enclosures on instruments.

The potential for a serious incident to occur at the Ladbroke Grove gas plant is low. A fire occurring at the condensate tanks or during truck loadout may be due to an uncontrolled ignition source or an electrical fault. The tanks are bottom filled and have pressure vacuum valves installed at the top of the tanks. The tanks are designed to AS1692 "Tanks for Flammable and Combustible Liquids". There are Loadout procedures with an emergency shutoff at the loadout pump.

Monoethylene glycol has a flash point of 116 deg C and is stored at the wellyards. In the event of a fire, Monoethylene glycol may breakdown into harmful substances. Daily inspections of the wellyards, no ignition sources and maintained firebreaks reduce the risk of a fire. At the Katnook Gas Plant glycol is pumped from 200 litre drums to a bulk storage tank before being taken to the wells.

A small inventory of methanol in 200 litre drums is kept on site. This is sourced from 2 bulk methanol storage tanks, each of 20 000 litre capacity, at the Ladbroke Grove wells 2 and 3. The methanol is drained from these bulk tanks into 200 litre drums for use on-site.

A small inventory of corrosion inhibitor is stored at the Ladbroke Grove gas plant in 200 litre drums. There is a reasonable inventory of condensate stored at the facility.

The Ladbroke grove power plant stores minor quantities of e.g. hydraulic oils in accordance with the packaging guidelines of AS1940 " Storage and handling of flammable and combustible liquids".

There are no other known hazardous materials in the surrounding area or plant which could affect the safe operation of the facility.

Facility Utilities

The adequacy and reliability of the utilities on-site is critical to the effective operation of the facility and security of production and supply.

The loss of instrument air is corrected by the operation of a 3-way valve to provide fuel gas to critical valves etc. to ensure continuity of production. There is a backup air compressor for Katnook Gas Plant but not for Ladbroke Grove Gas plant.

There is a backup generator in the event of power failure.

Computer hardware failure is corrected by a backup PLC and manual operation of the plant.

The Hot Water System for the Low temperature Separator has two redundant water heaters plus auxiliary units.

All critical items are maintained and provided with backups with a minimum cutover time to ensure continuity of production and security of supply to customers.

Statement of Expected Fitness-For-Purpose

The Katnook and Ladbroke Grove Gas Plants will be the subject of periodic Fitness-For-Purpose Assessments to eliminate or reduce risk to as low as reasonably practical. There is a consultative process of informing employees, community and neighbours.

An action plan has been developed as a result of this first Fitness-for-Purpose Assessment. It seeks to address identified discrepancies in process safety and management systems.

The current status of the facilities and management systems need to be maintained together with the implementation of the following suggested actions to enable continued risk reduction. This will achieve the expected level of fitness-for-purpose of the Katnook Gas and Ladbroke Grove Gas Plants in the future.

Future impact on Public Health and Safety

Safe separation distances to public boundaries need to be maintained and a review of the hazardous area classifications versus distance to the site boundary for the Haselgrove wells, and for the Ladbroke Grove Gas plant relative to the adjacent road is required.

The control of static electricity and in particular static earthing procedures for tanker loading/unloading and interceptor pit pumping activities are to be reviewed and brought up to date. Ensure that well yards have earthing capable of coping with lightning strikes.

Aerial surveillance by ElectraNet helicopters over the Gas Plant when inspecting power lines should be rerouted to reduce potential for pilots to be at risk from hydrocarbon releases.

The likelihood of a vehicle/train collision at the railway line should be further reduced by improvement of visibility at the intersection.

Future Environmental Protection

The presence of mercury in the gas processing plant and soil is under continuous testing and monitoring. Rehabilitation of the soil will occur in the future with ongoing monitoring of the levels of mercury.

On-going Security of Production and Supply of Gas

There is an initiative in place for implementation of the plan to reinstate out-of-service but producing wells. Prioritising of flow scheduling will continue to ensure supply of gas to customers is not interrupted.

Physical Condition of Facility

There is a drive by senior management towards a preventative Maintenance system which is clearly documented and provides an audit trail. Currently, plant maintenance is reactive.
Continued corrosion monitoring will be undertaken.

Management Systems

Commitment from onsite personnel and leadership from senior management should realise the full implementation of the Safety Management Systems which is expected in the near future. Other recent process safety management initiatives include Waste Management Plan, Chemical Management Plan and the Environmental Management Plan driven by Origin Energy's HSE Management System.

REPORT

1 Introduction

Myrna Hepburn Pty Ltd (MHPL) was commissioned by Origin Energy Resources Ltd (OERL) to carry out a Fitness-For-Purpose Assessment of the Katnook Gas Plant and Ladbroke Grove Gas Plant at Penola, in South Australia.

This is done by identification of significant hazards and ensuring that there are appropriate measures in place to eliminate the risk or reduce the risk to tolerable levels. Where this cannot be achieved, a check is made for protective or mitigation measures to meet relevant criteria in order to satisfy the requirements of safety, health and environmental protection and to ensure as far as reasonably practicable, security of supply for users of natural gas.

1.1 Fitness-For-Purpose Assessment Objectives

Objectives

The objectives of this study are to assess the fitness-for-purpose of the facilities operated on land within the area of the license. The study is carried out periodically in order to assess risks currently imposed by the facilities on public health and safety, and the environment. It also examines the capability of the Katnook Gas and Ladbroke Grove Gas Plants to provide a secure supply of natural gas.

The Fitness-For-Purpose Assessment has as its fundamental aim the identification of potential significant hazards, in particular loss of containment which could lead to flammable, explosive, biological or toxic release and its consequential Safety, Health and Environment effects on the Katnook and Ladbroke Grove Gas Plants, and the Public whilst ensuring security of gas supply.

It checks the engineering controls that are in place to detect and prevent a serious or reportable incident. Plant physical condition and reliability of the utilities and critical equipment are also checked to assess fitness-for-purpose.

It also examines any changes to process conditions which could lead to consent levels for gaseous, liquid, solid, odour or noise levels being exceeded and considers any impact that the plant may have either on-site or off-site.

It reviews the effectiveness of the management systems for safe operation of the Katnook and Ladbroke Grove gas plants.

Hazard Register

The Fitness-For-Purpose Assessment will produce a Hazard Register for each operation at the Katnook and Ladbroke Grove Gas Plants which can be reviewed regularly and updated. The Hazard Register summarises all of the foreseen hazards associated with a facility. It documents whether sufficient controls exist to prevent, detect and mitigate the incident to reduce the risk to as low as practicable.

Action Plan

The Hazard Register will uncover any discrepancies for protection against hazardous events. Further risk reduction initiatives are developed as an Action Plan for those identified hazards where the risk is deemed to be high or significant.

1.2 Origin Energy Penola Katnook and Ladbroke Grove Gas Plants Description

Origin Energy operates the Katnook and Ladbroke Grove Gas Plants on behalf of the PPL 62 and PPL 168 Joint Ventures. These facilities are owned by Origin Energy Resources Limited (approximately 75%) and Australian Worldwide Exploration (approximately 25%).

Sales gas is processed via the Katnook Gas Plant before transmission via the Epic Energy pipeline to end use customers.

High CO_2 gas is processed via the Ladbroke Grove Gas Plant for sale to Origin Energy Power which then burns the gas in the Ladbroke Grove Power Station to generate electricity for sale into the National Electricity Market.

1.2.1 Origin Energy Katnook and Ladbroke Grove Gas Plants Location

The site is located in the southeast of South Australia. The nearest town is Penola approximately 8 km northeast of the gas production facilities. The Katnook and Ladbroke Grove Gas Plants are located south of the Coonawarra region, one of Australia's most successful wine producing regions. Tourism is a growth industry, with timber products and agricultural production being the other main industries in the area.

Grasslands for grazing stock dominate the Katnook and Ladbroke Grove gas processing plant immediate vicinity.

1.2.2 Katnook Gas Plant

The Katnook Gas Plant occupies approximately 3 hectares of land and processes natural gas from the Katnook, Redman and Haselgrove fields for sale to the local gas market. Key customers include the township of Mount Gambier including Kimberly Clark Australia (KCA), Carter Holt Harvey and Saffries potato chip factory. The processing activity is focused upon achieving a dew point specification through glycol dehydration and low temperature separation. Condensate is produced along with the natural gas. The condensate is trucked to Mobil's Adelaide refinery. Produced water is predominantly boiled off to atmosphere via the glycol recovery system. The gas conditioning process operates 24 hours a day.

There are 3 flowlines supplying the Katnook Gas Plant namely the Katnook 2 Redman/Katnook 3 and Haselgrove flowlines. The Katnook 1 flowline is no longer in service. It is capped and contains residual hydrocarbon. The Katnook 2 and Redman/ Katnook 3 flowlines cross privately owned grazing farmland and roads before entering the Katnook Gas Plant via a common manifold.

The Haselgrove flowline crosses public roads, farmland, some privately owned pine plantations and a railway crossing before entering the Katnook Gas Plant. In the vicinity of these flowlines, there are power lines overhead, Telstra fibre optic lines, a gas transmission line to Mt. Gambier and other flowlines.

1.2.3 Ladbroke Grove Gas plant

The Ladbroke Grove Gas Plant occupies approximately 3 hectares and processes high CO_2 gas for sale to the Ladbroke Grove gas turbines, which are operated by Origin Energy Power. These turbines generate electricity for sale into the National Electricity Market. The processing activity is focused upon liquids removal and gas heating to ensure that gas supplied to the turbines is at a temperature in excess of its dew point. Condensate is produced along with the high CO_2 gas. This is trucked to Mobil's Adelaide refinery. Produced water is supplied to an evaporation pond on-site.

There is one flowline from the Ladbroke Grove field which supplies the Ladbroke Grove Gas Plant.

1.3 Fitness-For-Purpose Assessment Scope

The Scope of this Fitness-For-Purpose Assessment is the Katnook Gas Plant and the Ladbroke Grove Gas Plant, and the gathering system that collects hydrocarbon from remote wellheads and supplies it to the two Gas Plants.

For each facility the following were assessed:

- the potential for serious incidents to occur at the Katnook and Ladbroke Grove Gas Plants, including the potential for hazardous materials or substances stored at or near the facility to affect the safe or effective operation of the facility; and the adequacy and reliability of the utilities required in order to enable the effective operation of each facility
- the potential for harmful exposure both on-site and off-site due to releases from the Katnook and Ladbroke Grove Gas Plants
- the potential for any impact on the environment whether gaseous, liquid, solid, noise due to the Katnook and Ladbroke Grove Gas Plants
- the potential for the environment to affect the safe and effective operation of the Katnook and Ladbroke Grove Gas Plants
- the culture, physical condition and the effectiveness of management systems for the operation and maintenance of each Katnook and Ladbroke Grove Gas Plants

The parts of the facility not addressed by the study include:

- Downhole facilities
- The Epic compound and associated pipelines
- The Mercaptan compound facility operated by Origin Energy Asset Management, but located within the Epic Compound
- The Ladbroke Grove Gas Turbines operated by Origin Energy Power

The boundary for the study is taken to be the emergency shutdown valves outlet of the Ladbroke Gas Plant, and the insulating flange at the outlet of the Katnook Gas Plant.

Downhole facilities were independently assessed outside of this study and the report is attached in Appendix 5.

2 Fitness-For-Purpose Assessment Methodology

2.1 General

The methodology used for the Fitness-For-Purpose Assessment is well recognised. It consists of a formal, systematic, critical examination of the process, using a qualitative risk matrix approach as per AS4360 “Risk Management” and in accordance with the relevant requirements of the Petroleum Act 2000 and the Petroleum Regulations 2000.

Methodical brainstorming and creative interaction of diverse disciplines is used to identify potential hazards due to current operations and management systems. The aim of the study is to identify hazards and assess the risks in a qualitative way. The risks may then be prioritised so that any impact by the facilities on public/plant personnel health and safety, the environment, security of production and supply of natural gas may be minimized and reduced to as low as practicable (ALAP).

The process involved systematic brainstorming, using a set of guidewords by a team of plant personnel experienced in the operation of the gas plants. If the team concluded that a risk reduction is warranted, then an action was recommended by the team to either prevent the occurrence of the hazard or mitigate its consequences.

The Fitness-for-Purpose Assessment facilitator plans and chairs the formal Fitness-for-Purpose Assessment and review and will:

- Plan for the Study (deciding on the logical review sequence of systems, applicable guidewords, information required, assist OERL in the selection of the preferred team composition, etc.)

- Lead the Fitness-for-Purpose Assessment team through the procedure for identifying hazards and the relative importance of the consequence;

- Encourage the team in thinking about possible deviations in operating equipment / processes;

- Aid the team in filtering out real concerns;

- Crystallise thoughts on problems and get agreement from the team for recording actions to address these concerns;

- Supervise the record taking during the Fitness-for-Purpose Assessment, then the production of the typed Study minutes, review/update the minutes to ensure that they adequately reflect the result of the Study and provide a detailed record for future audits.

2.2 Fitness-For-Purpose Assessment Procedure

The study systematically works through the flowsheets breaking the plant into blocks or sections which correspond to major items of process equipment or plant. Each of these sections is stepped through identifying significant hazards associated with each stage of the process. At each section, a brief explanation of the process and its operation is given.

2.2.1 Plant Sections studied

The Katnook Gas Plant was divided into the following units:

- Wellheads
- Flowlines
- Katnook Gas Processing Train:
  - Normal processing train (High Pressure Separator/Low Temperature Separator)
  - Backup processing train (Katnook gas/slugcatcher/CaCl tower)
- Glycol Circuit
- Condensate Storage / Trucking Facilities
- Water handling
- Evaporation Pond
- Buildings/warehouse/living quarters/control room

The Ladbroke Grove Gas Plant was studied as a whole.

2.2.2 Risk Category

The guidewords used focussed on the following breakdown:

- Public Health and Safety
- Environmental
- Security of Production & Supply of Gas

Other risk categories considered included:

- Consultation with Community
- Community Perception
- Corporate image
- Human and Organisational factors
- Land access
- Operations and transport
- Utilities Supply

When assessing security of production and supply the following 4 distinct operational situations were noted viz.:

- On-line
- Start-up / Shutdown
- Off line for Short duration
- Repair for Long duration

Each hazardous event is assessed in terms of its frequency of occurrence, the consequences, both immediate and ultimate, and systems in place to eliminate, mitigate or manage the impacts. The probability of successful mitigation if initiated was also considered. The risk was then qualitatively ranked to determine the level of initial risk and actions recommended to further reduce the risk.

2.2.3 Qualitative Analysis

Significant risks and the "worse case credible " scenarios were addressed for potential causes and consequences.

The controls to prevent and mitigate were reviewed to test the quality and the quantity of the information available by the team. Positive and negative controls were discussed. An example of a negative control is a Procedure that is incorrect, out of date or not readily available.

The following Risk matrix was used to assess the risk in a descriptive or qualitative way:

Table 1 - Qualitative Risk Matrix

Likelihood	Consequence Severity				
	Low/Insignificant	Minor	Moderate	Major	Catastrophic/High
A Almost certain	S	S	H	H	H
B Likely	M	S	S	H	H
C Moderate	L	M	S	H	H
D Unlikely	L	L	M	S	H
E Rare	L	L	M	S	S

Legend:H = high risk, detailed research and management planning required at senior levels
S = significant risk; senior management attention needed.
M = moderate risk; management responsibility must be specified
L = low risk; manage by routine procedures

Probability of the consequences being realised was based on the team's experiential data.

2.3 Fitness-For-Purpose Assessment Team

The Fitness-for-Purpose Assessment depends on the methodical brainstorming and creative interaction of diverse disciplines. The size of the Fitness-for-Purpose Assessment team was limited to no more than eight (8) participants and included:

- experienced plant operators in the nominated facility;
- the plant superintendent/ process engineer
- a control/instrument engineer;
- an independent facilitator.

Representatives from the Regulator, Primary Industries and Resources, SA (PIRSA) were invited to attended and accounted for two members of the team.

The Instrument / Electrical Engineer was nominated to take the study minutes.

Table 2 - Team

Name	Company	Discipline / Title
Myrna Hepburn	MHPL	FFP Assessment Leader
Peter Gayen	OERL	Process Engineering Supervisor/ Katnook Plant Superintendent
Simon Mooney	OERL	Operator, Katnook Gas Plant
Russell Campbell	OERL	Field Supervisor, Katnook Gas Plant (10 yrs)
Jeff Pearman	GPA Engineering	Control / Instr & Elec Engr, Minute taker
Michael Malavazos	PIRSA	Engineering Regulations Manager
Richard McDonough	PIRSA	Engineering Regulations Manager, Petroleum Group

The Audit team included Ian Cook, Operations Manager for Oil Company of Australia, and Jim McMullen, an independent oil and gas consultant.

2.4 Timing

The Fitness-For-Purpose Assessment took place over two consecutive days close to site at Penola on 5th and 6th March, 2001. Some time was allowed for site induction and site visits before and during the study.

The maximum time spent in the Risk Assessment each day should be restricted to six (6) hours due to the deterioration in quality of the Study if the study exceeds this time, and to allow participants time to review and follow up actions and prepare for the following day. However, the sessions were typically 8 hour in length but with frequent breaks.

A further audit of the findings was carried out by senior personnel on 12th and 13th July 2001.

3 Documentation

The following documentation was available on the day of the Study:

1. Schematic Diagram showing the overview of the Katnook / Ladbroke Grove operations
2. Section from the Site Safety Manual summarizing the site hazards
3. Process Flow Diagrams (showing instruments, controls, shutdowns)

4. Drawing Numbers K-00-001 to K-15-004 and KL-00-001 to KL-15-001 were available on the day (See Appendix 1)

5. Equipment process details e.g. design pressures, temperatures and flows.

6. Layout Drawings

7. Hazardous Area Classifications

8. Cause and Effect Diagrams for both the Katnook and Ladbroke Grove facilities.

4 Fitness-For-Purpose Assessment Outcomes

Minutes

The minutes of the Fitness-for–Purpose Assessment are attached in Appendix 2. These were the basis for the Hazard Register and Action Plan.

Hazard Registers

For each hazardous event identified, the known causes, consequences, existing controls, the severity and likelihood of the event and qualitative risk were recorded. The Hazard Registers are included in Appendix 3.

Action Plan

To eliminate or further reduce the risk to as low as reasonably practical, an Action Plan was developed. The action plan suggests the management and engineering controls that need to be adopted to further reduce risk at the Katnook and Ladbroke Grove Gas Plants (Appendix 4).

5 Fitness-For-Purpose Assessment Follow- up

The Action Plan needs to be followed-up to further reduce risk at the Katnook and Ladbroke Grove Gas Plants. This is to ensure the on-going fitness-for-purpose of the facilities.

The review of the Action Plan should be carried out and the results audited by a team which includes the project manager and the Fitness-for-Purpose Assessment facilitator to ensure that the original concerns have been met and that risk reduction has occurred.

6 Fitness-For-Purpose Assessment Findings & DISCUSSION

High and significant risks need to be reviewed to ensure that all existing protective systems and safety management systems in place are current and effective.

The Katnook and Ladbroke Grove Gas Plants have been designed to the AS2885 Code for gas pipelines, and B31.3 for gas plants. Control of undesirable static electricity and design for storage tanks for flammable highly hazardous material has been allowed for.

Pressure vessels are designed and maintained to AS1210 “Pressure Vessel”.

Several safety management system strategies are in place and other management systems are in the process of being develop and implemented.

The site is constantly manned with 2 operators on-site at all times.

Training (hazard awareness and refresher) is on-going with competency testing carried out. Plant personnel are cognizant of their obligations and responsibilities to HSE. Fire-fighting equipment and fire training is good.

The Emergency Response Plan involves a close co-operation with the local CFS, medical and other emergency services. Community involvement appears to be good.

Fire is a known hazard due to the nature of the product and the location of the gas plants. Ignition sources have been eliminated with delineated hazardous areas and the plants are protected by a fusible loop network. Separation distances including firebreaks are maintained. Flashback can occur from the reboiler via the fuel gas system to the flowlines. There are PRVs in place and electric motors that are rated Ex"e" and with explosion proof enclosures on instrumentation. Firesafe valves shut feed to the turbines in the event of a fire. Condensate tanks for storage and handling are designed as per AS1940 " Storage and Handling of Flammable and Combustible Liquids" and AS1692 "Tanks for flammable and combustible liquids".

ESDs on pressure signals shutdown the gas plants in case of a major release of high pressure gas. Overpressure in the flowlines is protected by PSVs and shutdown on high pressure. The continuous vent is maintained to overcome blockages.

Liquid hydrocarbon spills are limited by small inventory and impervious bunding. Methanol is used in designated hazardous areas only.

Corrosion damage to flowlines due to CO_2 / water and sulphur reducing bacteria is constantly monitored by ultrasonic testing. Corrosion inhibitor dosing of flowlines occurs daily. An audit occurred in January 2001 as part of the Corrosion Management System.

Operator exposure to corrosion inhibitor is minimised by special PPE and environmental effects are being investigated by trialling of emulsion breakers.

Hydrate formation in equipment is remedied by glycol or methanol injection, to reduce downtime.

Mercury is present at the wells, flowlines, as sludge in vessels, in the sales gas and in the soil. Mercury levels in the gas stream were found to be within the gas specification at 2.6 g/SCM. Tests to monitor the levels are on-going. More rigorous testing of the gas stream is planned to reconfirm that the mercury level is not a problem. Operator exposure is minimised by Mercury Handling Procedures and special PPE. No evidence of chronic symptoms in plant personnel was noted, but health assessment documents were not produced.

During seismic surveys, pre-activity planning to regulatory requirements reduce the risk of flowline damage or rupture.

Redundancy for the Katnook gas processing train is in the $CaCl_2$ Tower which itself is undersized to meet current peak demand. However, plant personnel have a prioritised scheduling system in place to ensure security of supply.

Reliability of utilities such as Instrument Air is good. There is a backup system for critical services allowing continued operation of the gas plants.

Product Stewardship issues regarding spills in transit need to be addressed. JSAs are carried out for most jobs. Minor modifications are supervised by plant personnel and there are recognised deficiencies in the documentation of Modifications. Fire risk management and Incident management appears to be well entrenched.

7 Data limitations

Information collated for the Fitness-For-Purpose Assessment was from experienced operators who had operated the Katnook Gas Plant for the past 10 years. Other data was provided by senior management and checked for its currency to ensure the accuracy of the risk profile of the Katnook and Ladbroke Grove Gas Plants and its fitness-for-purpose.

The draft findings were reviewed over 2 days on site to check against plant and processes. The team included a senior operations manager and an independent view of the operations by experienced oil and gas personnel. A brief audit of Process and instrumentation Drawings (P&IDs) and Material Safety Data Sheets (MSDSs), equipment general arrangements and specification, and the Cause and Effect Matrix were used as references. A walk through the plant, discussion with operators to check data and inspection of road and rail together with wellyard proximity to the Public were also carried out to ensure the accuracy of the data.

There are no known additional factors which may adversely affect or compromise the fitness-for-purpose of the facility.

8 Sensitivity

The significant risks of fire / explosion and harmful releases have prevention and detection controls in place. If these controls fail, mitigation management procedures, plant personnel training and engineering hardware come into effect. These need to be tested and audited regularly to ensure ongoing fitness-for-purpose of the plants.

9 References

1. *South Australian Petroleum Regulations 2000* being No. 235 of 2000: *Gaz* . 21 September 2000, p. 2158
2. *South Australian Petroleum Act 2000* being Petroleum Act 2000 No. 60 of 2000 [Assented to 27 July 2000]
3. *Statement of Environmental Objectives for Production and Processing of Petroleum and Associated Activities in the Otway Basin- South Australia* September 2000.

APPENDIX 1 - LIST OF DRAWINGS

Drawings used in the Study

Drawing No.	Revision	Title
K-10-001	2	Katnook Gas Plant Process Flow Diagram
K-10-102 to K-10-122	NA	Katnook Gas Plant P&IDs
K-00-002	7	Katnook Gas Plant Site Safety Plan
K-10-003	7	Katnook Gas Plant Hazardous Area Extents
K-15-001 to K-15-004	NA	Katnook Gas Plant Cause and Effect Diagrams
KL-00-002	3	Ladbroke Grove Power Station Site Safety Plan
KL-00-002 to KL-10-016	NA	Ladbroke Grove P&IDs
KL-10-021 to LL-10-024	NA	Ladbroke Grove Hazardous Area Extents
KL-15-001	3	Ladbroke Grove Cause and Effects Matrix

APPENDIX 2 - FITNESS-FOR-PURPOSE ASSESSMENT MINUTES

FITNESS FOR PURPOSE ASSESSMENT: Katnook & Ladbroke Grove Gas Plants

Client: Origin Energy
Project Title: Katnook / Ladbroke Grove
Project Nº: 01054
Sheet 1 of 4 Date: 5 March 2001

Chair Person: Myrna Hepburn
Secretary: Jeff Pearman Simon Mooney, Travis Holland
Design Engineer: Peter Gayen
Observers: Richard McDonough, Michael Malavazos
Location: Katnook

Item Nº	Drawing Nº. Equipment Identification Guide Word	Deviation and Possible Causes	Consequences	Action Required and Comments	Action By / Priority	Completed Yes/No
1	Wellheads	External fire	Fuel to fire, loss of equipment	Reduce amount of flammables stored at well. Ensure house keeping is adequate. Up to date fire training for operators. Details clearly described in emergency response manual. Add fusible loop system to Katnook and Haselgrove wells. Addition of telemetry to Katnook and Haselgrove wells for remote operation. Organise workshop for local CFS for procedures.	H / Origin	
		Lightening	Damage equipment, ignite fire	Ensure that well yards have lightening strapped earths. Check hat procedures clearly state fire fighting principles and responsibilities.	M / Origin	
		Internal fire	High pressure gas fuel fire, loss of equipment	Ensure static earthing procedures are up to date.	M / Origin	
		Environmental	Fire, product spillage, contamination of soil and ground water	Glycol tanks are bunded. Look over MSDS. Cranes fitted on vehicles to ensure safe loading and unloading of drums of condensate. Only one drum of condensate is carried at a time.	H / Origin	
		Security of supply	Unable to meet peak loads.	Redundancy of wells at this point in time. New wells are being added. Refurbish older wells.	H / Origin	
2	Flow lines	Mechanical damage during harvest time of pines.	Rupture of Haselgrove flow line.	Check depths of buried pipe in areas of flooding. Liase with forestry dept. before harvesting. Ensure land owners are aware of dangers.	H / Origin	

Item Nº	Drawing Nº. Equipment Identification Guide Word	Deviation and Possible Causes	Consequences	Action Required and Comments	Action By / Priority	Completed Yes/No
		Corrosion / Erosion	Degradation of flow line.	Procedures in place for corrosion checks. Corrosion inhibitors used at Ladbroke Grove wells. CP program in place. Procedure needs to be created for physical inspection for corrosion. Determine whether it is possible to pig Ladbroke Grove flow lines. Ultrasonic surveys are undertaken on regular intervals. Corrosion coupons installed. Erosion resistant spools have been installed at Ladbroke Grove wells, and chemical injection points moved. Investigate standards for corrosion and PSV inspection	M / Origin	
		Locations – Ladbroke Grove	Damage to or from railway.	Railway possibly becoming commercial. Check pipe depths around railway crossing.	L / Origin	
		Over pressure / Under pressure	Flow line rupture	Check ratings of flowlines throughout Katnook / Ladbroke Grove.	M / Origin	
		Environmental	Contamination due to liquid spills.	Check feasibility of launching an intelligent pig to detect leaks. Check discharge of Safries effluent lines to ensure it cannot damage Haselgrove flowline. Check signage along flowlines	M / Origin	
		Seismic	Mechanical damage to flowlines.	Ensure truck drivers know that there are flowlines in the vicinity.	M / Origin	
		Emergency response procedures	Confusion in emergency.	Possibility of running mock trials for emergencies involving CFS.	M / Origin	
3	Katnook gas train	CaCl Tower	Open to atmosphere causing corrosion.	Check that CaCl has not solidified on a regular basis.	L / Origin	
			Undersized, minimised production.	If using CaCl tower for extended periods, have a procedure to shut off KCA.	M / Origin	

Item Nº	Equipment Identification Guide Word	Deviation and Possible Causes	Consequences	Action Required and Comments	Action By / Priority	Completed Yes/No
		Slug catcher	Unreliable in the removal of liquids.	Have procedure stating that redundant paths are to continue supply to township, isolating KCA if need be.	L / Origin	
		Critical spares	Loss of production.	Check status of critical spares.	H / Origin	
		Fire / Explosion	Damaged equipment. Safety of operators and public.	Have procedure to test fusible loop on a periodic basis.	M / Origin	
		Environmental	Release of gases to atmosphere.	Check records kept of depressurisation.	M / Origin	
4	Environmental	Methanol spill in plant	Contamination. Create hazardous area.	Bund methanol drum in plant (200lt). Check to see whether a spill could cause a hazardous area around the GRU.	M / Origin	
		Access	Unable to truck condensate.	Check whether Scotts can provide tanks if floods forecast.	L / Origin	
5	Glycol injection / storage	Spillage	Contamination.	Mercury sulphides collect with glycol. Check that it is acceptable to cultivate, fertilise, seed and fence contaminated earth.	M / Origin	
		Blockage of GRU stack.	Product spills from stack.	Include regular cleaning of stack in site procedures.	L / Origin	
		Contact with mercury sulphides.	Contamination.	Arrange periodic sampling of GRU emissions and surrounding soil.	M / Origin	
6	Ladbroke Grove Gas Plant	Public safety	Toxic gas release (high CO_2)	Unable to hear emergency evacuation alarm from Ladbroke Grove Power Plant control room. Investigate interaction of alarming between the two plants. Revisit dispersion study looking at the close proximity of Argyle Rd.	H / Origin	
		Helicopter access	Gas cloud surrounding helicopter.	Ensure that ElectraNet are aware that helicopters are not to hover over gas plant when inspecting lines.	M / Origin	
		Turbine stack emissions	Public exposed to dangerous emissions.	Turbine stack emissions are corroding plant. Have samples of emissions taken to determine the governing factor for the corrosion.	H / Origin	

Item Nº	Equipment Identification Guide Word	Deviation and Possible Causes	Consequences	Action Required and Comments	Action By / Priority	Completed Yes/No
		Accidental ESD	Vehicles come into contact with ESD button, venting inventory.	Enforce strict control of vehicles entering the gas plant. Provide plant personnel to supervise.	H / Origin	
		Corrosive atmosphere	Rupture	Go over feasibility studies on plant location.	H / Origin	
		Corrosion inhibitor, spillage and exposure	Exposure to toxins	Get independent assessment of active ingredient.	H / Origin	
7	Turbines	Emergency signals	Feeding fuel to fire	Bring back ESD status from power plant to gas plant. Review operating procedures for turbines with both Origin business units.	H / Origin	
		Earthing	Energise earth grid	Look in to whether heat tracing negates isolation of turbines to gas plant.	M / Origin	
8	Condensate tanks	Emergency exit gate	Location distant to loading point	Review installation of emergency exit gate at truck loading bay.	H / Origin	
		Safety shower	Prolonged contamination	Install safety shower at truck unloading bay.	H / Origin	
		Public safety	Proximity of public road	Get council recommendation on having road only open to local traffic.	M / Origin	
		Truck filling	Driver affected by condensate fumes	Investigate construction of loading platform. Review loading procedure.	L / Origin	
		Vehicle accident	Inventory spillage	Determine who is responsible for condensate once in transit. Inquire about a turning lane from Penola rd. to Millers Lane. Increase visibility at train crossing.	H / Origin	
		Level measurement	Over flow tank	Add level measuring instrument to each condensate tank.	H / Origin	
9	Public entry	Operators away from reception area.	Vandalism	Review site security issues.	M / Origin	
10	Water handling	Corrosion inhibitor introducing condensate to evaporation pond	Exposure to condensate vapour	Investigate alternative corrosion inhibitors and emulsifiers. Investigate findings from other oil and gas companies.	H / Origin	

Item Nº	Equipment Identification Guide Word	Deviation and Possible Causes	Consequences	Action Required and Comments	Action By / Priority	Completed Yes/No
		Spillage during pumping condensate from pond	Contamination	Investigate method of sludge disposal. Look at putting a bund around tank in which condensate is pumped. Statically earth interceptor pit. Review operating procedures for interceptor pit pumping. Review new vent stack for fuel gas venting. Current vent is in the interceptor pit.	H / Origin	
		Bubbles in evaporation pond	Reduced volume, spillage	Currently under review.	H / Origin	
11	Human resources	Expansion of plant	Long hours worked by operators	Review need for additional site personnel.	M / Origin	

APPENDIX 3 - HAZARD REGISTERS

PLANT/ACTIVITY: System:	Katnook Gas Plant Wellheads	TEAM MEMBERS:	OERL: Peter Gayen (Plant Superintendent / process Engineer), Russell Campbell (Supervisor), Simon Mooney (Operator), Travis Holland (Operator) GPA Engng: Jeff Pearman (Control / I&E Engineer) PIRSA: Richard McDonough (Eng Regs Mgr, Petroleum), Michael Malavozos (Eng Regs Mgr)	DATE OF STUDY: March 5-6, 2001
LOCATION:	Penola, South Australia	STUDY LEADER:	M. Hepburn (MHPL)	

NO.	HAZARD EVENT OR SCENARIO	RISK TYPE	POSSIBLE CAUSE (S)	CONSEQUENCES IMMEDIATE / ULTIMATE	CONSEQ SEVERITY	PREVENTED OR CORRECTED BY	FREQCY of EVENT	EMERGENCY MEASURES / MITIGATION	PROBABILITY of CONSEQ REALISED	RISK
K1	External fire	Public Health & Safety Security of Production & Supply of Gas	• Grass fire • Bush fire • Fire in the well yard • Ignition from introduced sources eg vehicle, power tools, smoking • Static electricity	• Glycol stored in the vicinity if heated could ignite Flash point 116 deg C • Vapours from Condensate tank vents could ignite • Loss of production • Evacuation of site • Public health and safety threatened • Possible loss of equipment due to fire damage • Possible injury to fire-fighters, public and employees • Public acute/chronic health effects from hydrocarbon combustion products • MEG breaks down into toxic combustion products • Possible damage to plant and equipment	High	• Maintained firebreaks • Installation designed to be failsafe- fusible loops at Ladbroke Grove Plant • ESD valves at boundary • Daily inspection of the flowing wells • Weekly inspection of the non-flowing wells • Separation distances of >5m clearance around the vents • Security fencing • Signage and locked fencing • No ignition sources • Small inventory of flammables stored • Limited MEG inventory 8000l and at remote location fenced off	Unlikely	• Wellhead designed for 35000kPa Current Pressure 14000kPa. • Staff availability on all Shifts • Induction • Awareness Training • Procedure Training • Behaviours (risk averse) • Refresher Training • Competency (qualifications & experience) • Emergency Procedures and Emergency Plan (including community alerts) • Fire extinguishers held and checked • Plant isolation • PPE • Fire management training done	Low	Significant

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LOCATION:	Penola, South Australia	STUDY LEADER:	M. Hepburn (MHPL)	

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				from heat radiation • Knock - on effects such as loss of supply, economic loss, public perception, redesign, bad publicity • Community concern				2 years; Company policy for • Safety First for Personnel		
K2	Fire	Public Health & Safety Security of Production & Supply of Gas	• Lightning strike ignites the vented gas or methanol at Ladbroke Grove	• Fire • Damage to equipment • Public health and safety threatened • Possible injury to personnel and fire-fighters	High	• Earthing straps • Grass and trees in the area are trimmed regularly	Unlikely	• Emergency procedures • Training • Fire fighting system	Low	Significant
K3	Fire	Security of Production & Supply of Gas	• Release of high pressure gas plus an ignition source due to static, friction and corrosion to release gas from piping under high pressure	• High pressure gas fuel fire • Loss of equipment • Security of supply threatened • Possible injury to personnel and public • Poor corporate image	High	• Control of static electricity in the area • Sound well maintained equipment • ESD on low pressure signal at Katnook flowlines • ESD on high and low pressure signal at Hazelgrove flowlines • Operating	Rare	• CFS close by and quick response • Emergency response teams close by • Emergency procedures • Fire training workshops • Good fire protection equipment	Low	Signifiant

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						Instructions • Inspections & ultrasonic testing as per AS2885 • Modification Control • Safe Work Systems e.g. Permit to Work				
K4	Liquid hydrocarbon Spills	Environmental	• Hydrocarbon liquid spill from recovery process at remote metering station sites • Maintenance errors	• Contamination of soil if spills outside bunded area • Flooding of area • Possible damage to equipment • Possible fire if flammable hydrocarbon finds an ignition source	Major	• Bunded area • Labelling • Signage • 200 l drums secured with lifting devices during unloading • Cranes fitted on vehicles to ensure safe loading and unloading of drums of condensate • Only one drum of condensate is carried at a time • Open area, vapour readily dispersed • Operating Instructions • Maintenance Procedures • Permit to Work Procedures	Moderate	• Emergency procedures • Firefighting equipment • Reportable if spill in uncontainable areas	Moderate	Significant

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K5	Wellhead Availability	Security of Production & Supply of Gas	• No wellhead redundancy	• Security of supply threatened	Moderate	• Manual hookup of equipment and bringing on line	Moderate	• Well utilisation programme being developed	Moderate	Moderate
K6	Mechanical damage during harvest time of pine trees.	Security of Production & Supply of Gas	• Rippers • Vines planted quite deep near flowlines • Subsidence due to flooding • Shallow groundwater	• Damage of EPICs 200 mm and the 80 mm HG flowlines during post tree harvesting in the pine forests at Haselgrove • Possible rupture of Hazelgrove flow line • Security of supply threatened	Major	• Implementation of pipeline management Plan as per AS 2885 • Pipeline signage as per AS2885 • "One Call" system implemented before anyone starts digging • Liaison with forest harvesters on logging activity (EPIC 200mm line) • Rippers go down approx. 1.5m	Unlikely	• Emergency Response Plan	Low	Moderate
K7	Corrosion / Erosion of flowlines	Security of Production & Supply of Gas	• Internal corrosion damage due to CO_2 and water combination at Ladbroke Grove • Expansion due to pressure at the wellhead	• Degradation of flow line • Long term failure of flowline • Economic loss due to replacement • Gas release may be due to pinhole or catastrophic	High	• Monitoring of flowline 200m K1 which has residual water, hydrocarbon and some vapour present but is capped. • Iron counts carried out. • Inhibitor dosing of flowlines	Unlikely	• Emergency procedures-pipeline isolation: Wells shut-in when pressure loss due to corrosion; Check valves and ESDs shut	Moderate	Significant

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			• Internal corrosion due to micro-organism sulphur reducing bacteria (SRBs) produce Hydrogen sulphide and sulphuric acid • External corrosion due to coating defects • Cathodic protection failure • Flow velocities and solids entrained	failure • Possible fire if gas ignites • Damage to equipment • Noise • Possible injury to personnel • Security of supply threatened		occurs daily. • Corrosion coupons inserted. Ultrasonic surveys are undertaken on regular intervals. • SS piping spools have been installed at Ladbroke Grove wells, and chemical injection points moved. • Ongoing program to detect corrosion/ erosion in place • Cathodic protection • No deadlegs • Ultrasonic baseline study underway • Audited Dec2000-Jan2001 for management of Corrosion		• Training • Katnook Gas i.e. sweet gas lines have no history of corrosion		
K8	Rail line incident due to location of Ladbroke Grove	Public Health & Safety	• Damage of Ladbroke Grove from tourist railway	• Damage to tourist railway • Public health and safety threatened • Damage to	Moderate	• Permit to work Procedures • Low pressure shutdown • LG1 crosses EPIC flowline	Unlikely	• Emergency Plan	Low	Low

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	flowlines and rail line			• equipment • Corporate image poor • Loss of supply to Power station		• ESDs				
K9	Over pressure	Security of Production & Supply of Gas	• Overpressure	• Flow line rupture • Damage to equipment • Smell due to gas release	High	• PSVs (9780 and 9320 kPag) provide protection on flowlines • Low pressure shutdown set at 2300 kPag • High pressures shutdown at 8200 kPag. • Controlled gas release during depressurising of flowlines • Inspections & Testing • Safe Work Systems	Moderate	•	Moderate	Significant
K10	Liquid Spills	Environmental	• Two effluent lines owned by Saffries's potato chip plant crosses the HHGS1 flowline and is partly buried • Flowline HGS1 and HG2 are buried under the effluent lines and	• Possible damage to pipeline coating • Potential for fire	Moderate	• Line checks carried out • CP monitoring	Unlikely		Unlikely	Low

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			corrodes and fails							
K11	Seismic survey activity	Security of Production & Supply of Gas	• Mechanical damage to flowlines due to seismic survey activity • Drilling into flowlines by others	• Rupture of flowlines • Gas release from flowline • Possible fire • Damage to equipment	High	• Signage at flowlines • Pre-activity planning • Consultation with operations • Regulatory requirement to drill 50m from flowline	Rare	• Emergency Plan	Low	Significant
K12	Fire	Public Health & Safety	• Condensate tanks have breathers which could ignite	• Fire on gas conditioning skids vents	Major	• Hot water service and burner outside Class 1 Zone 2 area	Unlikely	• Emergency procedures • Training • Firefighting system	Low	Low
K13	Fire	Public Health & Safety Security of Production & Supply of Gas	• Lightning strike ignites the vented gas/ condensate gas or methanol	• Fire • Damage to equipment • Public health and safety threatened • Possible injury to personnel and firefighters	High	• Earthing straps • Grass and trees in the area are trimmed regularly	Unlikely	• Emergency procedures • Training • Firefighting system	Low	Significant
K14	Liquid hydrocarbon Spills	Environmental	• Hydrocarbon heavies spill during tanker refuelling carried out weekly. Inventory of 8000l max / nom 5000l • 200 litre glycol spill on to ground	• Contamination of soil and ground water • Flooding of area • Potential for fire if volatiles find an ignition source • Damage to equipment • Spills	Major	• Bunded area • Glycol will biodegrade • Labelling • Signage • 200 l drums secured with lifting devices during unloading; Cranes fitted on vehicles to	Moderate	• Emergency procedures • Firefighting equipment • Reportable if spill in uncontainable areas	Moderate	Significant

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			• Maintenance errors			ensure safe loading and unloading of drums of condensate. • Only one drum of condensate is carried at a time. • Operating Instructions • Maintenance Procedures • Permit to Work Procedures				
K15	Corrosion in the $CaCl_2$ Tower	Security of Production & Supply of Gas	• Open to atmosphere causing corrosion	• Damage to equipment • Loss of integrity • Pressure derating and taken out of service then lose backup dehydration	Moderate	• Keep pressurised • Thickness testing • Internal vessel inspection • NDT • Visual check to see $CaCl_2$ level.	Unlikely	• Have procedure stating that redundant paths are to continue supply to township, isolating Kimberly Clark if need be	Low	Low
K16	$CaCl_2$ Tower undersized	Security of Production & Supply of Gas	• Undersized for today's peak demand • Desiccant solidifies on trays under high temperature and 11250m3/hr	• Cannot supply key customer, Kimberley Clark • Only 2 days supply to Mt Gambier township • Production downtime	High	• Have preventative and prioritised flow scheduling	Moderate		Moderate	High
K17	Liquid carryover in	Security of Production &	• Hydrated dump lines	• Reduced production rate	Low	• Nil	Moderate	• Redundancy to maintain	Low	Low

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	the High Pressure Separator	Supply of Gas	• Liquids influx greater than what HP separator can process • Failure of dumps.					supply to Mt Gambier and Kimberley Clark • Slugcatcher brought back on line		
K18	Failure of Critical Joule-Thompson (JT) valve	Security of Production & Supply of Gas	• Loss of instrument air supply • Eroded seats on JT valve • Inlet choke controller fails open at the inlet manifold •	• Loss of production as valves fail closed • Full wellhead pressure of 23000 kPa potentially released at JT valve if fails open, currently set at 10000kPa. • Dew point goes up	High	• Have redundancy in 3-way valve to reroute Sales gas to heat exchanger and LTS • Alarm raised for fail open • High flow alarm • High Pressure alarm 8500 kPa on Low Temperature Separator	Unlikely		Low	Significant
K19	Blockage due to Hydrate formation in the Heat exchanger	Security of Production & Supply of Gas	• Hydrate formation adheres to tube of Heat exchanger •	• Tubes block up • Possible damage to equipment • Production rate reduced • Supply to customers may be lost	Major	• Glycol injection • Loss of flow to Heat Exchanger • Temperature rise in LTS • Operator intervention • Methanol injection pumps for hydrate • DP cell on shell and tube of heat exchanger	Moderate	• Methanol injection	Moderate	Significant
K20	Hydrate formation in	Security of Production &	• Low temperature	• Demister pad on High	Major	• Glycol injection • Operating	Moderate	• Methanol injection	Moderate	Significant

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	piping, vessels, flowlines	Supply of Gas	• Gas at / below dew point • High Pressure • High velocity • Pressure pulsation • Agitation • Crystal introduction to hydrate	Pressure Separator blocks up • Loss of supply to customers		procedures				
K21	Thermal cycling of Katnook Plant	Security of Production & Supply of Gas	• Brittle stress fracture	• Loss of vessel integrity	Moderate	• Cycles logged on LTS • Class 1H LTS Vessel under the Pressure Vessel code AS1210 • Instrument fuel gas as back up for Instrument air • PSVs 8575 kPa on $CaCl_2$ tower set lower than on LTS 9928 kPa relief	Unlikely	• Visual surface inspections • Thickness testing by approved Third party • Internal inspections by Third party	Low	Low
K22	Slugcatcher failure	Security of Production & Supply of Gas	• External corrosion of buried slugcatcher	• Failure of 150 NB pipe	Major	• Cathodic protection for slugcatcher • External visual inspections	Moderate		Low	Significant
K23	Methanol spill in plant	Public Health & Safety	• Methanol injection as an alternative to glycol • Overfilling during	• Contamination of soil if in unbunded area • Possible fire • Heat	High	• Small inventory of methanol (2X 200 litre drums) • Hazardous area • Static earth leads	Moderate	• Emergency Procedures • Fusible loop • Training • Firefighting equipment	Low	Significant

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			transfer • Knocking over drum • Falling from truck rupturing drum • Ignition source from vehicles	radiation: methanol has low radiation intensity • Possible property damage • Potential injury to personnel and firefighters		• Spark arresters fitted to vehicles • Vehicle access only under permit to replenish supplies • Engine shuts off air intake				
K24	Poor Vehicle Access on Argyle Road	Security of Production & Supply of Gas	• Flood damage • Tanker overturned	• Road blocks and unable to truck condensate out	Moderate	• No economic solution •	Rare	• Crisis Management Plan • Emergency Procedures	Low	Low
K25	Continuous vent failure	Security of Production & Supply of Gas	• Blockage of flame arresters • Debris in system	• Plant blowdown system • Possible fire • Damage to equipment	High	• Maintenance •	Unlikely	• Emergency Procedures • Training • Firefighting equipment	Low	Significant
K26	Contact with mercury sulphides.	Public Health & Safety Environmental	• Mercury sulphide plus rust plus hydrocarbon form a “sooty” accumulate which collects at Glycol tank • Free mercury collects in low points of process plant	• Blockage • Contamination of catchment or pond • Personnel exposure	Moderate	• Regular testing for free Mercury in Sales gas quality, liquid gas for KGP and Ladbroke Grove Plant • Confined to plant.	Unlikely	• PPE: BA for vessel entry by Authorised personnel; mask • Mercury and Mercury sulphide contaminated filters taken away by Cleanaway	Moderate	Moderate
K27	Mercury levels in soil	Environmental	• Mercury sulphide seeps into soil	• Contamination of soil	High	• Future rehabilitation of the site	Unlikely		Low	Significant
K28	Loss of PLC	Security of	• Internal PLC	• Production	Moderate	• Backup CPU	Unlikely		Low	Low

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		Production & Supply of Gas	error	loss		available • Manual operation of process				
K29	Loss of Power	Security of Production & Supply of Gas	• Sudden power breakdown	• Production loss	Moderate	• Backup generator available	Unlikely		Moderate	Moderate
K30	Loss of Instrument air	Security of Production & Supply of Gas	• Air compressor failure	• Production loss	Moderate	• Use conditioned gas for instrument air • Backup air compressor for KGP but not for Ladbroke Grove Plant	Unlikely		Moderate	Moderate
K31	Loss of HWS	Security of Production & Supply of Gas	• Sudden failure due to gas supply, water supply, power loss	• Hydrate Low Temperature Separator over time if lost both heaters	Moderate	• Redundancy of 2 water heaters plus auxiliary units	Unlikely	• Production loss	Low	Low

PLANT/ACTIVITY: System:	Katnook Gas Plant Glycol injection / storage circuit	TEAM MEMBERS:	OERL: Peter Gayen (Plant Superintendent / process Engineer), Russell Campbell (Supervisor), Simon Mooney (Operator), Travis Holland (Operator) GPA Engng: Jeff Pearman (Control / I&E Engineer) PIRSA: Richard McDonough (Eng Regs Mgr, Petroleum), Michael Malavozos (Eng Regs Mgr)	DATE OF STUDY: March 5-6, 2001
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K32	Ethylene Glycol spills	Public Health & Safety Environmental	• Vehicle accident in transit • Glycol storage tanks have Mercury sulphide sludge	• Spill onto road • Bad publicity • Operator exposure	Major	• Driver training	Unlikely	• PPE • Emergency procedures	Low	Moderate
K33	Blockage of Glycol Regeneration Unit stack	Security of Production & Supply of Gas	• Product spills from stack • Poor operation of unit	• Clogging of still stack/glycol Reboiler • Cannot get product into Reboiler	Major	• Clean stack every 6-8 months • Regular maintenance • Column redesign	Moderate	• Swap to methanol injection	Low	Significant
K34	Spill of Ethylene Glycol in bund and bund full of rainwater	Environmental	• Sightglass cracks and fails • Seals on pump fail	• Discharge to bund • Rainwater may become contaminated in bunds • Soil and groundwater contamination	Moderate	• Visual inspections • When doing glycol injection, inspections are more frequent • Stormwater goes to Evaporation Pond	Unlikely	• Frequent pump off of water in wet weather	Low	Low
K35	Exposure to contaminated Sludge (Prescribed Waste)	Public Health & Safety	• Filter changeouts a high maintenance activity • Every 6-8 months, boilers are stripped out	• Operator exposed to Mercury sulphide sludge	Major	• PPE • Ventilation • Training • Maintenance Procedures • Signage	Likely	• Washdown PPE after filter changeouts	Moderate	Significant

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K36	Exposure to contaminated Filters (Prescribed Waste)	Public Health & Safety	• High maintenance filter changeouts	• Operator exposed to Mercury sulphide	Major	• Filters into plastic lined bins and removed by Cleanaway • PPE • Signage • Ventilation • Training • Filters contained in bund in a filter cage	Likely		Low	Significant
K37	Vent gas containing Hydrogen sulphide	Public Health & Safety	• 11 ppm Hydrogen sulphide in vent gas off LFV • The vapour space on the Glycol tank is Hydrogen sulphide filled	• Operator exposed to Hydrogen sulphide (TWA 10ppm)	Major	• Signage • PPE • Ventilation • Training • Maintenance Procedures • Permit to Work procedures	Unlikely	• Hydrogen sulphide sampling on vent stack	Low	Moderate
K38	Fire on Reboiler	Public Health & Safety	• Flashback on Reboiler to fuel gas system and into flowlines	• Fire • Damage to equipment	High	• Pressure reducing valves • Check valves in lines • Hazardous area classification Class 1 Zone 2 • Explosion proof motors on all pumps and explosion	Low	• Availability on all Shifts • Induction • Awareness Training • Procedure Training • Emergency Procedures (including community alerts) • Fire	Low	Significant

PLANT/ACTIVITY: System:	Katnook Gas Plant Glycol injection / storage circuit	TEAM MEMBERS:	OERL: Peter Gayen (Plant Superintendent / process Engineer), Russell Campbell (Supervisor), Simon Mooney (Operator), Travis Holland (Operator) GPA Engng: Jeff Pearman (Control / I&E Engineer) PIRSA: Richard McDonough (Eng Regs Mgr, Petroleum), Michael Malavozos (Eng Regs Mgr)	DATE OF STUDY: March 5-6, 2001
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						proof enclosures on instruments		extinguishers • Plant isolation		

PLANT/ACTIVITY:		Ladbroke Grove Gas Plant		TEAM MEMBERS:		OERL: Peter Gayen (Plant Superintendent / process Engineer), Russell Campbell (Supervisor), Simon Mooney (Operator), Travis Holland (Operator) GPA Engng: Jeff Pearman (Control / I&E Engineer) PIRSA: Richard McDonough (Eng Regs Mgr, Petroleum), Michael Malavozos (Eng Regs Mgr)			DATE OF STUDY: 5-6 March 2001	
LOCATION:		Penola, South Australia		STUDY LEADER:		M. Hepburn (MHPL)				
NO.	**HAZARD EVENT OR SCENARIO**	**RISK TYPE**	**POSSIBLE CAUSE (S)**	**CONSEQUENCES IMMEDIATE / ULTIMATE**	**CONSEQ SEVERITY**	**PREVENTED OR CORRECTED BY**	**FREQCY Of EVENT**	**EMERGENCY MEASURES/ MITIGATION**	**PROBABILITY of CONSEQ REALISED**	**RISK**
L1.	Major gas release	Public Health & Safety Security of Production & Supply of Gas	• Gas release at Katnook Plant	• Turbine failure • Potential gas cloud • Evacuation alarms not heard at Ladbroke Grove plant if incident at Katnook plant	High	• Maintenance checks • Vessel inspections	Unlikely	• ESDs trigger an emergency alarm • Plant evacuation • Evacuation procedures • Emergency procedures • Training	Low	Significant
L2.	Helicopter flying too low over exhaust stacks on turbines (Off-site source)	Public Health & Safety	• Helicopter aerial surveillance	• Gas cloud surrounding helicopter • Pilot exposed to stack emissions	Major	• Communication with ElectraNet re inspections of power cables and access above plant	Unlikely	• Emergency procedures • Training	Low	Moderate
L3.	Accidental ESD	Public Health & Safety Security of Production & Supply of Gas	• Vehicles come into contact with ESD button at Water Treatment Plant located at exit gate of south east boundary of Katnook Plant	• Vent inventory • Plant shutdown	Moderate	• Induction • Protection around exposed ESD buttons	Unlikely	• Training	Low	Low
L4.	Corrosive atmosphere (Off-site source)	Public Health & Safety Environmental	• Cooling water disposal • Vent releases salts in	• Corrodes exposed steel surfaces	Major	• Corrosion monitoring • Corrosion Management Plan • Plant and	Unlikely	• Vegetation monitoring for salts • Soil sampling for salts	Low	Low (Public Health &Safety) Moderate (Environmental)

PLANT/ACTIVITY:		Ladbroke Grove Gas Plant		TEAM MEMBERS:		OERL: Peter Gayen (Plant Superintendent / process Engineer), Russell Campbell (Supervisor), Simon Mooney (Operator), Travis Holland (Operator) GPA Engng: Jeff Pearman (Control / I&E Engineer) PIRSA: Richard McDonough (Eng Regs Mgr, Petroleum), Michael Malavozos (Eng Regs Mgr)			DATE OF STUDY: 5-6 March 2001	
LOCATION:		Penola, South Australia		STUDY LEADER:		M. Hepburn (MHPL)				
NO.	**HAZARD EVENT OR SCENARIO**	**RISK TYPE**	**POSSIBLE CAUSE (S)**	**CONSEQUENCES IMMEDIATE / ULTIMATE**	**CONSEQ SEVERITY**	**PREVENTED OR CORRECTED BY**	**FREQCY Of EVENT**	**EMERGENCY MEASURES/ MITIGATION**	**PROBABILITY of CONSEQ REALISED**	**RISK**
			stream			equipment painted				
L5.	Plant failure or Rupture	Public Health & Safety Security of Production & Supply of Gas	• Failure due to corrosion of HPS • Failure due to corrosion of Coalescer at the water interface	• Possible rupture • Substation close by • Possible Injury	Moderate	• Corrosion inhibitors • Vessel inspections • Ultrasonic testing • Ignition sources controlled on LG1 plant due to intrinsically safe equipment • Plant integrity • Operating Procedures • Training	Rare	• Plant isolation • Shut in of wells on low pressure • Inventory available rapidly consumed	Low	Low
L6.	Corrosion inhibitor spillage	Environmental Public Health & Safety	• Minor spills of Corrosion inhibitor • Transport spill on road near pond	• Possible chronic exposure to carcinogens • Filming of amines / emulsion formed on pond • Fouling of gutters • Fouling of swamps • Odour release with smell similar to mercaptan	High	• Small inventory of 200 litres handled • Handling arm checked regularly • Communication with Supplier • Trailing emulsion breakers to eliminate emulsions forming	Unlikely	• Cleanup procedures • Chemical Management Plan	Low	Significant
L7.	Corrosion inhibitor exposure	Public Health & Safety	• Manual handling of Corrosion	• Possible chronic effects /exposure to	Moderate	• PPE as per MSDS • Handling	Moderate		Low	Moderate

PLANT/ACTIVITY:		Ladbroke Grove Gas Plant		TEAM MEMBERS:		OERL: Peter Gayen (Plant Superintendent / process Engineer), Russell Campbell (Supervisor), Simon Mooney (Operator), Travis Holland (Operator) GPA Engng: Jeff Pearman (Control / I&E Engineer) PIRSA: Richard McDonough (Eng Regs Mgr, Petroleum), Michael Malavozos (Eng Regs Mgr)			DATE OF STUDY: 5-6 March 2001	
LOCATION:		Penola, South Australia		STUDY LEADER:		M. Hepburn (MHPL)				
NO.	**HAZARD EVENT OR SCENARIO**	**RISK TYPE**	**POSSIBLE CAUSE (S)**	**CONSEQUENCES IMMEDIATE / ULTIMATE**	**CONSEQ SEVERITY**	**PREVENTED OR CORRECTED BY**	**FREQCY Of EVENT**	**EMERGENCY MEASURES/ MITIGATION**	**PROBABILITY of CONSEQ REALISED**	**RISK**
			inhibitor	carcinogens • Odour release		procedures • Dedicated equipment • Training • Communication with Supplier				
L8.	Power station interruption / failure	Security of Production & Supply of Gas	• Failure at LG1 due to loss of Instrumentation air • ESD on condensate loadout	• Electrical / power stations go down when turbines are running	High	• Use conditioned gas for instrument air • Backup air compressor for KGP but not for Ladbroke Grove Plant • Maintenance checks • Vessel inspections • Induction • Protection around exposed ESD buttons • Corrosion inhibitors • Ultrasonic testing • Ignition sources controlled on LG1 plant due to intrinsically safe equipment • Plant integrity • Operating Procedures • Training	Moderate	• ESDs trigger an emergency alarm • Plant Evacuation procedures • Emergency procedures • Training • Plant isolation • Shut in of wells on low pressure • Inventory available rapidly consumed	Moderate	High

PLANT/ACTIVITY:		Ladbroke Grove Gas Plant		TEAM MEMBERS:		OERL: Peter Gayen (Plant Superintendent / process Engineer), Russell Campbell (Supervisor), Simon Mooney (Operator), Travis Holland (Operator) GPA Engng: Jeff Pearman (Control / I&E Engineer) PIRSA: Richard McDonough (Eng Regs Mgr, Petroleum), Michael Malavozos (Eng Regs Mgr)			DATE OF STUDY: 5-6 March 2001	
LOCATION:		Penola, South Australia		STUDY LEADER:		M. Hepburn (MHPL)				
NO.	**HAZARD EVENT OR SCENARIO**	**RISK TYPE**	**POSSIBLE CAUSE (S)**	**CONSEQUENCES IMMEDIATE / ULTIMATE**	**CONSEQ SEVERITY**	**PREVENTED OR CORRECTED BY**	**FREQCY Of EVENT**	**EMERGENCY MEASURES/ MITIGATION**	**PROBABILITY of CONSEQ REALISED**	**RISK**
L9.	Katnook Gas Plant feed if fire at Turbines	Security of Production & Supply of Gas	• Feeding gas to fire at LG1 from Katnook Gas Plant	• Fire safe XSVs at turbines fail closed: feed gas stops	High	• Explosion walls exist at transformer • Katnook gas used at Start-up only	Unlikely	• Emergency Procedures	Low	Significant
L10.	Heat tracing at Ladbroke Gas Plant	Security of Production & Supply of Gas	• Electrical heat tracing at LGP to turbines	• Potential to negate electrical isolation of gas plant and turbines	High		Moderate		Low	High
L11.	Fire on condensate tanks	Public Health & Safety	• Ignition due to lightning strike • Not using Intrinsically safe equipment at top of tanks • Static electricity inside the tank	• Potential Fire • Commercial loss • Negative Publicity • Incident Investigation	High	• Procedural control • Tanks designed to AS1940 Code • Bottom filled tanks • Pressure vacuum vents installed on top of tanks • Hazardous area defined	Unlikely	• Emergency Plan • Crisis Management Plan • ESD to shut down both plants to stop product being fed to the tanks	Low	Significant
L12.	Fire at truck loadout bay	Public Health & Safety Environmental	• Static electricity • Electrical fault on the truck • Introduced ignition source e.g. smoking, cigarette lighter,	• Potential to spread fire • Loss of truck • Possible Injury • Commercial loss	High	• Loadout system with emergency shutoff at load out pump • Manual shut and isolate tank to stop product flow • Static electricity controls	Unlikely	• Emergency Response Plan implemented • Shut down Gas Plant • Isolate condensate inventory • Crisis Management	Low	Significant

PLANT/ACTIVITY:		Ladbroke Grove Gas Plant		TEAM MEMBERS:		OERL: Peter Gayen (Plant Superintendent / process Engineer), Russell Campbell (Supervisor), Simon Mooney (Operator), Travis Holland (Operator) GPA Engng: Jeff Pearman (Control / I&E Engineer) PIRSA: Richard McDonough (Eng Regs Mgr, Petroleum), Michael Malavozos (Eng Regs Mgr)			DATE OF STUDY: 5-6 March 2001	
LOCATION:		Penola, South Australia		STUDY LEADER:		M. Hepburn (MHPL)				
NO.	**HAZARD EVENT OR SCENARIO**	**RISK TYPE**	**POSSIBLE CAUSE (S)**	**CONSEQUENCES IMMEDIATE / ULTIMATE**	**CONSEQ SEVERITY**	**PREVENTED OR CORRECTED BY**	**FREQCY Of EVENT**	**EMERGENCY MEASURES/ MITIGATION**	**PROBABILITY of CONSEQ REALISED**	**RISK**
			mobile phones; Aluminium dip sticks; • Trucks carry large inventory • High traffic area • Loadout bay closer to road than Ladbroke Gas Plant			• Loadout procedures		Plan		
L13.	Transport Spill of Condensate	Environmental	• Condensate spill between Port Stanvac and Penola • Ignition source • Proximity to road	• Environmental • Fire if ignition source • Possible injury • Bad publicity	Major	• Truck driver training	Moderate	• Initiate Emergency Response	Low	Significant
L14.	Release at truck load out bay	Public Health & Safety	• Loadout shuts down and tanker overfills • Hydrocarbon vapours present at top of tanker where driver stands • Driver slips off top of tanker	• Driver affected by condensate fumes	Moderate	• PPE	Moderate	• Initiate Emergency Plan	High	Moderate
L15.	Vehicle accident	Environmental	• Inventory spillage of	• Contamination • Potential for	Moderate	• Council Maintenance of	Unlikely	• Emergency Response	Moderate	Moderate

PLANT/ACTIVITY:		Ladbroke Grove Gas Plant		TEAM MEMBERS:		OERL: Peter Gayen (Plant Superintendent / process Engineer), Russell Campbell (Supervisor), Simon Mooney (Operator), Travis Holland (Operator) GPA Engng: Jeff Pearman (Control / I&E Engineer) PIRSA: Richard McDonough (Eng Regs Mgr, Petroleum), Michael Malavozos (Eng Regs Mgr)			DATE OF STUDY: 5-6 March 2001	
LOCATION:		Penola, South Australia		STUDY LEADER:		M. Hepburn (MHPL)				
NO.	**HAZARD EVENT OR SCENARIO**	**RISK TYPE**	**POSSIBLE CAUSE (S)**	**CONSEQUENCES IMMEDIATE / ULTIMATE**	**CONSEQ SEVERITY**	**PREVENTED OR CORRECTED BY**	**FREQCY Of EVENT**	**EMERGENCY MEASURES/ MITIGATION**	**PROBABILITY of CONSEQ REALISED**	**RISK**
		Public Health & Safety	Dangerous Goods • National road to Penola with known "hotspots" • Tourist route	injury • Limited access for Emergency vehicles if there is a traffic incident		roads • Signage speed restrictions • Driver Training		Plan		
L16.	Rail incident	Public Health & Safety Environmental	• Poor visibility at rail line crossing • Not stopping	• Potential for injury • Contamination • Potential for fire	Moderate	• Need stop sign • Obeying road rules	Unlikely	• Emergency Response Plan	Low	Low
L17.	Vapour level on Condensate tanks	Public Health & Safety	• Pressure vacuum valves blocked • Overflow tank • Vapour release especially on cold night and near road plus ignition source e.g. car	• Bunds can fill with vapour and ignition source • Localised "lazy" Fire • Personnel injury	Moderate	• Dipping tanks • Mechanical Backup Pressure relief on dip-tube cap	Unlikely		Low	Low
L18.	Condensate tankers cannot get out	Security of Production & Supply of Gas	• Flooding • Road blockage • Local bushfires	• Ladbroke grove Gas Plant production down after 5 days	Low	• Reasonable inventory of 80000-100000 litres with Katnook Gas Plant and K2 & K3 as back up wells • Maximise	Unlikely	• Load shedding according to customer to Township, KCA	Low	Low

PLANT/ACTIVITY:		Ladbroke Grove Gas Plant		TEAM MEMBERS:		OERL: Peter Gayen (Plant Superintendent / process Engineer), Russell Campbell (Supervisor), Simon Mooney (Operator), Travis Holland (Operator) GPA Engng: Jeff Pearman (Control / I&E Engineer) PIRSA: Richard McDonough (Eng Regs Mgr, Petroleum), Michael Malavozos (Eng Regs Mgr)			DATE OF STUDY: 5-6 March 2001	
LOCATION:		Penola, South Australia		STUDY LEADER:		M. Hepburn (MHPL)				
NO.	**HAZARD EVENT OR SCENARIO**	**RISK TYPE**	**POSSIBLE CAUSE (S)**	**CONSEQUENCES IMMEDIATE / ULTIMATE**	**CONSEQ SEVERITY**	**PREVENTED OR CORRECTED BY**	**FREQCY Of EVENT**	**EMERGENCY MEASURES/ MITIGATION**	**PROBABILITY of CONSEQ REALISED**	**RISK**
						ullage at all times				
L19.	Public access to site	Public Health & Safety	• Visitors wandering on to site	• Injury • Vandalism • Property damage	Moderate	• Controls at the Gate, Reception • Induction to site • Removal of Mobile phones • Signage	Unlikely		Low	Low
L20.	Emulsion formation	Environmental Public Health & Safety	• Corrosion inhibitor (Ladbroke Grove Plant) introducing condensate to evaporation pond	• Condensate emulsion on the ponds • Vapour release on ponds • Exposure to condensate vapour	Moderate	• Introducing emulsion breakers • Improved skimming techniques	Likely	Nil	Low	Significant
L21.	Spillage during pumping condensate from pond	Environmental	• Hose failure • Fitting failure during transfer	• Local Contamination • Possible fire danger	Low	• Industry standard fittings	Unlikely	• Cleanup procedure as per Waste Management Plan	Low	Low
L22.	Excess fuel gas low pressure vent	Public Health & Safety	• Intermittent release of fuel gas • When hatch is removed for inspection	• Atmospheric release when hatch opened once a day • Potential fire	Low	• Investigation of alternative suppliers / inhibitors	Likely		Low	Low
L23.	Ignition	Public Health & Safety	• Static electricity and some vapour present	• Fire	Moderate	• Static earthing • Air driven diaphragm pump used • Control of ignition sources • Control of Hot	Unlikely	Not applicable	Low	Low

PLANT/ACTIVITY:		Ladbroke Grove Gas Plant		TEAM MEMBERS:		OERL: Peter Gayen (Plant Superintendent / process Engineer), Russell Campbell (Supervisor), Simon Mooney (Operator), Travis Holland (Operator) GPA Engng: Jeff Pearman (Control / I&E Engineer) PIRSA: Richard McDonough (Eng Regs Mgr, Petroleum), Michael Malavozos (Eng Regs Mgr)			DATE OF STUDY: 5-6 March 2001	
LOCATION:		Penola, South Australia		STUDY LEADER:		M. Hepburn (MHPL)				
NO.	**HAZARD EVENT OR SCENARIO**	**RISK TYPE**	**POSSIBLE CAUSE (S)**	**CONSEQUENCES IMMEDIATE / ULTIMATE**	**CONSEQ SEVERITY**	**PREVENTED OR CORRECTED BY**	**FREQCY Of EVENT**	**EMERGENCY MEASURES/ MITIGATION**	**PROBABILITY of CONSEQ REALISED**	**RISK**
						work • Observing prevailing winds • Operating procedures to shutdown plant or Liquids Flash Vessel • Lower inventory				
L24.	Leaking evaporation pond	Environmental	• Hole in HDPE liner • Flooding	• Contamination of water table • Communication from EPA	Moderate	• Leak detection sampling program • Rainfall study completed to determine maximum fuel height on pond	Unlikely		Low	Low
L25.	Fire in buildings	Public Health & Safety	• Cooking in kitchen • Electrical fault • Smoking	• Potential for fire	Major	• Smoke detectors • Training • Signage • Good house-keeping	Unlikely	• Fire extinguishers • Fire blankets • Residual current devices on all electrical	Low	Moderate
L26.	Manning / poor morale	Public Health & Safety	• Peak workload • Long hours • Attitude	• Operator error	Moderate	• Manning under review • Safety awareness • Improved understand-ing of obligations and responsibilities • Structured work plans	Moderate	• Safety Management System	Low	Moderate

APPENDIX 4 - ACTION PLAN

ACTION PLAN
Suggested Actions to further reduce Risks
Katnook Plant: Wellheads
External Fire
• Reduce amount of flammables stored at well. • Ensure house keeping is adequate. • Update fire training for operators. • Clearly describe fire response details in emergency response manual. • Add fusible loop system to Katnook and Hazelgrove wells. • Add telemetry to Katnook and Hazelgrove wells for remote operation. • Organise workshop for local CFS and plant for emergency procedures • Check that procedures clearly state fire fighting principles and responsibilities
Methanol Fire
• Check potential for loss of methanol for heat radiation contours and location of possible ignition sources.
Static Earthing
• Ensure that well yards have lightning strapped earths.
• Ensure static earthing procedures are up to date.
Corrosion Inhibitor
• Review MSDS for corrosion inhibitor.
Redundancy of Wellheads
• Reinstate older wells.
Katnook Gas Plant Flowlines
• Check depths of buried pipe in areas of flooding. • Liase with Forestry dept. before harvesting.
Corrosion
• Procedure needs to be written and implemented for physical inspection for corrosion. • Determine whether it is possible to pig Ladbroke Grove flow lines. • Investigate standards for corrosion and PSV inspection.
• Check pipe depths around railway crossing.
• Check ratings of flowlines throughout Katnook / Ladbroke Grove.
• Check feasibility of launching an intelligent pig to detect leaks on flowlines. • Check discharge of Saffry's effluent lines to ensure it cannot damage Hazelgrove flowline coating.
• Ensure truck drivers know that there are flowlines in the vicinity.
• If using CaCl tower for extended periods, have a procedure to shut off KCA.
Glycol Injection
• Check that it is acceptable to cultivate, fertilise, seed and fence contaminated earth.
• Include regular cleaning of stack in site procedures.
• Arrange periodic sampling of GRU emissions and surrounding soil.
Ladbroke Grove Gas Plant and Power station
• Investigate interaction of alarming between the two plants to ensure signal returns to Ladbroke Grove control room to enable emergency evacuation alarm from Ladbroke Grove Power Plant control room to be heard at KG1.
• Upgrade Evacuation procedures to accommodate peak periods such as construction, maintenance.
• Ensure that ElectraNet are aware that helicopters should not hover over gas plant when inspecting power lines.

ACTION PLAN
Suggested Actions to further reduce Risks
• Take samples of emissions taken to determine the governing factor for the corrosion from the turbine stack emissions which are corroding KG1 plant.
Visitor Access
• Enforce strict control of vehicles entering the gas plant. Provide plant personnel to supervise.
• Get independent assessment of active ingredient of corrosion inhibitor
• Bring back ESD status from power plant to gas plant.
• Provide output for Fire and Detection panel to Katnook Gas Plant to enable gas supply to LG1 to be shut off
Electrical heat tracing
• Review whether electrical heat tracing negates electrical isolation of turbines to gas plant.
Emergency Exit Gate
• Review need for installation of emergency exit gate at truck loading bay.
• Install safety shower at truck unloading bay/ condensate tank.
Condensate Tanks
• Add level measuring instrument to each condensate tank to report to CITECT. Provide cabling, ultrasonics or telemetry.
• Check vessel and level instrumentation compliance with relevant AS Code, AS1940.
• Review site security issues at Katnook and Ladbroke Grove.
Water Handling
• Investigate provision of a bund around tank into which condensate is pumped. • Statically earth interceptor pit. • Review operating procedures for interceptor pit pumping. • Review new vent stack for fuel gas venting. Current vent is in the interceptor pit.
• Install a dedicated vent for LFV at Katnook Gas Plant.

APPENDIX 5 - DOWNHOLE FACILITIES FFP ASSESSMENT

ORIGIN ENERGY RESOURCES LIMITED
FITNESS-FOR-PURPOSE ASSESSMENT
HAZARD REGISTER

PLANT/ACTIVITY: ALL WELLS		Katnook / Ladbroke Grove Wells		TEAM MEMBERS:		OERL: Peter Gayen (Plant Superintendent / Process Engineer), Joe Parvar (Staff Petroleum Engineer) Bill Fawcett (Staff Geologist)			DATE OF STUDY: March 2001	
LOCATION:		Adelaide Office		STUDY LEADER:		P Gayen				
NO.	**HAZARD EVENT OR SCENARIO**	**RISK TYPE**	**POSSIBLE CAUSE (S)**	**CONSEQUENCES IMMEDIATE / ULTIMATE**	**CONSEQ SEVERITY**	**PREVENTED OR CORRECTED BY**	**FRE. Of EVENT**	**EMERGENCY MEASURES/ MITIGATION**	**P**	**RISK**
	Corrosion of casing allows gas leaks and pressurises freshwater aquifer system	PH&S	• Leak to the aquifer via multiple casing strings	• Gas release to atmosphere via water bores, or via water boring activity • Potential ignition of such a leak • Compromised Public Health and Safety • Loss of resource	Severe	• Standard well design with multiple casing strings • Wellhead control system • Monitoring Program for corrosion and abnormal casing pressures	Rare	• Competency (personnel qualifications and experience) • Emergency Response Procedures • Liaison with Emergency Authorities		Low
	Corrosion of casing allows saline formation water leaks and contaminates freshwater aquifer system	Env	• Leak from deep to shallow aquifers via multiple casing strings	• Contamination of freshwater aquifer • Loss of resource (freshwater aquifer unusable)	Severe	• Standard well design with multiple casing strings • Wellhead control system • Monitoring Program for corrosion and abnormal casing pressures	Rare	• Competency (personnel qualifications and experience) •		Low
	Failure of wellhead components causes surface blow-out	PH&S Env	• Leak at or near surface or failure of wellhead component	• Gas release to atmosphere • Potential ignition of such a leak • Potential escalation of such a fire • Compromised PH&S •	Major	• Standard well design with multiple casing strings • Wellhead Control System • Monitoring Program • Operating Procedures • Permit to Work system	Rare	• Competency (personnel qualifications and experience) • Emergency Response Procedures • Liaison with Emergency Authorities		High

ATTACHMENT 2 – Status of Katnook and Ladbroke Grove Vessel Inspections & PSV's

Status of Katnook and Ladbroke Grove Vessel Inspections and PSV's

Katnook:

- All Katnook vessels are due for external inspections before the end of 2001; this is currently programmed to occur.
- An internal inspection on Vessel K-V-004 is due and will be completed before the end of 2001.
- K-V-107 is not due an internal inspection however it has been deemed prudent to conduct a further internal inspection based upon this vessels service duty.
- Internal inspections on vessels K-V-001 and K-E-002 will be required in 2002. Additional wall thickness tests will be performed before the end of 2001 allowing internal inspections to be extended to the end of 2003, which brings these 2 vessels in line with all other plant vessels.

Ladbroke Grove:

- Internal and External inspections are scheduled for vessels KL-H-002 and KL-H-003 before the end of 2001.

Katnook and Ladbroke Grove PSV Status

Katnook:

- PSV's on vessels K-V-001, K-V-004 and K-E-002 are overdue for replacement. These will be recertified before the end of 2001 or sooner.
- All remaining PSV's in the Katnook Gas Plant will be checked for certification and those out of certification will be replaced with compliant PSV's before the end of 2001.

Ladbroke Grove:

- All PSV's in the Ladbroke Grove Gas Plant are current for their certifications until 2003.

Table 1 - Vessel Inspection Status

Location	DAIS Registration No.	Serial No.	Tag No.	Pressure Vessel Description	Manufacture Date	Last Inspection Report		Next Inspection Report		Inspections required before:	
										31/12/2001	
						External	Internal	External	Internal		
Ladbroke Grove											
	S34112MG	NCD 243	KL-H-001	Ladbroke Water Bath Heater	Sep 99	None		Sep 04	Sep 11		
	S34113MG	NCD 241	KL-V-002	Ladbroke Filter Coalescer	Sep 99	17 Dec 00	17 Dec 00	17 Dec 02	17 Dec 04		
	S34114MG	NCD 240	KL-V-001	Ladbroke Inlet Separator	Sep 99	17 Dec 00	17 Dec 00	17 Dec 02	17 Dec 04		
	S34115MG	NCD 242	KL-V-003	Sweet Filter Coalescer	Sep 99	17 Dec 00	17 Dec 00	17 Dec 02	17 Dec 04		
	S34116MG	215305	KL-H-002	Ladbroke Gas Heater	Aug 99	None		Aug 00	Aug 00	**External**	**Internal**
	S34117MG	215306	KL-H-003	Sweet Gas Heater	Aug 99	None		Aug 00	Sep 00	**External**	**Internal**
	S34118MG	KPS-99-01	KL-V-004	Ladbroke Liquids Flash Vessel	Jun 99	17 Dec 00	17 Dec 00	17 Dec 02	17 Dec 04		
Katnook											
	S27299MG	PT96317	K-V-001	High Pressure Separator	Apr 97	22 Dec 99	Mar 98	22 Dec 01	Mar 02	**External**	
	S34304MG	1078-9		Air Receiver		22 Dec 99		22 Dec 01	22 Dec 03	**External**	
	S343005MG	3357		Air Receiver (for Ladbroke Grove)		22 Dec 99		22 Dec 01	22 Dec 03	**External**	
	S34306MG	1072-9		Air Receiver		22 Dec 99		22 Dec 01	22 Dec 03	**External**	
	S32196MG	MCM1146	K-E-002	Gas/Gas Heat Exchanger	Oct 96	22 Dec 99		22 Dec 01	22 Dec 03	**External**	
	S26313MG	V-79	K-V-002	Low Temperature Separator	Nov 90	23 Dec 99	23 Dec 99	23 Dec 01	23 Dec 03	**External**	
	S26314MG	90-W-1526-0A	K-V-003	Calcium Chloride Dehydration Unit	Feb 91	22 Dec 99	22 Dec 99	22 Dec 01	22 Dec 03	**External**	
	S26319MG	2883	K-V-004	Liquids Flash Vessel	May 95	19 Mar 98	12 Dec 96	19 Mar 00	Dec 00	**External**	**Internal**
	S26321MG	V-80	K-V-005	Low Pressure Separator	Nov 90	22 Dec 99	22 Dec 99	22 Dec 01	22 Dec 03	**External**	
	Registration Reqd.	??	K-V-107	Glycol Regeneration Unit	May 97	7 May 99	7 May 99	May 01	May 03	**External**	

Katnook Plant

Tag No.	Location/ Description	Serial No.	Last Tested	Test Freq Months	Test Due	Make	Model	Set Press k.p.a.	Inlet Flange	Outlet Flange	Vent Type	Spares	Spares Status		Comments
PSV-321	Inlet H.P. Sep. K-V-001	20381-001	4/3/97	48	Mar 01	Crosby	JOS-65-A	22500	11/2" ASA 1500	2" ASA 600	To Atmosphere			Built in 1997	Capacity 3053.75
PSV-025	Low Press. Gas Sep. K-V-005	KA 27112	18/3/98	48	Mar 02	Farris	2740	1380	¾" FNPT	1" FNPT	To Atmosphere			22455 Ser. No.?	38.7 mm2 orifice
PSV-215	Fuel Gas Inlet Supply Line	KA 27109	No Tag	48	???	Farris	2741 U	1903	11/2" FNPT	2" FNPT	To Atmosphere			KD Ser. No.?	0.398" orifice
PSV-060	Calc. Chlor. Dehy. Unit K-V-003	KA 27111	20/3/98	48	Mar 02	Farris	2742 U	8500	1 1/2" FNPT	2" FNPT	To Atmosphere			KD Ser. No.?	Test 11-3-94
PSE-xxx	Rupture Disk LTS	BO 2117 7 001		48	???	Fike??	????	1710 kPa	2" ASA 150	2" ASA 150	To Atmosphere				Rupture Disk on
PSV-332	Gas/Gas Heat Exchanger K-E-002	KA-29474	26/9/96	48	Sep 00	Farris	26JA13-120	9428	2 ½" ASA 900	3" ASA 150	To Atmosphere				
PSV-470	Glycol Regen Unit K-E-108	S/N 9375		48	???	Pressure Systems		20	2" Table 'E'	2½" ASA 150	To Atmosphere				
PSV-239	Liquids Flash Vessel K-V-004	422508	29/2/96	48	???	FukuiSeisakhusho	REC 151-S (A)	1375	1½" ASA 150	3" ASA 150	To Atmosphere				
PSE-xxx	Inlet Line to CCDU			48	???	Fike		9928	1" NPT	1" NPT	To Atmosphere				Disk Dwg No. K-10-
PSV-xxx	Outlet line from Fuel Gas K.O.Pot	KA 27664		48		Farris	2740	1500	¾" MNPT	1" FNPT	To Atmosphere				Drawing (Isolated)
LADBROKE GROVE PLANT															
PSV-631	Inlet Ladbroke Coalescer KL-V-002	413797-1-DX	8/2/99	48	Feb 03	Farris	38NC13-120	5100	4" ASA 600	6" ASA 150	To Atmosphere				Pilot Operated
PSV-622	KL-V-001 Inlet Relief Valve	414698-1-KE	28/9/99	48	Sep 03	Farris	27CA23-420	10890	(3/4" ASA1 500)	1" ASA 300	To Atmosphere				
PSV-687	KL-V-004 Relief Valve	99/15129		48		AGCO	24305F12/SI/BFP/FTC	1375	1" ASA 150	2" ASA 150	To Atmosphere				Pilot Operated
PSV-705	KL-V-003 Inlet Relief Valve	413796-1-DX	9/10/99	48	Oct 03	Farris	38GC13-120	5100	1 ½" ASA	3" ASA 150	To Atmosphere				Pilot Operated
PSV-806B	Ladbroke Grove #3 Flowline	KA 32094	29/2/00	48	Feb 04	Farris	26AH13-210	9780	2" ASA 600	3" ASA 150	To Atmosphere				
PSV-806A	Ladbroke Grove #3 Flowline	KA 32093	2/2/00	48	Feb 04	Farris	26AH13-210	9320	2" ASA 600	3" ASA 150	To Atmosphere				
PSV-606A	Ladbroke Grove #2 Flowline	KA431851		48		Farris	26AH13-210	9780	2" ASA 600	3" ASA 150	To Atmosphere				
PSV-606B	Ladbroke Grove #2 Flowline	KA 431852		48		Farris	26AH13-210	9320	2" ASA 600	3" ASA 150	To Atmosphere				
PSV-691	Air Receiver KL-V-005	SV-95-746		48		TUV		1035	1" BSP		To Atmosphere				
PSV-748	Fuel Gas To Burner Relief Valve	15371183		48		Fisher	1808	200	2" NPT	2" NPT	To Atmosphere				

ATTACHMENT 3 - Fitness-For-Purpose Assessment – Downhole Facilities

ASSESSMENT NOTES

ORIGIN WELL COMPLETION POLICY:

Origin Energy general policy of casing design, well completion and well operation is based on the following principles:

- Providing maximum safety to people (prevent surface blow out)
- Protection of the environment (prevent downhole leak and contamination of fresh water aquifer system)
- Hydrocarbon production with due consideration to safe operations.

HAZARD SCENARIOS:

- Surface blow out
- Down hole communication with fresh water aquifer system

PREVENTIVE MEASURES:

1-MULTI-LAYER CASING CONFIGURATION

Origin has carried out the following types of casing design and well configurations:

-Standard multi-layer casing configuration with carbon steel tubing for low CO2 gas (less than 1 mole%).

Includes: Katnook 1, 2, 3, Haselgrove 1, 2 and Redman 1.

2 7/8" or 3 ½" carbon steel tubing
7" carbon steel production casing
9 5/8" carbon steel surface casing (or intermediate)

-Standard multi-layer casing configuration with chrome tubing for high CO2 gas (includes Ladbroke Grove 2 and 3).

3 ½" Chrome tubing
7" carbon steel production casing
9 5/8" carbon steel surface casing (or intermediate)

-Mono-bore configuration for low CO2 gas (includes Haselgrove South 1 and 2).

3 ½" carbon steel production string
9 5/8" carbon steel surface casing

Notes: There is communication between tubing and casing at Katnook 2. However, the tubing leak does not jeopardize casing integrity as the Katnook gas has a very low CO2 (approximately 0.2mole%) and there are still two layers of casing (7" and 9 5/8") to protect the aquifer system.

Ladbroke Grove 1(non-active) is not equipped with tubing strings. However, it has been completed with multi-layer casing (7" and 9 5/8") and a down hole bridge plug set above the reservoir section to protect the 7" casing string from high CO2 gas.

2- WELL HEAD CONTROL SYSTEM

Origin uses wellhead and X-mass tree with multi gate valve system equipped with adequate redundancies for well control.
All the producers have the following wellhead configurations.

- One swab valve (crown valve)
- One flow-line valve
- Two master valves
- One or two annulus valve

All the production strings (tubing or mono-bore) are equipped with two master valves to ensure redundancy.

Notes:

With respect to Katnook 2 tubing leak, additional annulus valve has been install to ensure adequate redundancy.

Ladbroke Grove 1 (non-active) is equipped with a single valve wellhead and one annulus valve. However, there is a down-hole bridge plug set above the reservoir to isolates the 7" casing (above the reservoir).

3- WELL MONITORING PROGRAM

Origin uses a routine monitoring of the tubing and casing pressure to ensure the well system integrity.

-Monitoring tubing pressure
weekly survey of all active wells
quarterly survey of all non-active wells

-Monitoring production casing pressure
weekly survey of active wells
quarterly survey of all non-active wells

-Monitoring surface (or intermediate) casing pressure
quarterly survey of all active and non-active wells

-Wellhead inspection
Yearly inspection/services of all active and non-active wells and also cased and suspended wells

Notes:

Active wells:	Katnook2, Katnook 3, Haslgrove 1, Haselgrove 2, Haselgrove South 1, Haselgrove South 2, Redman 1, Ladbroke Grove 2 and Ladbroke Grove 2.
Non-active wells:	Katnook 1, Ladbroke Grove 1, Jacaranda Ridge 1 and Killanoola 1.
Cased& Suspended wells:	Wynn1 and Katnook 4 and Limestone Ridge 1

4-OPERATING PROCEDURES

All operations related to wells (down hole and surface) shall be in accordance with the safety requirements specified by the government regulation, Origin health safety and environmental policies and operational manuals to ensure safe and trouble free operations.

5- SPECIFIC ISSUES

A- High CO2 Gas Producers (Ladbroke Grove 2 and 3)

As discussed above the Ladbroke Grove wells produce high CO2 gas. High CO2 gas has substantial potential for corrosion that could increase possibility of hazard events (as outlined above). With respect to the high CO2 gas producers Origin adhere to the following preventive measures.

-Use surface and production casing (usually 7" and 9 5/8" strings)

-Use corrosion resistance tubing (chrome alloys)

-Do not complete wells with mono-bore configuration

-Use corrosion resistance wellhead system (stainless steel)

-Use wellhead with multi gate valve system and adequate redundancy (see section 2)

-Ensure tubing and casing integrity by monitoring the tubing and casing pressure (See section 3)

-Ensure tubing integrity by running calliper surveys (as required)

-Ensure remedial workover if there was communication between tubing and casing

B- Ladbroke Grove 1 Issue (High CO2 Gas)

Ladbroke Grove 1 (non-active well) is not equipped with tubing. The well has been completed with multi-layer casing. A down hole plug has been set above a perforated zone (within the reservoir section) after a cased hole test was conducted. The down hole plug isolates the 7" casing (above the reservoir) from reservoir and the high CO2 gas.

With respect to this well Origin has taken the following preventive measures:

-The well has been completed with multi-layer casing (7" and 9 5/8")

-The 7" casing (above the reservoir) has been isolated from the reservoir via a down hole plug set above a perforated zone within the reservoir section.

-The well is equipped with a single valve wellhead and one annulus valve to ensure well control if the downhole plug fails.

-Tubing and casing pressure is monitored quarterly to ensure system integrity.

-A remedial workover will be required if the downhole plug fails.

C- Katnook 2 Tubing Leak

Communication between tubing and casing has been detected in Katnook 2 due to a down hole leaky sliding sleeve.
With respect to this well Origin has taken the following preventive measures.

-The tubing leak does not jeopardize the casing integrity as the gas has a very low CO2 (approximately 0.2mole%)

-The well has been completed with surface and production casing (7" and 9 5/8" strings) that should protect the aquifer system.

-The well is equipped with multi gate valve wellhead system and adequate redundancy (see section 2)

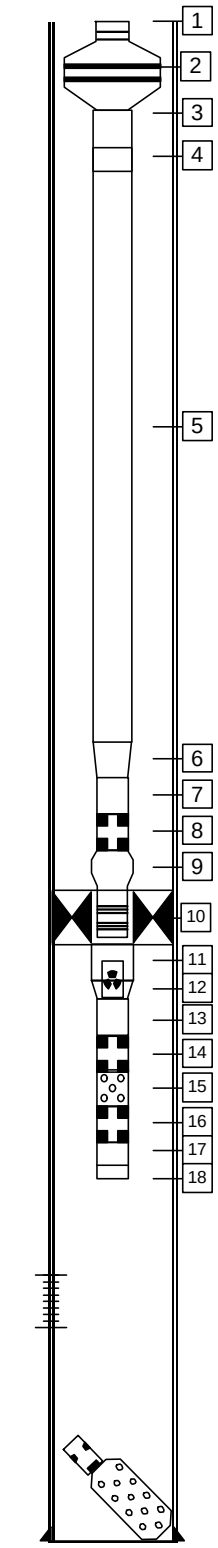
- Additional annulus valve has been install to ensure adequate redundancy for the 7" casing

-The surface casing is monitored quarterly to ensure casing integrity

BERL

Downhole Installation Diagram

Well: Ladbroke Grove 2



PBTD: 2760 mKB
(loggers 10/10/98)

Item No.	Description	Length (m)	Depth (m KB)	Min ID (in)
1	KB to top of tubinghead spool	4.40		
2	Hanger, 4-1/2" K-Fox x 4-1/2" EUE, 4.0" Nat BPV	0.32	4.40	3.855
3	1 jnt 4-1/2" K-Fox 12.6# KO-13Cr-80 tubing	9.34	4.72	3.958
4	4-1/2" K-Fox pup jnts, 2 x 10', 1 x 8', 1 x 1'	9.12	14.06	
5	258 jnts 4-1/2" K-Fox 12.6# KO-13Cr-80 tubing	2467.05	23.18	
6	2-7/8" BH3 p x 4-1/2" K-Fox b 13Cr xover swage	0.28	2490.23	2.390
7	4' x 2-7/8" BH3 6.4# 13Cr Pup Jnt	1.12	2490.51	2.379
8	2-7/8" 13Cr BH3 X nipple	0.34	2491.63	2.313
9	2-7/8" BH3 G-22 Seal Locator Assembly, 80-32	0.31	2491.97	2.435
	w/ 2 x V-Ryte seal units, 1 x bonded upper seal		2492.28	
10	7" Baker SB-3 hydraulic set packer, 84-32	1.31	2492.28	3.250
11	4-1/2" BH3 pin x pin millout extension	1.64	2493.59	
12	4-1/2" BH3 x 2-7/8" BH3 pin x-over swage	0.19	2495.23	
13	2-7/8" ABIJ 6.5# J55 pup jnt (3.01m)	3.01	2495.42	
14	2-7/8" BH3 X nipple	0.29	2498.43	
15	2-7/8" ABIJ 6.5# J55 perf pup jnt (3.04m)	3.04	2498.72	
16	2-7/8" BH3 XN nipple	0.31	2501.76	
17	2-7/8" ABIJ 6.5# J55 pup jnt (3.03m)	3.03	2502.07	
18	2-7/8" ABIJ box x 2-7/8" EUE pin crossover	0.16	2505.10	

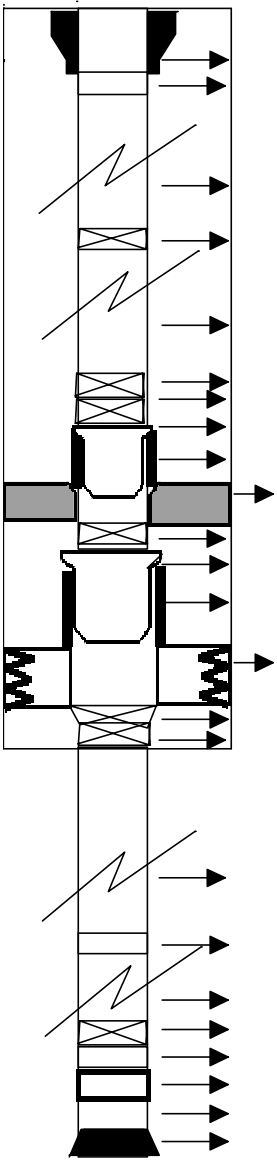
PERFORATIONS		Gun		Charges			
Formation	Interval (m KB)	Size	Type	SPF	Type	Ph	gm
Pretty Hill Sandstone	2521.5-2541.0, 2548.0 -2573.5, 2576.0 - 2586.0 2588.0 - 2598.0	4.5"	TCP	4	HMX	135 /45	21.0

Surface Casing	9-5/8"	36 ppf	K55	Shoe at 765 mKB	
Production Casing	7" (New Vam) 29 ppf		N80	Shoe at 2791 mKB	
Cementing Details	524 sx Class G with 1.2% Halad 322				
Remarks	SB3 packer re-set with 5,000 psi (Aug 99)				
	G-22 landed 0.12m off shoulder				
String Weight Calculated			**Actual**	78,000#	

Wellsite Supervisor	Adrian Stallman			Not to Scale	
Date of Installation	12-10-1998; 13Cr tubing 25/8/99			Proposed	
Drafted by	AS	Date:	25/8/99	Re-Completio	X
Checked by	P O N	Date:	9/9/1999	Completion	

HASELGROVE SOUTH 1 S/T COMPLETION DETAILS

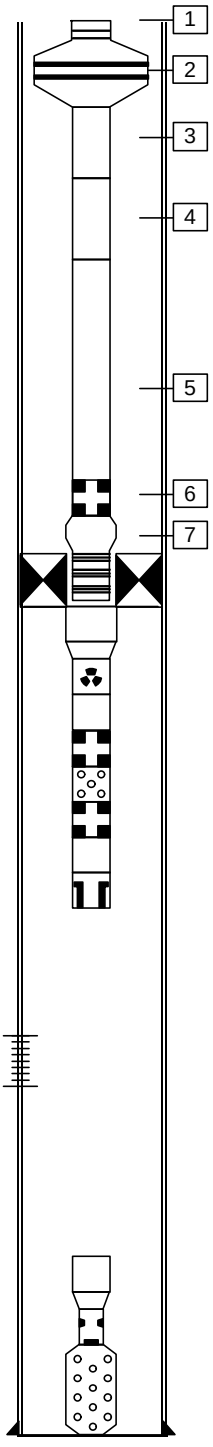
NOVEMBER 1996



	ITEM. NO.	DESCRIPTION PRODUCTION STRING	LENGTH	DEPTH (TOOL TOP)	ID	OD
1						
2			m	m KB	in	in
	1	TUBING HANGER "FBB" NSCT (BxB)	0.310	-4.19	2.992"	3 1/2"
	2	3 1/2" NIPPLE NSCT (PxP)	0.445	-4.50	2.992"	3 1/2"
3		1 JT 3 1/2", L-80, 9.2#, NSCT TUBING	11.870	-4.95	2.992"	3 1/2"
		PUP JT 3 1/2", L-80, 9.2# NSCT TUBING	1.260	-16.82	2.992"	3 1/2"
4		PUP JT 3 1/2", L-80, 9.2# NSCT TUBING	2.405	-18.08	2.992"	3 1/2"
	3	61 JT 3 1/2", L-80, 9.2#, NSCT TUBING	720.280	-20.48	2.992"	3 1/2"
	4	X-OVER3 1/2" NEW VAM (P) x 3 1/2" NSCT (B)	0.655	-740.76	2.75"	3 1/2"
5	5	89 JT 3 1/2", L-80, 12.7 # NEW VAM TUBING	851.540	-741.41	2.75"	3 1/2"
	6	X-OVER 3 1/2" NSCT (P) x 3 1/2" NEW VAM (B)	0.630	-1592.95	2.992"	3 1/2"
6	7	X-OVER 5" NSCC (P) x 3 1/2" NSCT (B)	0.360	-1593.58	2.9345"	4.959"
7	8	BAKER SEAL STEM	(1.722 m)	-1593.94	4.304"	5.239"
8		LOCATOR 5" NSCC (B)	0.235	-1593.94	4.304"	5.77"
9	9	BAKER TIE BACK EXTENSION 5" NSCC	2.340	-1594.18	5.2685"	5.704"
10	10	BAKER CPH PACKER 5" NSCC (P)	0.770	-1596.52	4.416"	5.9195"
	11	X-OVER 3 1/2" NSCT P x 5" NSCC B	0.270	-1597.29	2.964"	5.345"
11	12	LINDSEY SEAL NIPPLE	(2.94 m)	-1597.56	4 1/4"	5 1/16"
12		LOCATOR 3 1/2" NSCT (B)	0.200	-1597.56	3 1/2"	5 3/4"
13	13	LINDSEY TIE BACK RECEPTACLE	4.120	-1597.76	5 1/4"	5 3/4"
	14	LINDSEY LINER HANGER 4 1/2" NEW VAM (P)	3.190	-1601.88	4.0"	5 7/8"
14	15	X-OVER 4 1/2" NEW VAM (B) x 3 1/2" NSCT (P)	0.51	-1605.07	2.992"	5 7/8"
	16	X-OVER 3 1/2" NSCT (B) x 3 1/2" NEW VAM (P)	0.64	-1605.58	2.75"	3 1/2"
15	17	132 JT 3 1/2", L-80, 12.7 # NEW VAM TUBING	1248.77	-1606.22	2.75"	3 1/2"
16	18	PUP JT 3 1/2", L-80, 12.7# NEW VAM TUBING	2.49	-2854.99	2.75"	3 1/2"
	19	15 JT 3 1/2", L-80, 12.7 # NEW VAM TUBING	144.11	-2857.48	2.75"	3 1/2"
	20	X- OVER 3 1/2" NSCT(P) x 3 1/2" NEW VAM (B)	0.64	-3001.59	2.75"	3 1/2"
	21	PUP JT 3 1/2", L-80, 9.2# NSCT TUBING	0.64	-3002.23	2.992"	3 1/2"
	22	LANDING COLLAR 3 1/2" NSCT (BxP)	0.34	-3002.87	1 3/4"	3 15/16"
17	23	1 JT 3 1/2", L-80, 9.2#, NSCT TUBING	11.88	-3003.21	2.992"	3 1/2"
	24	FLOAT SHOE 3 1/2" NSCT (B)	0.51	-3015.09		3 15/16"
18		BOTTOM OF FLOAT SHOE AT		-3015.60		
19		PERFORATION INTERVALS (Halliburton Tri-star-phased deepstar 1 11/16" strip guns loaded with 7.6 gram charges at 4 spf)				
20		ZONE 1 2947.5 - 2953.7 mKB	Notes:			
21		ZONE 2 2920.8 - 2927.2 mKB	1) Casing to 1656 mkb (MD) is 7", 26#, Buttress			
22		ZONE 3 2916.7 - 2919.8 mKB	2) The maximum deviation in the hole is 17 deg.			
23		ZONE 4 2907.7 - 2910.0 mKB	3) ED tagged at 2959.5 mKB MD in Nov. 1996.			
24		ZONE 5 2894.5 - 2906.0 mKB				
		ZONE 6 2882.3 - 2892.5 mKb				

Downhole Installation Diagram

Well: Redman 1



PBTD: 2943.1 mKB
(Schlumberger CBL)

Item No.	Description	Length (m)	Depth (m KB)	Min ID (in)
1	KB to top of tubinghead spool	4.54		
2	Hanger, EN 7-1/16" x 2-7/8" ABIJ3SS susp thread 2-7/8" EUE lift thread, 2.5" CIW BPV thread prep	0.18	4.54	2.500
3	2-7/8" ABIJ3SS pin x 2-7/8" new Vam box x-over	1.15	4.72	
4	2-7/8" new Vam 6.5 lb/ft J55 pup jnts (6', 10', 1')	5.20	5.87	
5	290 jnts 2-7/8" new Vam 6.5 lb/ft J55 tubing	2793.13	11.07	2.441
6	2-7/8" new Vam 'X' nipple	0.30	2804.20	2.313
7	G-22 locator seal assy, 2-7/8" new Vam box w/ 3 V-Ryte seal units	0.39	2804.50	
	Shoulder on permanent packer (pipe tally)		2804.89	
	Note: G-22 length includes 0.17 m initial space out above shoulder point			
	plus top of G22 to shoulder point distance (0.22 m)			

PERFORATIONS		Gun		Charges			
Formation	Interval (m KB)	Size	Type	SPF	Type	Ph	gm
Pretty Hill Sandstone	2823.5 - 2825.5	4-1/2"	TCP	12	HMX	135/45	22.7
Pretty Hill Sandstone	2830.0 - 2836.0	4-1/2"	TCP	12	HMX	135/45	22.7
Pretty Hill Sandstone	2838.0 - 2840.5	4-1/2"	TCP	12	HMX	135/45	22.7
Pretty Hill Sandstone	2844.5 - 2846.5	4-1/2"	TCP	12	HMX	135/45	22.7
Pretty Hill Sandstone	2847.5 - 2850.5	4-1/2"	TCP	12	HMX	135/45	22.7
Pretty Hill Sandstone	2852.0 - 2857.0	4-1/2"	TCP	12	HMX	135/45	22.7
Pretty Hill Sandstone	2859.0 - 2860.0	4-1/2"	TCP	12	HMX	135/45	22.7
Pretty Hill Sandstone	2861.0 - 2862.5	4-1/2"	TCP	12	HMX	135/45	22.7
Pretty Hill Sandstone	2864.5 - 2866.0	4-1/2"	TCP	12	HMX	135/45	22.7
Pretty Hill Sandstone	2869.0 - 2872.5	4-1/2"	TCP	12	HMX	135/45	22.7
Pretty Hill Sandstone	2874.0 - 2876.0	4-1/2"	TCP	12	HMX	135/45	22.7

Surface Casing	9-5/8" / 36 ppf / K55 / LTC	Shoe @ 771 mKB	
Production Casing	7" / 26 ppf / NT80-HE / LTC	Shoe @ 2955 mKB	
Cementing Details			
Remarks	TOC at 1850 mKB (observed)		
	29/4/98: 2-7/8" New Vam string pulled to repair tubing leak (tool jnt)		
String Weight Calculated	#60,200	**Actual**	#52,500

Wellsite Supervisor	Adrian Stallman			Not to Scale	
Date of Installation	20/4/98			Proposed	
Drafted by	A Stallman	Date:	6/4/98	Re-Completion	X
Checked by	P0 N	Date:	12/6/98	Completion	