NSW GOVERNMENT | Industry & Investment

Investigation Report

Incident resulting in fatal injuries to a subcontractor on Eastern Star Gas Petroleum Assessment Lease 2 on

1 August 2009

Report prepared for the Director-General of the Department of Industry and Investment by the Investigation Unit, Thornton

Mine Safety Investigation Unit

Title: Investigation Report,
Incident resulting in fatal injuries to a subcontractor on Eastern Star Gas Petroleum Assessment Lease 2 on 1 August 2009.

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Overview

The incident

On 1 August 2009 at about 3:45pm, Bruce Austin, a 57 year old subcontractor was struck by a 200mm diameter, recoiling Polyethylene pipeline of about 150 metres in length. He sustained fatal injuries on that day and died in hospital on 4 August 2009.

At the time of the incident on 1 August 2009 Mr Austin was close to the pit from which the retrieval of the polyethylene pipe was occurring. The pipe was being pulled from a horizontal borehole.

The pipe was being pulled by an excavator using a two legged chain set when the chain failed and released the pipe which recoiled and reared up. In an incident that was not witnessed, Mr Austin received a blow to the head that caused fatal injuries.

Incident site

The incident occurred on a Petroleum Assessment Lease, (PAL 2), located approximately 35km south west from the township of Narrabri in Northern NSW.

The Person and TSG

Mr Austin was the director of his company, The Saver Guys (TSG). TSG was engaged to supply a prime mover truck and an operator to provide the services of a vacuum (sucker) truck at PAL2.

The Lease Holder

Eastern Star Gas (ESG) is the holder of PAL 2, it undertakes coal seam gas exploration in NSW.

ESG produces gas from one Petroleum Production Lease. This, together with gas from four production testing sites on PAL 2, is fed to a Joint Venture power station near Narrabri.

The Joint Venture

ESG is a party to the Narrabri Coal Seam Gas Joint Venture (NCSGJV). The joint venture is 35% owned by Santos and 65% owned by ESG subsidiaries.

The project

ESG was in the process of installing gathering lines for the Bibblewindi West Production Pilot.

ESG had used a Queensland company, GD Pipelines, who had installed pipelines using trenching techniques, to either side of the creek.

To complete the pipelines ESG needed gas and water pipes installed under Bohena Creek. ESG assessed the most practicable method of doing this was using Horizontal Directional Drilling (HDD), which is a trenchless technology now widely used.

ESG engaged Austerberry Directional Drilling Services (ADDS), to install the pipelines beneath the creek, to link the installed pipelines on either side of the creek.

Engaging TSG

ADDS engaged Applied Soil Technology (AST) to provide vacuum truck services to remove excess drilling mud.

AST in turn engaged TSG to provide a prime mover and an operator to provide vacuum truck services to ADDS on it's behalf. AST provided the vacuum tanker and Mr Austen was the operator.

Equipment

The Polyethylene Pipe

The 200mm diameter pipe

The pipe being installed was high density polyethylene PE 100, SDR 21. This is also known as HDPE pipe. The pipe is a Carbon-Hydrogen polymer and rated as an environmentally friendly product.

Mark on the pipe

When the pipe recoiled it was covered in drilling mud. As it recoiled it apparently struck Mr Austin creating a 'wipe' mark on the pipe. Testing showed the DNA of Mr Austin was present on the pipe.

The pipe with the wipe mark, showing the point where the pipe is thought to have struck Mr Austin.

The failed two legged chain set

The failed chains

The 10mm chain set used had two legs, each leg was broken. The chain set had a nominal 5.5 tonne Working Load Limit (WLL) based on using the two chains at a 60 degree separation. Each leg of the 10mm diameter high tensile chain used in the incident had a nominal WLL of 3.2 tonnes and a minimum tensile failure load of 12.8 tonnes when used as lifting chain.

The chain set was used to pull the pipe with one leg tied in a clove hitch knot around the pipe and the other leg connected around a bucket tooth.

As the chains were used in a knot and pulled over hard surfaces, an unquantified de-rating of the chain capacity is applicable. The chains would then be expected to fail below the rated failure strength of 12.8 tonnes.

General view of the two leg chain set. Both chain legs were broken.

The excavator

The machine

The machine being used to pull the pipe at the time of the incident was a Caterpillar 320C Hydraulic Excavator. It nominally weighed 21 tonnes, had a Drawbar Pull of 196kN (19.98 tonnes) and a bucket crowd force of 128kN (13.05 tonnes).

It appears the excavator had sufficient capacity, under normal operating conditions, to create enough pull force to rupture the chains.

The Cat 320C excavator at the incident scene.

An overview of Horizontal Directional Drilling

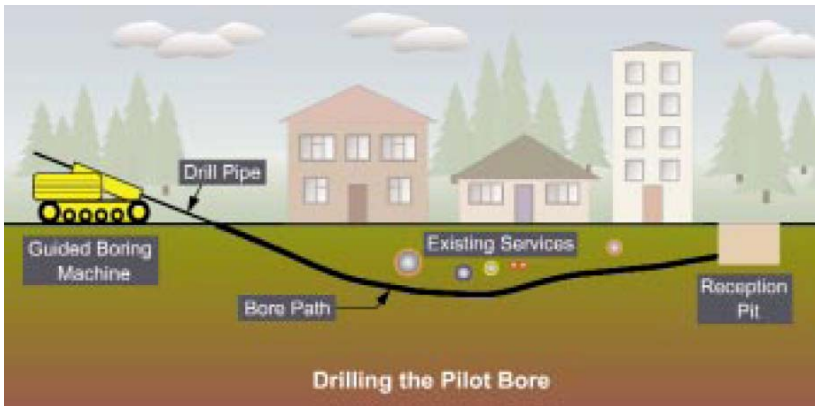
The HDD technology

Horizontal Directional Drilling (HDD) is a technology that was developed over 30 years ago and is now used in many applications of industrial activity.

Its predominant use is in installation of services under the ground in areas where it is difficult, expensive or unacceptable to use conventional methods. Such areas could be highways, water courses, council streets or near services such as fibre optic and power cables.

The HDD method

In the HDD method a pilot hole is drilled using the directional drilling technique that allows control of line and depth. Once the drill string arrives at the reception pit a reaming device is attached and the pilot hole is enlarged as the reaming bit is returned along the path of the pilot hole. The formed hole is lubricated, sealed and its profile maintained using a drilling mud. See diagram below.



The pipeline was towed into the hole

In many instances, the pipeline to be installed, is dragged behind the reamer attached to a swivel. This was the method being used in the activity when the incident occurred at Bohena Creek. The method is illustrated in the below photo.

Showing drill string, reamer and pipeline, about to enter the horizontal directional bore, via the pilot hole exit pit.

The incident occurred adjacent to this pit.

The incident

On 1 August 2009 at about 3:45pm, Mr Austin, a 57 year old subcontractor was struck by a 200mm diameter recoiling Polyethylene pipeline of about 150 metres in length.

The pipeline had previously been pulled into a horizontal directional borehole, behind the reaming head for the bore. The pipeline had been pulled in about 230 metres when the drill string coupling failed, disconnecting the reaming head and the pipeline from the drilling string.

Attempts by the ADDS supervisor to excavate to the reamer in the creek had failed. It was then decided to attempt to pull the pipeline out using the excavator.

Discussions were held about pulling the pipe and the need to keep clear of it. Mr Austin was operating the excavator when pulling on the pipe at the exit pit commenced. The chains had been connected by an ADDS crew member using a clove hitch knot around the pipe and by placing the other leg of the chains around a bucket tooth.

Pulling with the excavator led to the chains breaking near the exit pit. The chains were again attached to the pipe, when pulling recommenced the pipe was crushed by the chains and the pipe was sheared off. Shearing of the pipe was repeated one or more times, leading to Mr Austin suggesting the solution of using a piece of wood.

Then a piece of wood was cut and place inside the pipeline, a better grip with the chain connection was achieved and the pipeline began to move when towed by the excavator.

Showing broken pieces of pipe found near the pit from which the pipeline was being recovered.

The incident occurred adjacent to the entry pit.

The piece of wood that was placed in the pipe was found at the scene next to a sheared piece of the pipeline.

Towing the pipe

Towing using the excavator continued, until about 35m of pipe had been extracted. At this point the ADDS supervisor took over driving the excavator. This was because of the difficulty, Mr Austin had in keeping the excavator straight, while driving backwards.

Mr Austin was instructed by the ADDS supervisor to move to an area he indicated away from the pipeline and he was last seen moving in that direction.

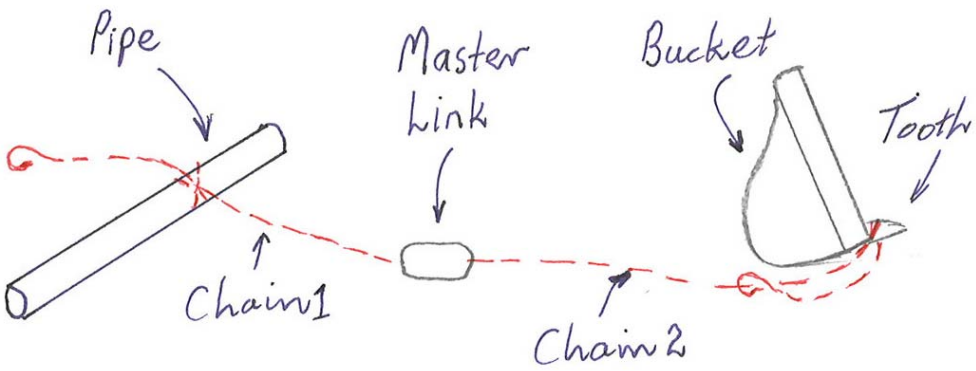
The ADDS supervisor resumed pulling of the pipeline, with directions being supplied by the ADDS crew member. The operation progressed with the pipeline reported to be moving freely. When approximately 150 metres of pipe was outside of the borehole, the chain failed and released the stored energy in the pipeline.

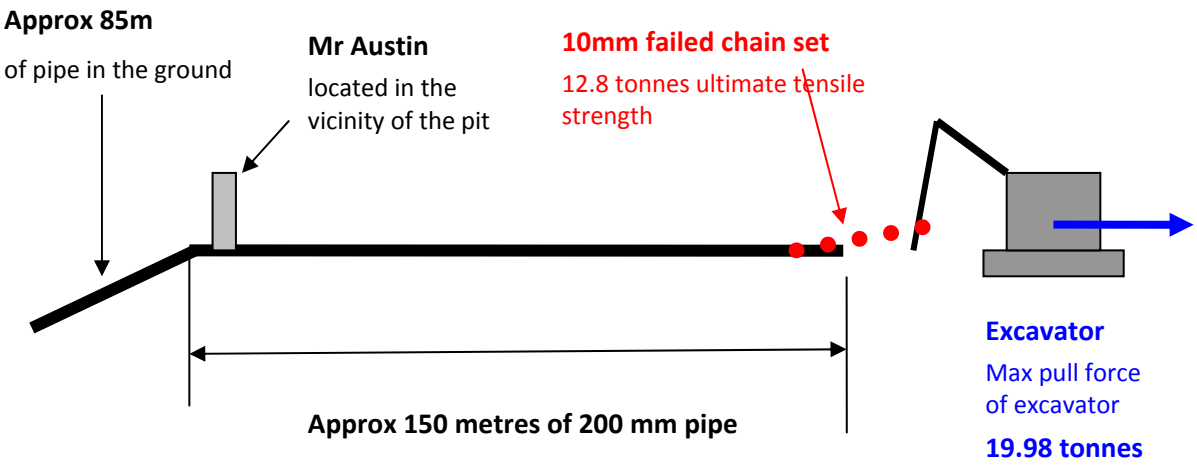
When the pipeline recoiled, it appears it reared up at the pit end and struck Mr Austin who was standing nearby.

The incident was not witnessed and Mr Austin was found lying near the pit a short time later. Those at the scene rang 000 and attended to Mr Austin until the Ambulance arrived at 4:23pm.

Mr Austin was retrieved from the scene with a serious closed head wound and broken jaw. He was initially admitted to Tamworth hospital and later transferred to intensive care at the John Hunter Hospital. Mr Austin died of his injuries on 4 August 2009.

Reported Rigging Method





Diagrammatic representation of the incident – not to scale

The deceased person

Name	Bruce Henry Austin
Age at time of incident	57 years
Occupation at time of incident	Director and Operator of the Company 'The Saver Guys Pty Ltd', a trucking business.
Relationship with ESG:	Sub-contractor
Date of incident:	1 August 2009
Time of incident:	Approx 3:45pm
Nature on injuries:	The autopsy found a cerebral haemorrhage, haemorrhage around the upper spinal cord, a broken jaw, an injury and laceration involving the left earlobe and a bruised scalp.

The investigation

Investigation methodology

The lines of inquiry

Lines of inquiry followed during the investigation included:

- Documenting the scene by way of notes, photos and survey
- Collection and examination of exhibits.
- Interviews with persons present at the scene as well as company representatives
- Document collection from companies involved

- Obtaining equipment information, concerning the excavator, the chains and the pipe
- The company safety systems applicable and the actual system of work used at the incident site

Department inspection of the incident scene

The investigator and other Department officers attended the site of the incident on 3 August 2009 and inspected and documented the scene.

Exhibits

A number of exhibits were taken and examined during the investigation, this included the two legged chain set and sections of polyethylene pipe.

Documents

Company documents relevant to the incident were collected and examined during the investigation. The priority was given to documents relating to safety and safety systems

External report on chain set

The Two Legged 10mm Chain Set

The chain set was found to consist of components with a WLL rating of 3.2 tonnes with the Master Link rated at a WLL of 5.5 tonnes. The chain set is designed with a factor of safety of four. This means the minimum breaking load of the chain is 12.8 tonnes.

It was evident that the two chain legs had failed. The report identified stretching (overload), of the chains as well as scuffing and marks on the chain, consistent with the chains being used while touching other metal objects, such as the chain or a hook.

The report found in summary that "*.. both legs had suffered tensile overload fracture failure. …Surface damage, suggestive of metal to metal contact was present on the chain links, possibly indicating that the pinlok latch hook had been choke hitched at the fracture location.*"

Training and guidance material

Training and competency on the excavator

There were three persons associated with excavator activities at the incident site, they all held an OHS certificate for excavator operation.

The training and assessment for an excavator certificate, includes safe load lifting guidance and requirements but it does not cover safe methods of pulling or towing objects

Lack of guidance on 'pulling' methods

A review of available literature, found there is very little practical guidance on establishing pulling systems. This is in marked contrast to the body of information available for crane and load shifting operations.

It would appear that persons, wishing to engage in pulling or towing operations, currently need to devise their own systems from first principles in a way that will ensure the safety of relevant persons.

Pulling loads is a common activity in mining, agriculture and industry generally. It is not an activity that is readily managed by applying lifting data and guidelines or by applying ad hoc arrangements.

Findings

Primary cause was proximity to a hazard

The primary cause of the incident was creation of a recognized hazard, (pulling on the pipe with chains and an excavator), in the absence of suitable barriers (or other controls such as an observer), to prevent a person being placed at risk, by coming into proximity of that hazard.

Risk Assessment was incomplete

Information was provided of a verbal risk assessment, recognition of the need for risk controls and verbal instructions to Mr Austin, to move away from the hazard.

Such a risk assessment should have been documented with clear risk controls indentified and defined actions implemented.

ADDS OHS system not applied

ADDS had a documented OHS system. That system did not specifically cater for the pipe pulling exercise, importantly it did have tools that if applied could have properly addressed the risk and prevented the incident.

ESG OHS system did not control the risk

ESG had a documented OHS system. Their OHS policy stated that all injuries are preventable. The OHS system, principally through induction, appeared to rely on contractors being aware of their duties and ensuring these were carried out.

ESG does not appear to have taken measures, to ensure ADDS was operating in accordance with its OHS system.

No guarding

There was no physical guard or barrier to define the 'No Go' area people were not to enter. Mr Austin had no clear physical indications of the area he must avoid to prevent him coming into proximity of the pipeline hazard.

System of work, information, instruction and supervision

The system of work being used to recover the pipe, did not control the hazards, it actually created some. The system of work did not ensure the safety of those using the system, or in the vicinity of the work.

Mr Austin was not subject to any supervision by ADDS at the time of the incident.

Risk realised

The risk of a person being struck by a recoiling pipe was realised when the chains attaching approximately 150 metres of pipe to the excavator became overloaded to the point of failure.

Deficient work practices

Deficient work practices identified were:

- No Safe working zone established or enforced
- Use of an excavator for a purpose other than which it was designed ie towing or pulling.
- Use of an excavator to apply unknown forces well in excess of the WLL of the chains.
- Use of chain set for purpose other than designed
- Exceed the rated load on the lifting chains
- Place a knot in the lifting chains
- Connect the chains to a bucket tooth on the excavator
- Incorrect attachment to the pipeline

The proper course of action

ADDS found themselves in a situation that required that, they choose to either abandon the pipe left in the ground or attempt to recover it.

If recovery was to be attempted, a safe system of work should have been devised, that enabled the work to be conducted without exposing persons to risk.

Guidance materials need to be developed

It would be beneficial for employers and operators if guidance materials were developed to assist them in planning to conduct pulling / towing work in a safe manner.

Persons conducting pulling operations may devise ad hoc systems, in the absence of guidance material.

It may be impractical to expect each operator to have the skills, or to engage the competent persons, necessary to properly devise safe pulling systems.

The precedence exists for regulators and industry associations to provide such guidance material.

Preventing a recurrence

Preventing the incident

The risk of this incident occurring, could have been significantly reduced, by ensuring compliance with the OHSA Regulation, clause 11 and 5. The clauses respectively require elimination/ control of risks and specify a hierarchy of control of risk by way of elimination, isolation, engineering controls, administrative controls and PPE.

The risk of the pipeline in tension, was foreseen, this risk could have been mitigated by:

- Abandoning the pipe and redrilling the hole
- Ensuring use of known forces, in conjunction with the known WLL of components, so overloading could not occur
- Setting up an exclusion, or safe working zone, around the pipe and assigning a person to supervise it
- Minimising the length of the pipe being pulled at any time, hence reducing the stored energy and the potential of the 'whipping' effect of the pipe
- Use of equipment only for its intended purpose and within design specifications

On a systemic basis the risk could have been mitigated by:

- Application of Chapter 8 of the OHSR, which requires, appointment of a principal contractor, an OHS management plan, use of Safe Work Method Statements and monitoring
- A Code of Practice, provided by the Horizontal Directional Drilling industry, to inform participants of considered methods for dealing with pipeline problems, such as those encountered at the incident site
- Application of a Contractor management plan by ESG, to ensure ADDS had appropriate systems in place and was applying those systems at the incident site
- Application of the guidance to be found in MDG 5003 - Guidelines for contractor OHS management for NSW mines

Actions after the incident

Action taken by ADDS

Immediate action	Mr Austin was found lying on the ground soon after the chain pulling the pipe snapped. He was rendered first aid, while emergency services were contacted for assistance.
Suspension of operations	Following the incident ADDS withdrew from the contract with ESG and removed its equipment from site.
Procedures manual	ADDS continued its process of introducing a certified system of Quality Management to meet ISO9001 and ISO14001. A Safe Work Method Statement (SWMS) was developed for the risks associated with retrieval of damaged or broken drill string or pipeline. ADDS developed a job pack that goes with the crew to each worksite.
Dissemination of information	ADDS personnel were made aware of the hazards of pipe towing as well as being provided updated information on an ongoing basis.
Equipment	ADDS decided, not to manufacture any components for themselves and indicated to suppliers that it required items, such as couplings, to be made to the highest possible standards.

Action taken by ESG

Immediate actions included

- ESG despatched their safety officer to the site. He proceeded to the incident site accompanied by those present at the time of the incident
- The site was secured using star pickets and orange barrier meshing across the entry road. The Police attended the scene, after the ambulance had left from the highway. The police collected information, took measurements and the failed chain set
- ESG provided a report of the incident to the Department in accordance with the Petroleum Onshore Act 1991
- ESG instructed all ESG staff to only use chains for their proper purposes and to ensure all chains were in date and certified. Any non certified chains were to be removed from site
- Contractor requirements were reinforced and strengthened
- Contractor monitoring was introduced including reporting of all incidents

OHS System

All procedures were reviewed, additional procedures developed and training and re-training conducted

Longer term measures introduced

- A Safety Manager was appointed at ESG
- All contractors were required to complete a pre-qualification check
- All contractors were to supply detailed Safety Management Plans and JSA's for the tasks required

- Contractor safety inspections
- Provision of an ESG construction supervisor
- Development of an ESG Surface Engineering Safety Management Plan
- Regular safe work observations of construction activities
- Use of new training management software
- Development of a personal risk assessment process called 'Challenge'
- Development of "Proact" – an ESG specific safety management system

Action taken by the department

Investigating the incident

The Investigation Unit conducted a scene assessment on 3 August 2009 and carried out a detailed and thorough investigation into the incident.

Liaison with the family of the deceased

The Investigation Unit met with the family of Mr Austin on a number of occasions. These interactions explained the investigation process, the basic circumstances of the incident, likely timelines and the possible coronial process.

A visit to the site of the incident was arranged for the family.

Safety Alert and Bulletin released

The Department issued safety alert *SA09-10-Directional-boring-fatality* warning industry of the incident and recommending

- Systems for ensuring safe operation in directional boring activities,
- Documented safe work procedures
- Consideration for the understanding loading forces and providing safeguards against the release of uncontrolled energy
- Review of the use of chains for pulling/snigging (to drag along the ground by a chain fastened at one end).

The department also released safety bulletin *SB09-03-Broken-pull-chain-results-in-fatality* recommending all mines should review current towing, pulling and snigging standards (activities). The bulletin provided a range of factors to be considered in doing so.

Industry Associations

The investigation contacted several industry associations, suppliers and contractors seeking Codes of Practice or other guideline information they may have relevant to the incident.

Following contact with them, two association took action:

- The Australasian Society for Trenchless Technology (ASTT) published on its website its *Standard for Horizontal Directional Drilling*, and
- The Pipeline Industry Association (APIA) undertook to develop a Code of Practice for installation of HDPE (High Density Polyethylene) pipelines.

Identified Gaps in Standards or Codes

The investigation identified that an apparent gap existed with Australian Standards and published industry Codes of Practice relating to HDPE applications related to trenchless boring techniques.

The Department is liaising with, and providing input to, efforts to produce a Code of Practice for the installation of these pipelines, particularly with respect to the Coal Seam Gas industry.

The Department is also reviewing opportunities to improve the current legislation applicable to Onshore Petroleum activities.

Related Published Resources

Further Information

The Department has published several safety alerts and other information regarding chains, stored energy, mobile plant and changed work practices that are relevant to this incident:

I&I NSW Safety Alerts and Bulletins

- SB07-10 Hazardous energy control
- SA05-01 Changed work practices employer obligations
- SA04-09 Broken chain connector results in serious injury
- SA04-05 Crane dogger killed while unloading trailer – updated
- SA03-10 Crane dogman killed unloading trailer
- SA00-01 Serious injury involving stored energy

Mine Safety Operations publications

- MDG 1010 Risk management handbook
- MDG 40 Guideline for hazardous energy control-isolation or treatment
- MDG 5003 Guidelines for contractor OHS management for NSW mines
- MDG 5004 A study of the risky positioning behaviour of operators of remote control mining equipment

Other

Inadequate Energy Dissipation and Isolation is listed on the Department's internet site as a mechanical engineering key risk (*Mechanical engineering key risks*: http://www.dpi.nsw.gov.au/minerals/safety/resources/mechanical/key-risks). The risk of stored energy was present during the task being undertaken at the time of the incident.

Risk management is listed on the Department's website as a key process at http://www.dpi.nsw.gov.au/minerals/safety/resources/risk-management requiring a management system and work process practices. The latter includes

- competent people
- fit for purpose equipment, and
- safe work practices

These issues should have been addressed in the planning and assessment of the task being conducted at the time of the incident.

Safety tools are provided on the Department's website at

http://www.dpi.nsw.gov.au/minerals/safety/resources/tools One of the tools supplied concerns Human Error. This tool is applicable to the manner of this incident.