



# **DSI UNDERGROUND**

## **RISK ASSESSMENT ON**

### **TRANSPORT, HANDLING AND APPLICATION OF**

### **STRATA BOND HA AND MINERAL BOND LV POLYMERIC INJECTION RESINS**

**JULY 2017**

**REPORT**

**ISSUE DATE 09.04.2018  
VERSION No.: 04**



---

Transport, Handling and Application  
of  
**Strata Bond HA & Mineral Bond LV  
Polymeric Injection Resins**

in  
Underground Coal Mines

**Risk Assessment**

Report

---

**Client:** Ian Yates, DSI  
**Report by:** Sally McPhee  
**Issue Date:** 9th April, 2018  
**Version No:** 04



**JIM KNOWLES GROUP**

Consultants in Occupational Health, Safety and Risk Management



## TABLE OF CONTENTS

FOREWORD .....	3
DOCUMENT CONTROL .....	3
1. RESULTS OF THE RISK ASSESSMENT	
1.1 Summary of Actions.....	4
1.2 Summary of Controls for Principal Hazards .....	5
2 INTRODUCTION	
2.1 General Background to the Risk Assessment .....	6
2.2 Context of the Review.....	6
2.2.1 Risk Management Context .....	6
2.2.2 Corporate Context .....	7
2.2.3 Strategic Context .....	7
2.3 Conduct of the Review.....	7
3 SCOPE & OBJECTIVES	
3.1 Scope.....	8
3.1.1 Scoping Meeting .....	8
3.1.2 Scope of the Review.....	8
3.2 Objectives of the Review .....	9
3.3 Description of the Materials .....	9
3.3.1 Strata Bond HA:.....	9
3.3.2 Mineral Bond LV:.....	9
3.3.3 Chemical containers and handling .....	10
3.4 Description of the Processes.....	10
3.4.1 Strata Injection Application .....	10
3.4.2 Job Steps Included .....	12
3.4.3 Levels of Training .....	13
3.5 Issues to be Considered .....	13
3.6 Assumptions / Conditions .....	13
3.7 Points of Note .....	13
4 METHOD OF APPROACH	
4.1 The Work of the Risk Assessment Team .....	15
4.1.1 Team Members of the Original Review .....	15
4.1.2 DSI Review Team Members.....	17
4.2 Review Method .....	18
4.3 Risk Ranking Criteria and Matrix .....	18
4.4 Controls.....	20
4.4.1 Safety Standard to be Achieved .....	20
4.4.2 Hierarchy of Controls.....	20
4.5 Risk Tables .....	21
4.5.1 Risk Table in Job Order.....	22
4.5.2 Risk Table in Risk Rank .....	32
APPENDIX 1 - EQUIPMENT PICTURES.....	42
APPENDIX 2 - SIGNED ATTENDANCE SHEET .....	45
ACKNOWLEDGEMENTS .....	46
REFERENCE DOCUMENTS .....	46

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	2



## FOREWORD

The Jim Knowles Group was engaged by DSI Underground to assist with the development of Risk Assessment on the application of Strata Bond and Mineral Bond LV polymeric injection resins for use in underground coal mine strata stabilisation and ventilation structure applications. DSI is seeking to gain a licence for the application of polymeric resins in underground coal mines in NSW and Queensland.

The Facilitator is an independent person within the team who assists the team through a systematic process of risk assessment, which is structured to meet guidelines of Australian Standard AS/NZ ISO 31000:2009. They maintain team focus on the scope and objectives while providing expert guidance where required. They document both the assessment process and outcomes.

This document is the report of the risk assessment reviews conducted on the application and handling of the DSI Strata Bond and Mineral Bond injectable resins and their component chemicals. The review was conducted over two sessions on 8th June and 28th July, 2017 at the DSI training rooms at Gateshead, Newcastle, NSW. This report was prepared by Sally McPhee of the Jim Knowles Group of Consultants.

### JIM KNOWLES GROUP

Consultants in Occupational Health, Safety & Risk Management

#### HUNTER VALLEY OFFICE

LHBEC Offices, Barton Street, Kurri Kurri  
PO Box 113, Kurri Kurri, NSW, 2327  
Phone: (02) 4937 5855  
Fax: (02) 4937 5844  
Email: sally.mcphee@jkggroup.com.au

## DOCUMENT CONTROL

Version Number	Date of Issue	Reason for Issue	Authorised by
00	15.06.17	Working table developed	SMcP
01	31.07.17	Preliminary results from second workshop issued for comment	SMcP
02	15.08.17	Report issued	SMcP
03	05.09.17	Additional team member background added	SMcP / IY
04	09.04.18	Addition of document / procedure numbers	SMcP / BL
05			

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	3



## 1. RESULTS OF THE RISK ASSESSMENT

### 1.1 Summary of Actions

The following is a summary of recommended additional actions to improve control and reduce the risk of hazards identified in the risk assessment.

No	Ref No.	Initial Risk	New / recommended Additional Controls	Action By	Due Date
1	8.7 8.8	6M	Define and develop levels of PPE required for access to ZOO in consultation with Occupational Hygienist <ul style="list-style-type: none"> <li>o Additional PPE packs to be provided for mine officials visiting the ZOO as required</li> <li>o Include in JSA</li> </ul>	I Yates	
2	8.7 8.8 8.9	6M	Health Monitoring regime for operational personnel in accordance with Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 <ul style="list-style-type: none"> <li>o Part 3 Health monitoring</li> <li>o 109 Health monitoring of worker</li> </ul>	I Yates	
3	2.2	5M	Include checking of transport compliance in contractor's checklist	W Edwards	
4	8.1	5M	Include auditing requirements for contractor supplied equipment in Contractor prerequisite checklist and audit system (maintenance)	W Edwards	
5	8.2	4M	DSI to develop and implement Fatigue Management Plan for Polymeric Resin applicators	I Yates	
6	2.3	3L	Information on safe storage and disposal to be provided to mine site	W Edwards	
7	11.1 11.2	3L	Procedure to be developed for safe disposal and return of chemical containers	W Edwards	

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	4



## 1.2 Summary of Controls for Principal Hazards

There were no hazards identified by the team as being 'extreme'. The hazards which could be deemed to be the principal hazards can be considered as those that have major or catastrophic consequences.

In this case there was only one hazard which was assessed as having major consequences (Major 4 - see below). Existing controls were considered adequate to control the risk to an acceptable level, no additional controls were considered necessary.

Item No.	Potential Incident, Hazards	Initial Risk	Existing Controls	Residual Risk
8.5	Excess PUR injected into coal produces overheating greater 150°C - potential ignition of coal	6H	<ul style="list-style-type: none"> <li>PUR product has been pretested and approved to NSW DPI standards and German Loba testing. (heat generated &lt; 150°C)</li> <li>Chemicals include fire retardants to NSW DTI standard</li> <li>Quantities monitored directly from IBC level reader, holding tanks requires for 20L drums</li> <li>Fire fighting equipment at injection site and transfer pump site</li> <li>Single piston purpose designed pumps (ratio 1:1)</li> <li>Injection Report Pumping DSI Resin No: GC_FRM - 0401</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> </ul>	5M

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	5



## 2 INTRODUCTION

### 2.1 General Background to the Risk Assessment

DSI Underground is applying for licences from the NSW Department of Trade and Industry (NSW-DTI) for the application of their polymeric injection resins in NSW and Queensland underground coal mines. Such activities have special classification in NSW under subclause 149(1) of the Coal Mine Health and Safety Regulation 2006, and require specific licensing approvals.

The products for which the application will be made are:

- ⇒ Strata Bond HA (polyurethane resin or PUR)
- ⇒ Mineral Bond LV (urea silicate resin or USR)

This risk assessment was conducted as part of the licencing application process and the results will form part of the licence application submission to the NSW-DTI.

Prior to the conduct of the review workshop, a scoping discussion was held between Ian Yates (DSI) and Sally McPhee of the Jim Knowles Group to determine the scope, method and resources required. This information, together with details of the risk assessment team, was provided to the NSW DTI Mining officers, prior to the review sessions.

The review was undertaken as a combined exercise for both materials. Although they are different chemically, the equipment and many of the job steps are common to all three processes. Accordingly it was considered appropriate to examine both the PUR and USR injection products together.

This review built upon a risk assessment on Polymeric Injection Resins recently conducted, jointly between DSI Underground and one of its partner independent applicators. The review used those results and revised and updated them in view of the changed scope. That is with DSI as the principal contractor seeking the licence rather than as chemical supplier only. In this case DSI would either carry out the work themselves or engage sub-contractor applicators who would carry out the work under their supervision.

This report is a record of the process, method and results achieved by the workshop team on 8th June and 28th July, 2017. The sessions were held at the DSI training rooms at their facility in Gateshead, Newcastle, and NSW.

### 2.2 Context of the Review

#### 2.2.1 Risk Management Context

The process followed in this review was based on the DSI Risk Management Procedure. This procedure is consistent with the requirements of the NSW DPI MDG1010 Guidelines for Risk Management and Risk Assessment and as well as the Australian / NZ Standard for Risk Management AS/NZ/ISO:31000:2009.

The results from the risk assessment will be used to ensure all controls including practices and procedures, are adequate for the identified risks.

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	6



## Risk Assessment Report for Strata Bond HA & Mineral Bond LV Polymeric Injection Resins

Additionally it defines the controls and conditions necessary to ensure the safe handling application and management of the materials, at any 'generic' location.

The Risk management process is one of on-going assessment, control, monitoring and review. It is a dynamic system, which should be part of an overall risk management process.

### 2.2.2 Corporate Context

The primary objectives of this policy and the Risk Assessment are to provide the framework for both DSI to:

- a. Identify hazards that may expose employees, subcontractors, mine personnel or other persons to an unacceptable level of risk.
- b. The development and implementation of controls that will ensure that hazards are adequately controlled according to the level of risk and reduce that risk to as low as reasonably practicable
- c. To fully comply with all relevant legislation.

The conduct and the results of the risk review will meet the requirements of both the DSI risk management plan and procedures.

### 2.2.3 Strategic Context

The review seeks to identify and prioritise any potential hazards that may be present with the application of DSI Polymeric injectable resins used for strata stabilisation in underground coal mines in NSW.

The risk assessment results will form part of the licence application for both the PUR and USR materials. Stakeholders who will use or review the results include:

- ⇒ NSW DTI Mining
- ⇒ Mine management
- ⇒ Mine workers
- ⇒ Applicators (DSI contractors)
- ⇒ Suppliers and distributors (DSI)

The results of the review will be used to ensure management plans for the safe handling and application of the materials are in place and implemented at all levels in the supply and application process.

## 2.3 Conduct of the Review

The review was conducted as a series of facilitated group reviews and workshop sessions. The review was based on a previous risk assessment conducted jointly with DSI and an application contractor. The previous risk assessment team had included a chemist and chemical hygienist, however they while not present at this review, were available by telephone for consultation if required. (refer Item 4.2 Team Members)

The scope and objectives for this review were discussed and confirmed by the team including, the application process and nature of the chemicals.

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	7





## 3 SCOPE & OBJECTIVES

### 3.1 Scope

#### 3.1.1 Scoping Meeting

The scope of the risk assessment was discussed between Ian Yates (DSI) and Sally McPhee (JK Group) prior to the workshop. At this session, the scope, resources and workshop participants were agreed. This information, along with a detail list of anticipated team members, was provided to the NSW Department of Trade and Industry - Mining, for approval.

In this case, a previous risk assessment conducted jointly between DSI Underground and an application contractor on the DSI injectable resins (Strata Bond and Mineral Bond), was used as a framework for this analysis

#### 3.1.2 Scope of the Review

Specifically the scope of the exercise is to:

*Examine the hazards related to all aspects of the transport, delivery, storage and application of DSI 'Strata Bond HA' (PUR) and 'Mineral Bond LV' (USR) in underground coal mines in NSW and Queensland. Risks to personal safety and health will be the principal hazards considered when identifying hazards and loss scenarios, however other loss scenarios may also be considered.*

##### Application situations considered:

- ⇒ Injection of 'Strata Bond HA' (polyurethane resin or PUR) and 'Mineral Bond LV' (urea silicate resin or USR) for:
  - Working face stabilisation
  - Stabilisation of outbye roof or ribs
  - Water or gas stopping

##### Inclusions:

Issues or activities specifically **included** in the review were:

- ⇒ Transport of chemicals to site
- ⇒ Site storage
- ⇒ Transport underground of materials and equipment
- ⇒ Equipment setup and operation
- ⇒ Injection of both products into strata
- ⇒ Cleanup and demobilisation'
- ⇒ Transport equipment etc back to surface.
- ⇒ Removal from site and disposal
- ⇒ Supervision of subcontractor applicators when applicable

##### Exclusions:

Issues or activities specifically **excluded** from the review were:

- ⇒ Mine site specific risks (e.g., terrain, local conditions)
- ⇒ Manufacture of materials
- ⇒ Associated activities not directly involving the chemicals such as drilling of injection holes

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	8



## 3.2 Objectives of the Review

The objective of the review is to provide a 'generic' risk assessment of the potential hazards involved with the supply and application of the materials. From this, it is anticipated that there will be recommendations for changes or improvements to plant and equipment as well as formulating of safe work procedures, based on the actual risks identified. Health and safety will be the principal loss scenarios considered, however potential hazards associated with environmental impact and potential cost or production impact will also be considered.

## 3.3 Description of the Materials

### 3.3.1 Strata Bond HA:

The DSI Strata Bond is a polyurethane resin used for injection strata binding. It is similar in chemical composition and product properties to several other PUR materials already in use in Australian mines.

The product consists of two parts - Parts A and B - mixed in a 1:1 ratio. It cures to a strong binding material. The chemical reaction is exothermic, in testing during curing the maximum curing temperature was between 110°C to 120°C (see Arnsberg permit). This may increase depending on volume. Carbon dioxide is given off during curing and the product foams slightly with an expansion factor of 3:1. The mixed chemical has lower viscosity than existing materials giving it slightly improved penetration. It may react with water during curing.

The material has been approved for use in Australia having the same fire characteristics as existing products already approved.

For more information, refer to SDS for chemicals in appendices of this report.

### 3.3.2 Mineral Bond LV:

The DSI Mineral Bond is a Urea Silicate resin, also used for injection strata binding. And again it is similar in chemical composition and product properties to several other Urea Silicate materials already in use in Australian mines.

The product consists of two parts - Parts A and B - mixed in a 1:1 ratio. It cures to a strong binding material. The chemical reaction is exothermic, however in testing during curing the heat developed heat is below 100°C regardless of the volume. The DSI product has slightly improved performance characteristics (improved adhesion) when compared to similar products already in use, while maintaining the desirable low heat and low vapour emitting characteristics.

The material has been approved for use in Australia having passed the fire and static testing requirements.

For more information, refer to SDS for chemicals in appendices of this report.

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	9



### 3.3.3 Chemical containers and handling

All the component chemicals for all the products will be supplied in either 20 litre drums or 1,000 litre IBC containers. All component chemicals are classified as hazardous (not dangerous).

#### Twenty litre containers

The 20 litre containers will be either metal drums or plastic containers (depending on chemical) and are designed to facilitate manual handling by limiting weight. The volume of chemical in the drums will be reduced to limit the maximum weight of the containers to 24kg.

The drums are packed on to pallets which are bulk handled into or out of the underground transport pods by forklift. When the chemical is consumed underground at the pump site, the drums are individually handled by the pumping crew and decanted into holding tanks on the pump pod.

If required, large quantities of drums may be transported underground in sealed pods. Otherwise smaller numbers may be transported individually.

Small containers of chemicals will only be used where access prohibits use of IBC containers. This minimises manual handling required and personal exposure to chemicals.

#### IBC 1,000 litre containers

Each IBC has a discharge valve at the base and a vented cap on top. The IBC's will be connected directly to the injection pump.

Design of the IBC containers has been developed and improved to allow better control and monitoring of chemical usage.

In general IBC containers are transported underground in sealed pods, large enough for two containers. IBC pods may also be transported individually using an LHD or dolly car as is usual for other fluids used underground. (such as hydraulic oil) The IBC's are of a robust manufacture which has been found to be highly resistant to mechanical damage.

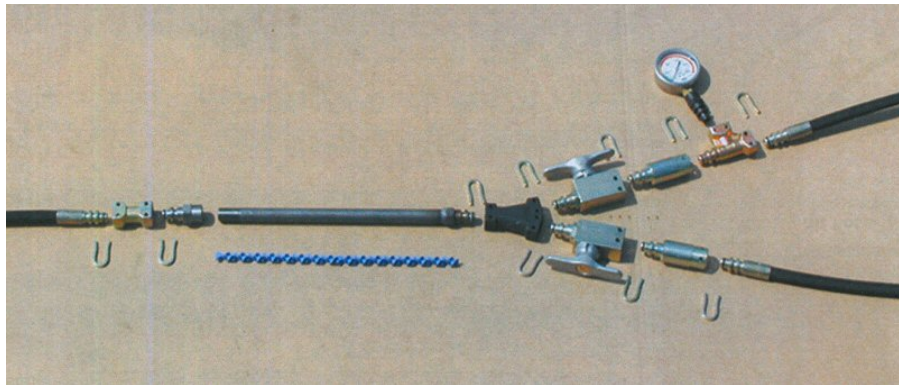
## 3.4 Description of the Processes

### 3.4.1 Strata Injection Application

The material is injected into strata using low to medium pressure, by connecting to self sealing packers inserted into pre-drilled holes. Operators are located at the pump pods and at the injection point. Raw materials (A & B) are pumped through separate hoses which are connected at the mixing handpiece. They are combined in a ratio of 1:1 through a mixing nozzle as it is injected into drilled holes.

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	10



*Injection nozzle assembly*

The pump configuration and Zone of Operation (ZOO) may vary according to the circumstances of the particular application.



**Equipment used in Strata Injection Application:**

Application Site:	Packers Spiral Mixing Assembly Injection lance Hoses
Pump Site:	Chemical pods (IBC or 20 ltr drums) IBC chemical containers Pump pods including pumps and holding tans (if used) Hoses and hose pods Hose accessories (valves/taps etc.)

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	11



## Risk Assessment Report for Strata Bond HA & Mineral Bond LV Polymeric Injection Resins



*Example of new design pump pod*

Additional equipment photographs and diagrams may be found in Appendix 1 of this report.

### 3.4.2 Job Steps Included

- ⇒ Delivery of chemical to mine site by DSI
- ⇒ Storage of chemicals at mine site
- ⇒ Handling on surface
  - \* Receiving / unloading
  - \* Replenishing pods
  - \* Either 20 ltr drums or IBC's
- ⇒ Transport underground (by mine personnel)
- ⇒ Storage and handling underground
- ⇒ Set up and run out hoses
- ⇒ Apply products
  - \* Strata injection
  - \* Longwalls, development, outbye
- ⇒ Replenish chemical
- ⇒ Clean up and pack up
- ⇒ Stand-down between repeat applications
- ⇒ Return equipment, used containers and residual chemical to surface
- ⇒ Remove from site – empty / partially filled containers
- ⇒ Disposal of used containers

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	12



### 3.4.3 Levels of Training

The following levels of training will be provided to personnel associated with the application process:

- Level 1 Familiarisation – any personnel who will come in contact with the product
- Level 2 Trainee Operator
- Level 3 Operator
- Level 4 Supervisor (based on practical experience and aptitude)

### 3.5 Issues to be Considered

- ⇒ Spillage both on the surface and underground
- ⇒ Manual handling - container sizes and equipment
- ⇒ Nature of chemicals / exposure of personnel to chemicals and cured product -contact inhalation etc
- ⇒ Skills and training of operators and mine personnel
- ⇒ Application of Safe Work Procedures
- ⇒ Heat developed during curing etc
- ⇒ Mine environment hazards (strata failure etc.)
- ⇒ Consideration of factors of safety during application (personnel exclusion zones etc.)
- ⇒ PPE requirements
- ⇒ Management of subcontractor applicators

### 3.6 Assumptions / Conditions

- ⇒ The conditions and requirements of the Loba 'Arnsberg Permit' shall be complied with.
- ⇒ Mine manager's rules regarding ventilation, traffic management, operation of mobile equipment and isolation will be complied with

### 3.7 Points of Note

Over time, improvements to the chemistry, equipment and procedures have been put in place, which serve to minimise and in some cases eliminate identified hazards. Inclusion of these engineering and system improvements have led to an over general reduction in the level of risk assessed.

These include but are not limited to:

- ⇒ Use of IBC's to minimise manual handling and exposure to component chemicals. Twenty litre drums are only used in exceptional circumstances where access may be limited.
- ⇒ Direct connection of IBC's to the chemical pump, which eliminates the use of open topped 'holding tanks'. This again minimises exposure of persons to the chemicals or chemical vapours.

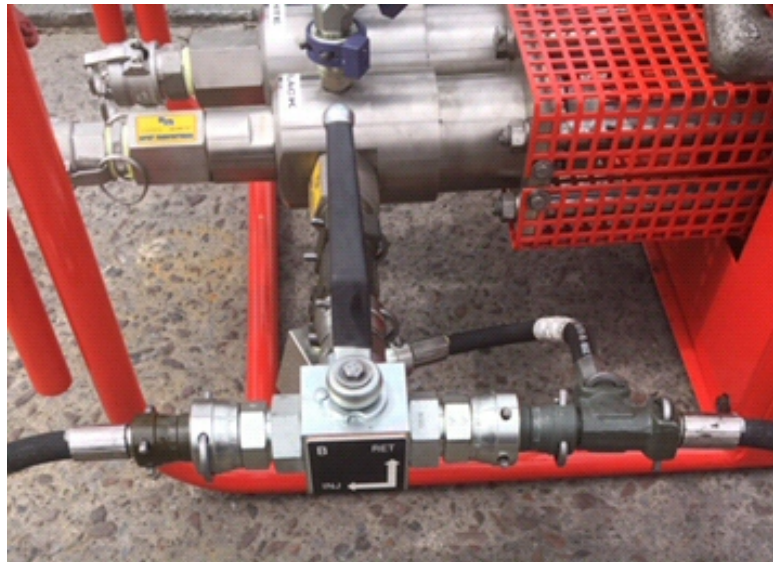
Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	13



## Risk Assessment Report for Strata Bond HA & Mineral Bond LV Polymeric Injection Resins

- ⇒ Pre-polymerisation of the chemicals which minimises heat developed during the reaction and also the production of reaction gases.
- ⇒ Addition of an automatic three-way valve at the pump which controls the hazard of over-pressurisation of the system. Previously this required manual control of two valves, the new valve eliminates the possibility of human error



- ⇒ Chemical pods have been re-designed to easily accommodate mechanical loading of either IBC's or 20 litre drums on pallets. They include safety features to eliminate or minimise injury to persons (e.g. lightweight lids with mechanical stays).



Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	14



## 4 METHOD OF APPROACH

### 4.1 The Work of the Risk Assessment Team

A key factor in the effectiveness of an exercise is the availability of relevant information and expertise. This is addressed mainly through the group workshop. Group workshops recruit the knowledge and experience of a group of people who are familiar with a particular work situation.

The role of team members is to provide their expertise, experience and technical knowledge, and to respect that provided by others. Outcomes are critically dependent on the team as a whole providing a balanced view at a level of expertise appropriate to the nature of the subject under Assessment. The experience and expertise of the team, together with the quality of facilitation, are crucial factors in the quality of the results derived.

#### 4.1.1 Team Members of the Original Review

The original review which forms the basis of the risk assessment for Polymeric Injection Resins was a joint exercise between DSI Underground and Techserve. That review was undertaken to support Techserve's submission to be granted an application licence for the product.

In turn, that original or base risk assessment used information from an earlier review conducted jointly with DSI and Mastermyne. There were a number of team members who participated in all three reviews and the experience and expertise of the group were similar.

The first DSI-Mastermyne risk assessment included Harald Bode, Senior Chemist from Willich in Germany. While he did not attend subsequent sessions, his expert advice was used throughout all three reviews.

Name	Title	Qualifications/Experience
Ian Yates	DSI Manager Ground Control Services	27 years experience with resin injection products, 2 years BASF , 25 years as principal owner for Ground Consolidation Regional Manager Asia Pacific, Ground Consolidation, MEYCO Underground Construction
Anthony Runge (part time)	DSI - QA and Safety Manager	OHS and Quality Systems training (DSI) Implementing Quality Management System Internal Auditor. Employed as an Industrial Services Technician at Mobil Altona refinery (Vic) as a member of their industrial services team, and as a specialist for Maintenance Shutdowns throughout Australia.

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	15





## Risk Assessment Report for Strata Bond HA & Mineral Bond LV Polymeric Injection Resins

Name	Title	Qualifications/Experience
Michelle Mathwin (part time)	DSI - Product Quality Standards Engineer	Associate Diploma Metals Technology (Metallurgy); Cert IV Business Frontline Management; Internal Quality Auditor/Quality Management Systems ISO9001; ICAM Incident Lead Investigator; Partial Six Sigma training. Quality Coordinator, responsible for quality management system including customer complaints and internal non-conformances. Assisted with Safety and Environmental systems including auditing, procedure development and reporting Laboratory supervisor, NATA signatory and NATA representative for Mechanical Testing Laboratory. Conduct of Root cause analyses, risk assessments, statistical analysis and process improvement.
Brian Letham	DSI Underground – Operations Co-ordinator	11 years experience as miner and deputy in underground coal mining and resin injection with Minova, UGM and Xstrata. 8 months with DSI
Wayne Edwards	DSI Underground – Operations Manager	20 years mining experience as miner, longwall installation and polymeric strata stabilisation with Minova and DS!
Warwick Lidbury	Lidco Services - Principal	Bachelor of OH&S Newcastle Univ. Mine surveyors Certificate of Competency, Mining Certificate, 1st Class Certificate of Competency (Underground Mine manager) NSW and Queensland, 3rd and 2nd class certificate of Competency , SSE certificate Qld. 40 years underground and open cut mining experience.
Darcy Prinsloo	Techserve - Quality Control Manager	MBA 2004 (Central Queensland University), Bach of Industrial Eng (Honours) 1993 (Univ of Pretoria), Bach of Industrial Eng1990 (University of Pretoria), 13 years mining experience (Aust.)
Rob Williams	Tolk Group – Production manager	11 years experience with mining projects and polymeric injection (RUS Mining), 4 years with Techserve
John Harris	Techserve – Resin Technician	30 years experience with mining services including resin injection, cementitious products including training and product support. BASF and RUS Mining prior to Techserve.
Pater Devey	HOH Occupational Hygienist	BSc Dip OHSM MAIOH COH Director, Hunter Occupational. Health Certified Occupational Hygienist with 25 years of experience in industry, Newcastle University and the Hunter New England Area Health Service. While teaching and research was included, most time has been in the provision of consultant workplace-environment assessments and measurements. As a Conjoint Lecturer, maintains a relationship with the Discipline of Environmental & Occupational Health in the University of Newcastle.

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	16



## Risk Assessment Report for Strata Bond HA & Mineral Bond LV Polymeric Injection Resins

Name	Title	Qualifications/Experience
Sally McPhee	Facilitator - Senior Consultant - Jim Knowles Group	Bach Build (U NSW), Grad Dip OH&S (Univ Newcastle), G3 Risk Management Certification (Univ. Qld). 20 years as Senior Consultant with the Jim Knowles Group conducting risk assessments in mining, construction and heavy industry. 20 years in civil, commercial, industrial and domestic construction in Sydney and Newcastle
Jane Frew	Technical support / scribe - Jim Knowles Group	Bach Science (U Syd) M Science (biology USyd) G1 and G2 10 years as part time technical assistant and scribe with Jim Knowles Group

### 4.1.2 DSI Review Team Members

Name	Title	Qualifications/Experience
Ian Yates *	DSI Manager Ground Control Services	27 years experience with resin injection products, 2 years BASF , 25 years as principal owner for Ground Consolidation Regional Manager Asia Pacific, Ground Consolidation, MEYCO Underground Construction
Anthony Runge *	DSI - QA and Safety Manager	OHS and Quality Systems training (DSI) Implementing Quality Management System Internal Auditor. Employed as an Industrial Services Technician at Mobil Altona refinery (Vic) as a member of their industrial services team, and as a specialist for Maintenance Shutdowns throughout Australia.
Wayne Edwards *	DSI Underground – Operations Manager	20 years mining experience as miner, longwall installation and polymeric strata stabilisation with Minova and DSI
Luke O’Grady	DSI - Laboratory Technical Assistant	1 Year experience
Daniel McGowan	DSI Operation Co-ordinator	9 years mining experience with polymeric chemicals
Scott Turton	DSI Operation Co-ordinator	13 years mining experience with polymeric chemicals
Sally McPhee *	Facilitator - Senior Consultant - Jim Knowles Group	Bach Build (U NSW), Grad Dip OH&S (Univ Newcastle), G3 Risk Management Certification (Univ. Qld). 20 years as Senior Consultant with the Jim Knowles Group conducting risk assessments in mining, construction and heavy industry. 20 years in civil, commercial, industrial and domestic construction in Sydney and Newcastle

\* Persons involved in original risk assessment

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	17



## Risk Assessment Report for Strata Bond HA & Mineral Bond LV Polymeric Injection Resins

In this case a smaller team of operational personnel and supervisors were brought together to review the results of the previous risk assessment. All of the team members have extensive experience in their fields of expertise. Several team members had been participants in the previous risk assessments. The session was facilitated by an independent consultant with extensive experience in the conduct of risk assessments and who had been involved in the previous reviews.

### 4.2 Review Method

The steps the review team followed were:

- Using the previous risk assessment as a foundation, each hazard was reviewed for relevance and any additional hazards added when necessary
- Confirm probability and consequence ranking of the hazards to determine inherent risk ranks for each of the hazards
- For each task confirm controls in place and identify any further actions required to manage the risks.
- Conduct risk ranking for residual risk
- Allocate responsibilities and time frame for implementing recommendations for improvement to the control of risks

### 4.3 Risk Ranking Criteria and Matrix

The scales of consequence and probability are combined to produce risk ranking as shown by the following scales and risk ranking matrix.

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	18



Risk Assessment Report for  
Strata Bond HA & Mineral Bond LV Polymeric Injection Resins

		Consequences					
Safety		Negligible Low-level short-term subjective inconvenience or symptoms. No measurable physical effects – first aid	Objective but reversible disability / impairment.	Moderate short-term or reversible disability or impairment.	Near fatality, Single fatality or severe irreversible disability or Impairment.	Short or long term health effects leading to multiple fatalities	
Environment		No lasting effect. Low-level impacts on biological or physical environment. Limited damage to minimal area of low significance.	Minor effects on biological or physical environment. Minor short-medium term damage to small area of limited significance.	Moderate effects on biological or physical environment but not affecting ecosystem function.	Serious environmental effects with some impairment of ecosystem function	Very serious environmental effects with impairment of ecosystem function.	
Reputation		Public concern	Minor adverse local or media attention	Attention from media nationally	Significant public or national media	Serious public or media outcry	
Financial		<\$5k	<\$50k	<\$500k	<\$5M	>\$5M	
		Insignificant	Minor	Moderate	Major	Catastrophic	
		1	2	3	4	5	
Likelihood	Almost certain	5	Moderate 6	High 7	High 8	Very High 9	Very High 10
	Likely	4	Moderate 5	Moderate 6	High 7	High 8	Very High 9
	Possible	3	Low 4	Moderate 5	Moderate 6	High 7	Very High 8
	Unlikely	2	Low 3	Moderate 4	Moderate 5	High 6	High 7
	Rare	1	Low 2	Low 3	Moderate 4	Moderate 5	High 6

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	19



## 4.4 Controls

### 4.4.1 Safety Standard to be Achieved

Selection of controls to reduce risks are made with due regard to their reliability. That is, installing engineering modifications is a superior control to operator training, education or warning signs. Removing the hazard altogether is the most effective control of all.

In every case the effectiveness of the controls in place was considered and assessed by the team for adequacy. In this manner the Risk Control Effectiveness (RCE) was assessed by the team using the risk rank and potential consequences of each hazard to ensure that the controls bring the risk to an acceptable level as low as reasonably practicable (ALARP). Residual risk ranking was conducted with controls in place (both existing and proposed new controls).

Risk Rating	Risk Level	Guidelines for Risk Rating Matrix
8, 9, 10	Very High	Senior executive management attention needed, action plans and management responsibility specified.
6, 7, 8	H - High	Action plans and management responsibility specified
4, 5, 6	M – Moderate	Manage by specific monitoring or response procedures
2, 3, 4	L - Low	Manage by routine procedures

### 4.4.2 Hierarchy of Controls

In occupational health and safety risk management there is a hierarchy of controls referred to as the Safety Precedence Sequence for Barriers/Controls. This lists the types of control and their effectiveness in descending order.

The most effective controls are those that eliminate the hazard. If a hazard cannot be eliminated it should be minimised to an acceptable level. This may be achieved through a system of engineering controls, often referred to as 'hard' barriers down to administrative controls usually referred to as 'soft' barriers. Hard barriers actually prevent or minimise the risk of contact with the hazard whereas soft barriers may rely on policies and procedures and their enforcement, training, skills and experience, work organisation and the wearing of personal protective equipment (PPE). These controls are primarily based on controlling human behaviour and are subject to human error. Therefore they may be less effective in preventing exposure to hazards. Nevertheless, there is a place for both hard and soft barriers in any risk management plan.

DSI Underground within its Risk Assessment Management Plan uses the following hierarchy:

1. Eliminating the hazard – removing the source of the hazard

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	20



## Risk Assessment Report for Strata Bond HA & Mineral Bond LV Polymeric Injection Resins

- completely, e.g. remove outdated equipment that cannot be safely maintained.
2. Substituting the hazard – with a hazard that poses a lower risk of harm e.g. the use of less hazardous chemicals, materials or different equipment.
  3. Isolate the hazard – controls that enclose the hazard, e.g. machine guards, barriers, remote handling, etc.
  4. Implementing engineering controls – e.g. ventilation systems.
  5. Administrative controls – e.g. safe work methods, training, job rotation, warning signs, etc.
  6. Personal protective equipment (PPE) – e.g. hard hat, hearing protection, respirators.

The effectiveness and place of each control on the 'hierarchy' is considered at all times when identifying and suggesting controls for hazards. Existing controls are considered and where necessary, additional controls are recommended

### 4.5 Risk Tables

Once the steps are listed and the hazards identified they are risk ranked in accordance with the above criteria. All of this information is logged onto a table. This table provides the framework to allow the group to identify and prioritise the most serious hazards and then to address those risks, in priority order and proposed controls to eliminate, reduce or manage those risks based on their risk ranking.

The results are tabulated in three ways:

- ⇒ In Process / Job flow order
- ⇒ Sorted into Risk Rank order
- ⇒ In consequence order - 'Serious Consequence' hazards only (consequence 5 and 4 only)

A summary of additional new controls are summarised in the action list at the beginning of this report.

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	21

## 4.5.1 Risk Table in Job Order

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
1.1	Set up job - Product selection / mobilisation of contract	Miscommunication of information. Client - DSI - Licensee	3	2	5M	A	<ul style="list-style-type: none"> <li>DSI system for product selection and scope - Mine Resin Selection and Order Form - DSI_GC_FRM-001</li> <li>DSI supervision</li> <li>DSI_GC_SWP_011_Incoming Emergency Response Questions</li> </ul>	Nil	2	2	4M		
1.2	Selection of applicator	Contractor not authorised or qualified to carry out work -	4	3	7H	F	<ul style="list-style-type: none"> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>Contractors will be certified as competent (individuals)</li> <li>DSI supervisor allocated for all jobs</li> <li>Regular auditing of contractors and applicators (by DSI – documented)</li> <li>QA system monitors quality and compliance with standards ISO 9001 – will include auditing of contractor compliance.</li> </ul>	Nil					
2.1	Chemicals and Equipment delivered to job – mine site	Incorrect equipment or chemical delivered to site.	3	1	4L	A	<ul style="list-style-type: none"> <li>Colour-coded labels on chemicals and hoses</li> <li>Materials certified from manufacturer (OS)</li> <li>DSI Quality Assurance system from manufacturer to site delivery</li> <li>Navision inventory management system (DSI)</li> <li>Equipment introduction to site approval process (all mine sites)</li> <li>DSI supervisor (includes checklist)</li> <li>DSI pre-job audit system - DSI Polymeric Injection Pre-job Audit System - DSI_GC_FRM – 0400</li> </ul>	Nil	2	1	3L		
2.2	Chemicals and Equipment delivered to job – mine site	Spill of chemical during transport - LTA securing - Accident	2	3	5M	A/E	<ul style="list-style-type: none"> <li>Some chemical transported in purpose built pods, double banded for IBC chemical storage containers or 20L drums</li> <li>IBC's certified for transport (pallets, roll cages, etc.)</li> <li>Hazardous (non-dangerous) chemicals only</li> <li>Drum design specific for purpose</li> <li>SDS and safety info on pallets and drums</li> <li>Preferred transport contractors used</li> <li>Compliance with Global DG Rules Code ADG Code 7 October 2011</li> <li>Transport managed by DSI</li> </ul>	<ul style="list-style-type: none"> <li>Include checking of transport compliance in contractor's checklist</li> </ul>	2	3	5M	W Edwards	
2.3	Chemicals and Equipment delivered to job – mine site	Aged or out-of-spec material delivered	2	1	3L	A	<ul style="list-style-type: none"> <li>DSI computerised stock control system and QA</li> <li>DSI Quality Assurance system from manufacturer to site delivery</li> <li>Navision inventory management system (DSI)</li> <li>Material deliveries controlled by DSI</li> </ul>	<ul style="list-style-type: none"> <li>Information on safe storage and disposal to be provided to mine site</li> </ul>	2	1	3L	W Edwards	



## 4.5.1 Risk Table in Job Order

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
3.1	Storage of Chemicals and equipment	LTA (Less than adequate) storage conditions for chemicals at mine site – subject to weather or extremes of heat or cold	3	3	6M	A	<ul style="list-style-type: none"> <li>All mines have designated stores areas</li> <li>Chemicals are designated as hazardous (not dangerous) - storage requirements not specialised</li> <li>Spill kits available</li> <li>Practice to 'normalise' temperature of chemicals by storage underground prior to use.</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> </ul>	Nil	2	3	5M		
3.2	Storage of Chemicals and equipment	Mine personnel not aware of chemical requirements - LTA training provided	3	2	5M	A/E	<ul style="list-style-type: none"> <li>Chemicals are designated as hazardous (not dangerous) - storage requirements not specialised</li> <li>Spill kits available (standard ones suitable)</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> <li>DSI Supervisor on site</li> </ul>	Nil	3	2	5M		
3.3	Storage of Chemicals and equipment	LTA response to spill	3	2	5M	A/E	<ul style="list-style-type: none"> <li>Chemicals are designated as hazardous (not dangerous) - storage requirements not specialised</li> <li>Spill kits available</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> <li>Concise, relevant material information provided on IBC and drum labels</li> <li>SDS information available on Chem Alert</li> <li>Existing mine site procedures adequate to control spill</li> <li>Emergency spill response packs will be included in chemical pods.</li> </ul>	Nil	2	2	4M		
4.1	Loading of chemical containers into pods – 20L drums or 1000 L capacity IBCs	Injury to person reloading pod with 20L drums or IBC	3	2	5M	P	<ul style="list-style-type: none"> <li>20L chemical drums have a maximum weight of 24kgs</li> <li>Preference is to use IBC's wherever possible to eliminate manual handling of drums</li> <li>Trained and competent personnel (forklift operator)</li> <li>Pods purpose design to facilitate easy and safe access</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> <li>Spill kits available (stone dust or water dilution)</li> </ul>	Nil	3	2	5M		





## 4.5.1 Risk Table in Job Order

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
4.2	Loading of chemical containers into pods – 20L drums or 1000 L capacity IBCs	Wrong chemical loaded into pod - delay to resupply - cost	3	2	5M	A	<ul style="list-style-type: none"> <li>All pods and chemical containers are clearly labelled and colour coded</li> <li>Trained and competent personnel (DSI contractor certification)</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_ Injection Resin L1 Familiarisation Assessment)</li> <li>DSI Supervision</li> </ul>	Nil	2	2	4M		
4.3	Loading of chemical containers into pods – 20L drums or 1000 L capacity IBCs	Forklift punctures chemical containers - uncontrolled spill	3	3	6M	A/E	<ul style="list-style-type: none"> <li>FFP forklifts available on site</li> <li>Pods designed to be lifted by forklift</li> <li>20L drums limit spill in case of puncture</li> <li>Robust design of IBC's</li> <li>All mines have designated stores areas</li> <li>Chemicals are designated as hazardous (not dangerous)</li> <li>Spill kits available</li> <li>Procedure to manage a damaged IBC (e.g. tip on side with puncture on top, etc.) included in Spill Control Training Polymeric Injection IBC and Equipment Storage - Mine Site - No: DSI_GC_SWP_002_Storage and Pumping of PUR_USR</li> <li>Polymeric Resins IBC and Equipment Storage - Mine Site</li> <li>DSI supervision</li> </ul>	Nil	3	2	5M		
4.4	Loading of chemical containers into pods – 20L drums or 1000 L capacity IBCs	Equipment used to lift chemical containers not FFP (pallets of 20ltr drums and IBC's) - Loss of control of load - spill of chemical - injury to person	3	3	6M	P/A	<ul style="list-style-type: none"> <li>Pods designed to be lifted by forklift, QDS and crane</li> <li>20L drums limit spill cradle used in case of puncture</li> <li>FFP forklifts available on site</li> <li>Competent and authorised forklift operators</li> <li>All mines have designated stores areas</li> <li>Spill kits available</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_ Injection Resin L1 Familiarisation Assessment)</li> </ul>	Nil	2	3	5M		



## 4.5.1 Risk Table in Job Order

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
5.1	Transport of chemical and equipment to application site underground	Loss of control of pod during transport - LHD - Dolly car	2	1	3L	A	<ul style="list-style-type: none"> <li>Robust design of pods, withstand impact, tie down points etc.</li> <li>Spill containment within pod</li> <li>Competent and authorised LHD and Dolly Car operators</li> <li>Spill kits available</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> <li>Mine Transport Rules</li> <li>20 litre drums will only be transported underground in pods</li> <li>Robust design of IBC's</li> </ul>	Nil	2	1	3L		
5.2	Transport of chemical and equipment to application site underground	Loss of control of IBC during transport on LHD / Dolly car – spill, injury to person	3	3	6M	P/E	<ul style="list-style-type: none"> <li>IBC's designed to be lifted by forklift</li> <li>Robust design of IBC's</li> <li>Competent and authorised LHD and Dolly Car operators</li> <li>Spill kits available</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> <li>Mine Transport Rules</li> </ul>	•	2	3	5M		
5.3	Transport of chemical and equipment to application site underground	Damage to mine infrastructure during transport	3	2	5M	A	<ul style="list-style-type: none"> <li>Robust design of pods, withstand impact</li> <li>Pods purpose designed for ease of access</li> <li>Mine Transport Rules</li> <li>Trained, competent and authorised operators</li> </ul>	Nil	2	2	4M		
5.4	Transport of chemical and equipment to application site underground	Damage to equipment / pods during transport	3	2	5M	A	<ul style="list-style-type: none"> <li>Robust design of pods, withstand impact</li> <li>Pods purpose designed for ease of access</li> <li>Mine Transport Rules</li> <li>Trained, competent and authorised operators</li> </ul>	Nil	2	2	4M		
5.5	Transport of chemical and equipment to application site underground	Spillage of chemical during transport	2	2	4M	A/P	<ul style="list-style-type: none"> <li>Robust design of pods, withstand impact,</li> <li>Robust design of IBC's</li> <li>20L drums limited spill</li> <li>Spill containment within pod</li> <li>Spill kits available</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> <li>Mine Transport Rules</li> </ul>	Nil	2	2	4M		



## 4.5.1 Risk Table in Job Order

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
5.6	Transport of chemical and equipment to application site underground	Loss of control of 20L drum during transport on LHD / Dolly car – spill, injury to person	3	1	4L	A/P	<ul style="list-style-type: none"> <li>Drums purpose built for chemical</li> <li>Mine Transport Rules</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_ Injection Resin L1 Familiarisation Assessment)</li> <li>Competent and authorised LHD and Dolly Car operators</li> <li>20 litre drums will only be transported underground in lockable pods</li> </ul>	Nil	2	1	3L		
6.1	Storage of chemicals underground	Storage area for pods, IBC or 20L drums not suitable <ul style="list-style-type: none"> <li>- subject to mechanical damage</li> <li>- not spill protected</li> <li>- chemical may be used for wrong purpose</li> <li>- unintentional damage (e.g. water)</li> <li>- malicious damage</li> </ul>	3	3	6M	A	<ul style="list-style-type: none"> <li>IBC's will be stored underground in robust, lockable pods</li> <li>20 litre drums will only be transported and stored underground in lockable pods</li> <li>Robust and purpose-built design of pods</li> <li>Designated, demarcated storage area in ventilated area</li> <li>Information about chemicals and storage area communicated with mine personnel</li> <li>Storage area barricade</li> </ul>	Nil	2	3	5M		
7.1	Setup of work area	Manual handling injury - hoses, pumps	3	2	5M	P	<ul style="list-style-type: none"> <li>Equipment designed to minimise manual handling hazard, e.g. handles for multi-person lift, shorter hoses, non-return valves etc.</li> <li>Preference to use IBC's in pods except where not possible due to restricted access</li> </ul>	Nil	3	2	5M		
7.2	Setup of work area	Uncontrolled energy release - air	3	2	5M	P	<ul style="list-style-type: none"> <li>PPE</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes start up and shut down etc.</li> </ul>	Nil	2	2	4M		
7.3	Setup of work area	Person struck by moving equipment / pod	3	3	6M	P	<ul style="list-style-type: none"> <li>Bollards or barriers established where there is a risk of mobile plant collision into chemicals, included in Procedure</li> <li>Purpose built transportation containers and pods / bunded pallets, designed to withstand reasonable impact</li> <li>Mine Transport Rules</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes start up and shut down etc.</li> <li>Personal job-based risk assessments (JSA / SLAM / Take 5)</li> </ul>	Nil	2	3	5M		
7.4	Setup of work area	Crossing of connections or hoses - wrongly connected	3	2	5M	A	<ul style="list-style-type: none"> <li>Chemical containers colour coded</li> <li>Hoses colour coded and incompatible - male / female connections (suction side)</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes start up and shut down etc.</li> <li>DSI Supervision</li> </ul>	Nil	2	2	4M		

## 4.5.1 Risk Table in Job Order

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
7.5	Setup of work area	LTA setup location - distance - communication - ventilation etc.	3	2	5M	A	<ul style="list-style-type: none"> <li>Location and setting up ZOO in consultation with mine officials</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes start up and shut down etc.</li> <li>Right to Refusal if location or situation is deemed unsafe by any operator</li> <li>ZOO established prior to chemicals being used which consider: ventilation, humidity, toxicity of chemical, density, proposed application, SDS and legislative restrictions or Client procedural requirements</li> </ul>	Nil	2	2	4M		
8.1	Injection process / application	Equipment failure - not FFP - when pressurised	2	3	5M	P/A	<ul style="list-style-type: none"> <li>Maintenance regime (DSI will supply or certify as FFP all pumps and equipment )</li> <li>Equipment pressure tested with FOS 5:1</li> <li>Compliance with MDG41 for hoses (if required for coal industry)</li> <li>Training packages – levels 2 and 3</li> <li>Wash down showers provided on pods</li> <li>SDS information available</li> <li>PPE provided and worn</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes start up and shut down and equipment checks</li> <li>Spill kits and first aid facilities available - application site and pump site</li> <li>Restricted access to Zone Of operation (ZOO) for qualified personnel and mine officials</li> <li>DSI audit system – includes pump maintenance and testing</li> </ul>	<ul style="list-style-type: none"> <li>Include auditing requirements for contractor supplied equipment in Contractor prerequisite checklist and audit system</li> </ul>	2	3	5M	W Edwards	
8.2	Injection process / application	Excess temp or humidity - fatigue, heat stress	2	2	4M	P	<ul style="list-style-type: none"> <li>Minimum mine ventilation requirements</li> </ul>	<ul style="list-style-type: none"> <li>DSI to develop and implement Fatigue Management Plan for Polymeric Resin applicators</li> </ul>	2	1	3L	I Yates	
8.3	Injection process / application	Operator exposed to mixed product - leaks from strata	3	1	4L	P	<ul style="list-style-type: none"> <li>First aid, eye wash and water available at application site</li> <li>Product cures readily - heat dissipated</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>Restricted access to ZOO</li> </ul>	Nil	3	1	4L		
8.4	Injection process / application	Excess pressure - fracture face - person exposed	3	3	6M	P	<ul style="list-style-type: none"> <li>Equipment includes pressure gauges on injection nozzle and pump, monitored by pump and nozzle operators</li> <li>Gauges modified to better suit conditions</li> <li>Pumps are pressure limited</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>DSI supervision and auditing</li> </ul>	Nil	2	3	5M		

## 4.5.1 Risk Table in Job Order

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
8.5	Injection process / application	Excess PUR injected into coal produces overheating greater 150°C - potential ignition of coal	2	4	6H	P/A/R	<ul style="list-style-type: none"> <li>PUR product has been pretested and approved to NSW DPI standards and German Loba testing. (heat generated &lt; 150°C)</li> <li>Chemicals include fire retardants to NSW DTI standard</li> <li>Quantities monitored directly from IBC level reader, holding tanks requires for 20L drums</li> <li>Fire fighting equipment at injection site and transfer pump site</li> <li>Single piston purpose designed pumps (ratio 1:1)</li> <li>F_GC_006 - Resin Injection Report</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> </ul>	Nil	1	4	5M		
8.6	Injection process / application	Large volume USR pumped - max heat approx. 100 deg C (below 150 deg C)	2	1	3L	A	<ul style="list-style-type: none"> <li>Urea Silicate product has been pretested and approved to NSW DPI standards and German Loba testing. (heat generated &lt; 110 deg C regardless of volume)</li> <li>Chemicals include fire retardants to NSW DTI standard</li> <li>Quantities monitored at pump using holding tanks (for both 20ltr drums and IBC)</li> <li>Fire fighting equipment at injection site and transfer pump site</li> <li>Single piston purpose designed pumps (ratio 1:1)</li> <li>See above with PUR</li> </ul>	Nil	1	1	2L		
8.7	Injection process / application	Person exposed to chemical in - leaking hose or connection - failure of equipment	3	3	6M	P	<ul style="list-style-type: none"> <li>Maintenance regime (DSI will supply or certify as FFP all pumps and equipment)</li> <li>Equipment pressure tested with FOS 5:1</li> <li>Compliance with MDG41 for hoses (if required for coal industry)</li> <li>Prestart checklists</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>SDS information available</li> <li>PPE provided</li> <li>Spill kits and first aid facilities available - application site and pump site</li> <li>Preference to use IBC's wherever possible (closed system minimises exposure)</li> <li>DSI SWP for injection chemicals</li> </ul>	<ul style="list-style-type: none"> <li>Define and develop levels of PPE required for access to ZOO in consultation with Occupational Hygienist</li> <li>Additional PPE packs to be provided for mine officials visiting the ZOO as required</li> <li>Include in JSA</li> <li>Health Monitoring regime for operational personnel in accordance with Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 <ul style="list-style-type: none"> <li>Part 3 Health monitoring</li> <li>109 Health monitoring of worker</li> </ul> </li> </ul>	2	2	4M	I Yates	



## 4.5.1 Risk Table in Job Order

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
8.8	Injection process / application	PPE not FFP or not used - possible contact or sensitisation of - operators - visitors - others	3	3	6M	P	<ul style="list-style-type: none"> <li>Restricted access to Zone Of operation (ZOO) for qualified personnel and mine officials</li> <li>Checklists - F_GC_006 - Resin Injection Report</li> <li>SDS info includes</li> <li>PPE available</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>Preference to use IBC's wherever possible (closed system minimises exposure)</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes setup procedure and PPE requirements</li> </ul>	<ul style="list-style-type: none"> <li>Define and develop levels of PPE required for access to ZOO in consultation with Occupational Hygienist</li> <li>Additional PPE packs to be provided for mine officials visiting the ZOO as required</li> <li>Include in JSA</li> <li>Health Monitoring regime for operational personnel in accordance with Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 <ul style="list-style-type: none"> <li>Part 3 Health monitoring</li> <li>109 Health monitoring of worker</li> </ul> </li> </ul>	2	3	5M	I Yates	
8.9	Injection process / application	Sensitised or vulnerable person exposed to isocyanate	2	3	5M	P	<ul style="list-style-type: none"> <li>Pre-employment medicals and interviews to identify sensitivity or other respiratory vulnerabilities – e.g. asthma, possible sensitivity from previous employment in certain identified industries, e.g. spray painting (Includes contractors)</li> <li>Ventilation systems with at least 0.5 m/sec ventilation flow over operators during application processes</li> <li>PPE</li> <li>Showers on pump pods</li> <li>Spill kits and first aid facilities available - application site and pump site</li> <li>Preference to use IBC's wherever possible (closed system minimises exposure)</li> </ul>	<ul style="list-style-type: none"> <li>Develop and implement Health Monitoring regime for operational personnel in accordance with Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 <ul style="list-style-type: none"> <li>Part 3 Health monitoring</li> <li>109 Health monitoring of worker</li> </ul> </li> </ul>	2	2	4M	I Yates	
8.10	Injection process / application	Product pumped out of ratio undetected or does not perform as required / expected	3	3	6M	A	<ul style="list-style-type: none"> <li>Single piston purpose designed pumps (ratio 1:1)</li> <li>Chemicals are tolerant of minor ratio imbalance without affecting quality of product (+/- 10%)</li> <li>Quantities monitored directly from IBC level reader, holding tanks required for 20L drums</li> <li>Sampling conducted on mixed product, records kept by DSI</li> <li>Troubleshooting Guide for Injection Issues</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>F_GC_006 - Resin Injection Report</li> </ul>	Nil	2	3	5M		
8.11	Injection process / application	Manual handling of 20L drums - injury	3	2	5M	P	<ul style="list-style-type: none"> <li>Chemical drums have a maximum weight of 24kgs</li> <li>Preference is to use IBC's wherever possible to eliminate manual handling of drums</li> </ul>	Nil	3	2	5M		
8.12	Injection process / application	Unauthorised person in ZOO disrupts communication or interferes with operations	2	2	4M	A	<ul style="list-style-type: none"> <li>ZOO demarcated with warning signage and barricade</li> <li>Tool box Talks / Shift Briefing</li> </ul>	Nil	2	2	4M		
8.13	Injection process / application	Person on return side of operation exposed to chemical aerosols or other hazard from injection operation (outside working area)	-	-	-	-	<ul style="list-style-type: none"> <li>No hazard identified - no restricted access on return side of ZOO</li> </ul>						

## 4.5.1 Risk Table in Job Order

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
9.1	Stand-down - recommence application	Chemicals not secured - mine personnel exposed to chemical	2	2	4M	P	<ul style="list-style-type: none"> <li>20L drums will be stored in lockable secure pods</li> <li>IBC's may be stored in lockable pods or otherwise stored in secure position</li> <li>Clear labelling and safety information (including SDS's), spill kits etc. included with pods and IBC's</li> <li>Toolbox Talks, Shift Briefings to inform workforce of polymeric chemical pumping operations</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes safe storage</li> </ul>	Nil	2	2	4M		
9.2	Stand-down - recommence application	Hoses or equipment damaged - not identified at restart	3	2	5M	P/A	<ul style="list-style-type: none"> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>Toolbox Talks, Shift Briefings to inform workforce of polymeric chemical pumping operations</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes setup procedure and PPE requirements</li> <li>DSI supervision</li> </ul>	Nil	2	2	4M		
9.3	Stand-down - recommence application	Improper use or intentional misuse or damage to hoses, equipment or chemical	3	2	5M	P/A	<ul style="list-style-type: none"> <li>Toolbox Talks, Shift Briefings to inform workforce of polymeric chemical pumping operations</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes setup procedure and condition checklist</li> <li>DSI supervisor</li> </ul>	Nil	2	2	4M		
10.1	Clean up / demobilisation return equipment to surface	Person contacts excess / spilled chemical - hoses, connectors	2	2	4M	P	<ul style="list-style-type: none"> <li>Barriers placed at boundaries of ZOO (no-go tape)</li> <li>Area warning signs e.g. "High pressure pumping in progress - Do not enter"</li> <li>Toolbox Talks, Shift Briefings to inform workforce of polymeric chemical pumping operations</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes shutdown procedure</li> </ul>	Nil	2	2	4M		
10.2	Clean up / demobilisation return equipment to surface	System not de-pressurised before disconnection	2	3	5M	P	<ul style="list-style-type: none"> <li>Pressure relief valves incorporated into pump circuit</li> <li>Maintenance regime</li> <li>Gauges, hoses, staple lock connections</li> <li>Fit for purpose tools / equipment / hoses to meet MDG 41 requirements in coal environment</li> <li>Pressure relief / rated valves / bleed valves</li> <li>Automatic pressure release on hoses into holding tanks</li> <li>When holding tanks are used, system depressurised</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes shutdown procedure</li> </ul>	Nil	2	3	5M		



## 4.5.1 Risk Table in Job Order

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
10.3	Clean up/Demobilisation return equipment to surface	Manual handling	3	2	5M	P	<ul style="list-style-type: none"> <li>Equipment designed to minimise manual handling hazard, e.g. handles for multi-person lift, shorter hoses, non-return valves etc.</li> <li>Preference to use IBC's in pods except where not possible due to restricted access</li> </ul>	Nil	2	2	4M		
10.4	Clean up/Demobilisation return equipment to surface	LTA clean-up/removal of used drums and spilt material - damage to reputation - cost	3	1	4L	A/R	<ul style="list-style-type: none"> <li>Supervisor's Checklist</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes shutdown procedure</li> <li>DSI supervision</li> </ul>	Nil	3	1	4L		
11.1	Remove used chemical containers and equipment from site	LTA packing of used containers for transport - possible loss of drums during transport return - reputation loss	2	1	3L	R	•	<ul style="list-style-type: none"> <li>Procedure to be developed for safe disposal and return of chemical containers</li> </ul>	2	1	3L	W Edwards	
11.2	Remove used chemical containers and equipment from site	LTA disposal of used containers	2	1	3L	E	•	Procedure to be developed for safe disposal and return of chemical containers	2	1	3L	W Edwards	



## 4.5.2 Risk Table in Risk Rank

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
1.2	Selection of applicator	Contractor not authorised or qualified to carry out work -	4	3	7H	F	<ul style="list-style-type: none"> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>Contractors will be certified as competent (individuals)</li> <li>DSI supervisor allocated for all jobs</li> <li>Regular auditing of contractors and applicators (by DSI – documented)</li> <li>QA system monitors quality and compliance with standards ISO 9001 – will include auditing of contractor compliance.</li> </ul>	Nil					
8.5	Injection process / application	Excess PUR injected into coal produces overheating greater 150°C - potential ignition of coal	2	4	6H	P/A/R	<ul style="list-style-type: none"> <li>PUR product has been pretested and approved to NSW DPI standards and German Loba testing. (heat generated &lt; 150°C)</li> <li>Chemicals include fire retardants to NSW DTI standard</li> <li>Quantities monitored directly from IBC level reader, holding tanks requires for 20L drums</li> <li>Fire fighting equipment at injection site and transfer pump site</li> <li>Single piston purpose designed pumps (ratio 1:1)</li> <li>F_GC_006 - Resin Injection Report</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> </ul>	Nil	1	4	5M		
3.1	Storage of Chemicals and equipment	LTA (Less than adequate) storage conditions for chemicals at mine site – subject to weather or extremes of heat or cold	3	3	6M	A	<ul style="list-style-type: none"> <li>All mines have designated stores areas</li> <li>Chemicals are designated as hazardous (not dangerous) - storage requirements not specialised</li> <li>Spill kits available</li> <li>Practice to 'normalise' temperature of chemicals by storage underground prior to use.</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> </ul>	Nil	2	3	5M		

## 4.5.2 Risk Table in Risk Rank

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
4.3	Loading of chemical containers into pods – 20L drums or 1000 L capacity IBCs	Forklift punctures chemical containers - uncontrolled spill	3	3	6M	A/E	<ul style="list-style-type: none"> <li>• FFP forklifts available on site</li> <li>• Pods designed to be lifted by forklift</li> <li>• 20L drums limit spill in case of puncture</li> <li>• Robust design of IBC's</li> <li>• All mines have designated stores areas</li> <li>• Chemicals are designated as hazardous (not dangerous)</li> <li>• Spill kits available</li> <li>• Procedure to manage a damaged IBC (e.g. tip on side with puncture on top, etc.) included in Spill Control Training Polymeric Injection IBC and Equipment Storage - Mine Site - No: DSI_GC_SWP_002_Storage and Pumping of PUR_USR</li> <li>• Polymeric Resins IBC and Equipment Storage - Mine Site</li> <li>• DSI supervision</li> </ul>	Nil	3	2	5M		
4.4	Loading of chemical containers into pods – 20L drums or 1000 L capacity IBCs	Equipment used to lift chemical containers not FFP (pallets of 20ltr drums and IBC's) - Loss of control of load - spill of chemical - injury to person	3	3	6M	P/A	<ul style="list-style-type: none"> <li>• Pods designed to be lifted by forklift, QDS and crane</li> <li>• 20L drums limit spill cradle used in case of puncture</li> <li>• FFP forklifts available on site</li> <li>• Competent and authorised forklift operators</li> <li>• All mines have designated stores areas</li> <li>• Spill kits available</li> <li>• Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> </ul>	Nil	2	3	5M		
5.2	Transport of chemical and equipment to application site underground	Loss of control of IBC during transport on LHD / Dolly car – spill, injury to person	3	3	6M	P/E	<ul style="list-style-type: none"> <li>• IBC's designed to be lifted by forklift</li> <li>• Robust design of IBC's</li> <li>• Competent and authorised LHD and Dolly Car operators</li> <li>• Spill kits available</li> <li>• Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> <li>• Mine Transport Rules</li> </ul>	•	2	3	5M		
6.1	Storage of chemicals underground	Storage area for pods, IBC or 20L drums not suitable  - subject to mechanical damage - not spill protected - chemical may be used for wrong purpose - unintentional damage (e.g. water) - malicious damage	3	3	6M	A	<ul style="list-style-type: none"> <li>• IBC's will be stored underground in robust, lockable pods</li> <li>• 20 litre drums will only be transported and stored underground in lockable pods</li> <li>• Robust and purpose-built design of pods</li> <li>• Designated, demarcated storage area in ventilated area</li> <li>• Information about chemicals and storage area communicated with mine personnel</li> <li>• Storage area barricade</li> </ul>	Nil	2	3	5M		



## 4.5.2 Risk Table in Risk Rank

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
7.3	Setup of work area	Person struck by moving equipment / pod	3	3	6M	P	<ul style="list-style-type: none"> <li>Bollards or barriers established where there is a risk of mobile plant collision into chemicals, included in Procedure</li> <li>Purpose built transportation containers and pods / banded pallets, designed to withstand reasonable impact</li> <li>Mine Transport Rules</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes start up and shut down etc.</li> <li>Personal job-based risk assessments (JSA / SLAM / Take 5)</li> </ul>	Nil	2	3	5M		
8.4	Injection process / application	Excess pressure - fracture face - person exposed	3	3	6M	P	<ul style="list-style-type: none"> <li>Equipment includes pressure gauges on injection nozzle and pump, monitored by pump and nozzle operators</li> <li>Gauges modified to better suit conditions</li> <li>Pumps are pressure limited</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>DSI supervision and auditing</li> </ul>	Nil	2	3	5M		
8.7	Injection process / application	Person exposed to chemical in - leaking hose or connection - failure of equipment	3	3	6M	P	<ul style="list-style-type: none"> <li>Maintenance regime (DSI will supply or certify as FFP all pumps and equipment)</li> <li>Equipment pressure tested with FOS 5:1</li> <li>Compliance with MDG41 for hoses (if required for coal industry)</li> <li>Prestart checklists</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>SDS information available</li> <li>PPE provided</li> <li>Spill kits and first aid facilities available - application site and pump site</li> <li>Preference to use IBC's wherever possible (closed system minimises exposure)</li> <li>DSI SWP for injection chemicals</li> </ul>	<ul style="list-style-type: none"> <li>Define and develop levels of PPE required for access to ZOO in consultation with Occupational Hygienist</li> <li>Additional PPE packs to be provided for mine officials visiting the ZOO as required</li> <li>Include in JSA</li> <li>Health Monitoring regime for operational personnel in accordance with Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 <ul style="list-style-type: none"> <li>Part 3 Health monitoring</li> <li>109 Health monitoring of worker</li> </ul> </li> </ul>	2	2	4M	I Yates	
8.8	Injection process / application	PPE not FFP or not used - possible contact or sensitisation of - operators - visitors - others	3	3	6M	P	<ul style="list-style-type: none"> <li>Restricted access to Zone Of operation (ZOO) for qualified personnel and mine officials</li> <li>Checklists - F_GC_006 - Resin Injection Report</li> <li>SDS info includes</li> <li>PPE available</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>Preference to use IBC's wherever possible (closed system minimises exposure)</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes setup procedure and PPE requirements</li> </ul>	<ul style="list-style-type: none"> <li>Define and develop levels of PPE required for access to ZOO in consultation with Occupational Hygienist</li> <li>Additional PPE packs to be provided for mine officials visiting the ZOO as required</li> <li>Include in JSA</li> <li>Health Monitoring regime for operational personnel in accordance with Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 <ul style="list-style-type: none"> <li>Part 3 Health monitoring</li> <li>109 Health monitoring of worker</li> </ul> </li> </ul>	2	3	5M	I Yates	



## 4.5.2 Risk Table in Risk Rank

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
8.10	Injection process / application	Product pumped out of ratio undetected or does not perform as required / expected	3	3	6M	A	<ul style="list-style-type: none"> <li>Single piston purpose designed pumps (ratio 1:1)</li> <li>Chemicals are tolerant of minor ratio imbalance without affecting quality of product (+/- 10%)</li> <li>Quantities monitored directly from IBC level reader, holding tanks required for 20L drums</li> <li>Sampling conducted on mixed product, records kept by DSI</li> <li>Troubleshooting Guide for Injection Issues</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>F_GC_006 - Resin Injection Report</li> </ul>	Nil	2	3	5M		
1.1	Set up job - Product selection / mobilisation of contract	Miscommunication of information. Client - DSI - Licensee	3	2	5M	A	<ul style="list-style-type: none"> <li>DSI system for product selection and scope - Mine Resin Selection and Order Form - DSI_GC_FRM-001</li> <li>DSI supervision</li> <li>DSI_GC_SWP_011_Incoming Emergency Response Questions</li> </ul>	Nil	2	2	4M		
2.2	Chemicals and Equipment delivered to job – mine site	Spill of chemical during transport - LTA securing - Accident	2	3	5M	A/E	<ul style="list-style-type: none"> <li>Some chemical transported in purpose built pods, double bundled for IBC chemical storage containers or 20L drums</li> <li>IBC's certified for transport (pallets, roll cages, etc.)</li> <li>Hazardous (non-dangerous) chemicals only</li> <li>Drum design specific for purpose</li> <li>SDS and safety info on pallets and drums</li> <li>Preferred transport contractors used</li> <li>Compliance with Global DG Rules Code ADG Code 7 October 2011</li> <li>Transport managed by DSI</li> </ul>	<ul style="list-style-type: none"> <li>Include checking of transport compliance in contractor's checklist</li> </ul>	2	3	5M	W Edwards	
3.2	Storage of Chemicals and equipment	Mine personnel not aware of chemical requirements - LTA training provided	3	2	5M	A/E	<ul style="list-style-type: none"> <li>Chemicals are designated as hazardous (not dangerous) - storage requirements not specialised</li> <li>Spill kits available (standard ones suitable)</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment</li> <li>DSI Supervisor on site</li> </ul>	Nil	3	2	5M		



## 4.5.2 Risk Table in Risk Rank

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
3.3	Storage of Chemicals and equipment	LTA response to spill	3	2	5M	A/E	<ul style="list-style-type: none"> <li>Chemicals are designated as hazardous (not dangerous) - storage requirements not specialised</li> <li>Spill kits available</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> <li>Concise, relevant material information provided on IBC and drum labels</li> <li>SDS information available on Chem Alert</li> <li>Existing mine site procedures adequate to control spill</li> <li>Emergency spill response packs will be included in chemical pods.</li> </ul>	Nil	2	2	4M		
4.1	Loading of chemical containers into pods – 20L drums or 1000 L capacity IBCs	Injury to person reloading pod with 20L drums or IBC	3	2	5M	P	<ul style="list-style-type: none"> <li>20L chemical drums have a maximum weight of 24kgs</li> <li>Preference is to use IBC's wherever possible to eliminate manual handling of drums</li> <li>Trained and competent personnel (forklift operator)</li> <li>Pods purpose design to facilitate easy and safe access</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> <li>Spill kits available (stone dust or water dilution)</li> </ul>	Nil	3	2	5M		
4.2	Loading of chemical containers into pods – 20L drums or 1000 L capacity IBCs	Wrong chemical loaded into pod - delay to resupply - cost	3	2	5M	A	<ul style="list-style-type: none"> <li>All pods and chemical containers are clearly labelled and colour coded</li> <li>Trained and competent personnel (DSI contractor certification)</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> <li>DSI Supervision</li> </ul>	Nil	2	2	4M		
5.3	Transport of chemical and equipment to application site underground	Damage to mine infrastructure during transport	3	2	5M	A	<ul style="list-style-type: none"> <li>Robust design of pods, withstand impact</li> <li>Pods purpose designed for ease of access</li> <li>Mine Transport Rules</li> <li>Trained, competent and authorised operators</li> </ul>	Nil	2	2	4M		
5.4	Transport of chemical and equipment to application site underground	Damage to equipment / pods during transport	3	2	5M	A	<ul style="list-style-type: none"> <li>Robust design of pods, withstand impact</li> <li>Pods purpose designed for ease of access</li> <li>Mine Transport Rules</li> <li>Trained, competent and authorised operators</li> </ul>	Nil	2	2	4M		

## 4.5.2 Risk Table in Risk Rank

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
7.1	Setup of work area	Manual handling injury - hoses, pumps	3	2	5M	P	<ul style="list-style-type: none"> <li>Equipment designed to minimise manual handling hazard, e.g. handles for multi-person lift, shorter hoses, non-return valves etc.</li> <li>Preference to use IBC's in pods except where not possible due to restricted access</li> </ul>	Nil	3	2	5M		
7.2	Setup of work area	Uncontrolled energy release - air	3	2	5M	P	<ul style="list-style-type: none"> <li>PPE</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes start up and shut down etc.</li> </ul>	Nil	2	2	4M		
7.4	Setup of work area	Crossing of connections or hoses - wrongly connected	3	2	5M	A	<ul style="list-style-type: none"> <li>Chemical containers colour coded</li> <li>Hoses colour coded and incompatible - male / female connections (suction side)</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes start up and shut down etc.</li> <li>DSI Supervision</li> </ul>	Nil	2	2	4M		
7.5	Setup of work area	LTA setup location - distance - communication - ventilation etc.	3	2	5M	A	<ul style="list-style-type: none"> <li>Location and setting up ZOO in consultation with mine officials</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes start up and shut down etc.</li> <li>Right to Refusal if location or situation is deemed unsafe by any operator</li> <li>ZOO established prior to chemicals being used which consider: ventilation, humidity, toxicity of chemical, density, proposed application, SDS and legislative restrictions or Client procedural requirements</li> </ul>	Nil	2	2	4M		
8.1	Injection process / application	Equipment failure - not FFP - when pressurised	2	3	5M	P/A	<ul style="list-style-type: none"> <li>Maintenance regime (DSI will supply or certify as FFP all pumps and equipment)</li> <li>Equipment pressure tested with FOS 5:1</li> <li>Compliance with MDG41 for hoses (if required for coal industry)</li> <li>Training packages – levels 2 and 3</li> <li>Wash down showers provided on pods</li> <li>SDS information available</li> <li>PPE provided and worn</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes start up and shut down and equipment checks</li> <li>Spill kits and first aid facilities available - application site and pump site</li> <li>Restricted access to Zone Of operation (ZOO) for qualified personnel and mine officials</li> <li>DSI audit system – includes pump maintenance and testing</li> </ul>	<ul style="list-style-type: none"> <li>Include auditing requirements for contractor supplied equipment in Contractor prerequisite checklist and audit system</li> </ul>	2	3	5M	W Edwards	

## 4.5.2 Risk Table in Risk Rank

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
8.9	Injection process / application	Sensitised or vulnerable person exposed to isocyanate	2	3	5M	P	<ul style="list-style-type: none"> <li>Pre-employment medicals and interviews to identify sensitivity or other respiratory vulnerabilities – e.g. asthma, possible sensitivity from previous employment in certain identified industries, e.g. spray painting (Includes contractors)</li> <li>Ventilation systems with at least 0.5 m/sec ventilation flow over operators during application processes</li> <li>PPE</li> <li>Showers on pump pods</li> <li>Spill kits and first aid facilities available - application site and pump site</li> <li>Preference to use IBC's wherever possible (closed system minimises exposure)</li> </ul>	<ul style="list-style-type: none"> <li>Develop and implement Health Monitoring regime for operational personnel in accordance with Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 <ul style="list-style-type: none"> <li>Part 3 Health monitoring</li> <li>109 Health monitoring of worker</li> </ul> </li> </ul>	2	2	4M	I Yates	
8.11	Injection process / application	Manual handling of 20L drums - injury	3	2	5M	P	<ul style="list-style-type: none"> <li>Chemical drums have a maximum weight of 24kgs</li> <li>Preference is to use IBC's wherever possible to eliminate manual handling of drums</li> </ul>	Nil	3	2	5M		
9.2	Stand-down - recommence application	Hoses or equipment damaged - not identified at restart	3	2	5M	P/A	<ul style="list-style-type: none"> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>Toolbox Talks, Shift Briefings to inform workforce of polymeric chemical pumping operations</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes setup procedure and PPE requirements</li> <li>DSI supervision</li> </ul>	Nil	2	2	4M		
9.3	Stand-down - recommence application	Improper use or intentional misuse or damage to hoses, equipment or chemical	3	2	5M	P/A	<ul style="list-style-type: none"> <li>Toolbox Talks, Shift Briefings to inform workforce of polymeric chemical pumping operations</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes setup procedure and condition checklist</li> <li>DSI supervisor</li> </ul>	Nil	2	2	4M		
10.2	Clean up / demobilisation return equipment to surface	System not de-pressurised before disconnection	2	3	5M	P	<ul style="list-style-type: none"> <li>Pressure relief valves incorporated into pump circuit</li> <li>Maintenance regime</li> <li>Gauges, hoses, staple lock connections</li> <li>Fit for purpose tools / equipment / hoses to meet MDG 41 requirements in coal environment</li> <li>Pressure relief / rated valves / bleed valves</li> <li>Automatic pressure release on hoses into holding tanks</li> <li>When holding tanks are used, system depressurised</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes shutdown procedure</li> </ul>	Nil	2	3	5M		

## 4.5.2 Risk Table in Risk Rank

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
10.3	Clean up/Demobilisation return equipment to surface	Manual handling	3	2	5M	P	<ul style="list-style-type: none"> <li>Equipment designed to minimise manual handling hazard, e.g. handles for multi-person lift, shorter hoses, non-return valves etc.</li> <li>Preference to use IBC's in pods except where not possible due to restricted access</li> </ul>	Nil	2	2	4M		
5.5	Transport of chemical and equipment to application site underground	Spillage of chemical during transport	2	2	4M	A/P	<ul style="list-style-type: none"> <li>Robust design of pods, withstand impact,</li> <li>Robust design of IBC's</li> <li>20L drums limited spill</li> <li>Spill containment within pod</li> <li>Spill kits available</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_Injection Resin L1 Familiarisation Assessment)</li> <li>Mine Transport Rules</li> </ul>	Nil	2	2	4M		
8.2	Injection process / application	Excess temp or humidity - fatigue, heat stress	2	2	4M	P	<ul style="list-style-type: none"> <li>Minimum mine ventilation requirements</li> </ul>	<ul style="list-style-type: none"> <li>DSI to develop and implement Fatigue Management Plan for Polymeric Resin applicators</li> </ul>	2	1	3L	I Yates	
8.12	Injection process / application	Unauthorised person in ZOO disrupts communication or interferes with operations	2	2	4M	A	<ul style="list-style-type: none"> <li>ZOO demarcated with warning signage and barricade</li> <li>Tool box Talks / Shift Briefing</li> </ul>	Nil	2	2	4M		
9.1	Stand-down - recommence application	Chemicals not secured - mine personnel exposed to chemical	2	2	4M	P	<ul style="list-style-type: none"> <li>20L drums will be stored in lockable secure pods</li> <li>IBC's may be stored in lockable pods or otherwise stored in secure position</li> <li>Clear labelling and safety information (including SDS's), spill kits etc. included with pods and IBC's</li> <li>Toolbox Talks, Shift Briefings to inform workforce of polymeric chemical pumping operations</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes safe storage</li> </ul>	Nil	2	2	4M		
10.1	Clean up / demobilisation return equipment to surface	Person contacts excess / spilled chemical - hoses, connectors	2	2	4M	P	<ul style="list-style-type: none"> <li>Barriers placed at boundaries of ZOO (no-go tape)</li> <li>Area warning signs e.g. "High pressure pumping in progress - Do not enter"</li> <li>Toolbox Talks, Shift Briefings to inform workforce of polymeric chemical pumping operations</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes shutdown procedure</li> </ul>	Nil	2	2	4M		



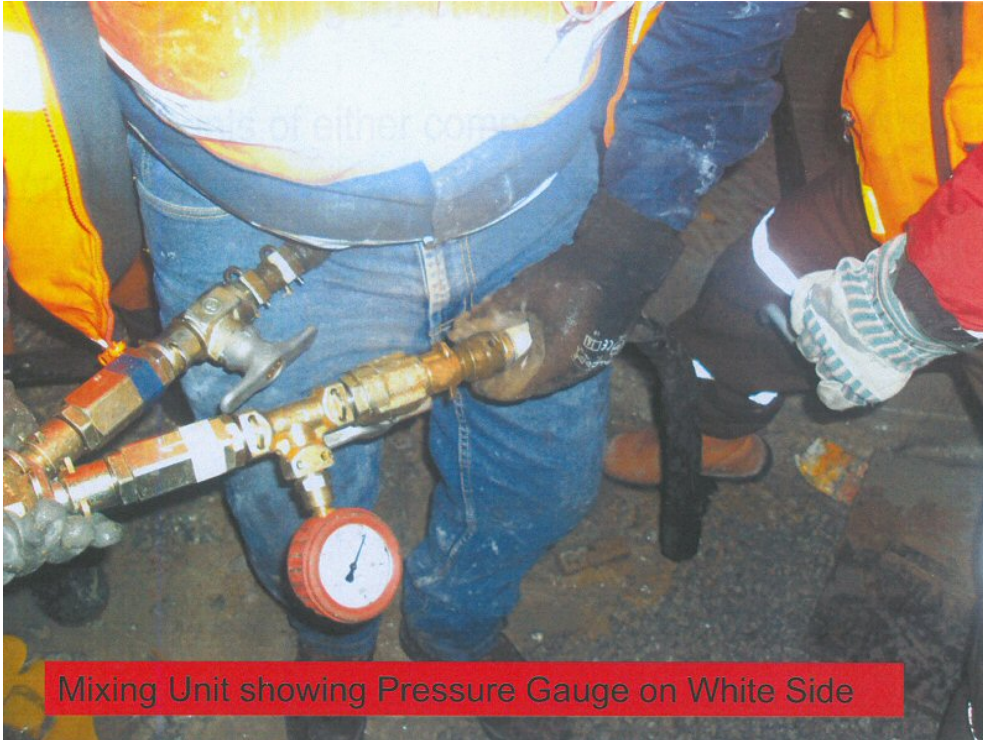
## 4.5.2 Risk Table in Risk Rank

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
2.1	Chemicals and Equipment delivered to job – mine site	Incorrect equipment or chemical delivered to site.	3	1	4L	A	<ul style="list-style-type: none"> <li>Colour-coded labels on chemicals and hoses</li> <li>Materials certified from manufacturer (OS)</li> <li>DSI Quality Assurance system from manufacturer to site delivery</li> <li>Navision inventory management system (DSI)</li> <li>Equipment introduction to site approval process (all mine sites)</li> <li>DSI supervisor (includes checklist)</li> <li>DSI pre-job audit system - DSI Polymeric Injection Pre-job Audit System - DSI_GC_FRM – 0400</li> </ul>	Nil	2	1	3L		
5.6	Transport of chemical and equipment to application site underground	Loss of control of 20L drum during transport on LHD / Dolly car – spill, injury to person	3	1	4L	A/P	<ul style="list-style-type: none"> <li>Drums purpose built for chemical</li> <li>Mine Transport Rules</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_ Injection Resin L1 Familiarisation Assessment)</li> <li>Competent and authorised LHD and Dolly Car operators</li> <li>20 litre drums will only be transported underground in lockable pods</li> </ul>	Nil	2	1	3L		
8.3	Injection process / application	Operator exposed to mixed product - leaks from strata	3	1	4L	P	<ul style="list-style-type: none"> <li>First aid, eye wash and water available at application site</li> <li>Product cures readily - heat dissipated</li> <li>DSI Training procedures – 4 levels – workers receive training level relevant to their duties</li> <li>Restricted access to ZOO</li> </ul>	Nil	3	1	4L		
10.4	Clean up/Demobilisation return equipment to surface	LTA clean-up/removal of used drums and spilt material - damage to reputation - cost	3	1	4L	A/R	<ul style="list-style-type: none"> <li>Supervisor's Checklist</li> <li>DSI_GC_SWP_002_Storage and Pumping of PUR_USR – includes shutdown procedure</li> <li>DSI supervision</li> </ul>	Nil	3	1	4L		
2.3	Chemicals and Equipment delivered to job – mine site	Aged or out-of-spec material delivered	2	1	3L	A	<ul style="list-style-type: none"> <li>DSI computerised stock control system and QA</li> <li>DSI Quality Assurance system from manufacturer to site delivery</li> <li>Navision inventory management system (DSI)</li> <li>Material deliveries controlled by DSI</li> </ul>	<ul style="list-style-type: none"> <li>Information on safe storage and disposal to be provided to mine site</li> </ul>	2	1	3L	W Edwards	
5.1	Transport of chemical and equipment to application site underground	Loss of control of pod during transport - LHD - Dolly car	2	1	3L	A	<ul style="list-style-type: none"> <li>Robust design of pods, withstand impact, tie down points etc.</li> <li>Spill containment within pod</li> <li>Competent and authorised LHD and Dolly Car operators</li> <li>Spill kits available</li> <li>Familiarisation training provided to mine personnel (Training package – Polymeric Resins Level 1 Chemical Familiarisation - DSI_GC_TP_007_ Injection Resin L1 Familiarisation Assessment)</li> <li>Mine Transport Rules</li> <li>20 litre drums will only be transported underground in pods</li> <li>Robust design of IBC's</li> </ul>	Nil	2	1	3L		

## 4.5.2 Risk Table in Risk Rank

Item No.	Activity / Task / Job Steps	Potential Incident, Hazards	L	C	Initial Risk	Loss Type	Existing Controls	New / Recommended Additional Controls	L	C	Residual Risk	Action By	Due Date
8.6	Injection process / application	Large volume USR pumped - max heat approx. 100 deg C (below 150 deg C)	2	1	3L	A	<ul style="list-style-type: none"> <li>Urea Silicate product has been pretested and approved to NSW DPI standards and German Lobe testing. (heat generated &lt; 110 deg C regardless of volume)</li> <li>Chemicals include fire retardants to NSW DTI standard</li> <li>Quantities monitored at pump using holding tanks (for both 20ltr drums and IBC)</li> <li>Fire fighting equipment at injection site and transfer pump site</li> <li>Single piston purpose designed pumps (ratio 1:1)</li> <li>See above with PUR</li> </ul>	Nil	1	1	2L		
11.1	Remove used chemical containers and equipment from site	LTA packing of used containers for transport - possible loss of drums during transport return - reputation loss	2	1	3L	R	•	• Procedure to be developed for safe disposal and return of chemical containers	2	1	3L	W Edwards	
11.2	Remove used chemical containers and equipment from site	LTA disposal of used containers	2	1	3L	E	•	Procedure to be developed for safe disposal and return of chemical containers	2	1	3L	W Edwards	
8.13	Injection process / application	Person on return side of operation exposed to chemical aerosols or other hazard from injection operation (outside working area)	-	-	-	-	• No hazard identified - no restricted access on return side of ZOO						

## APPENDIX 1 - EQUIPMENT PICTURES



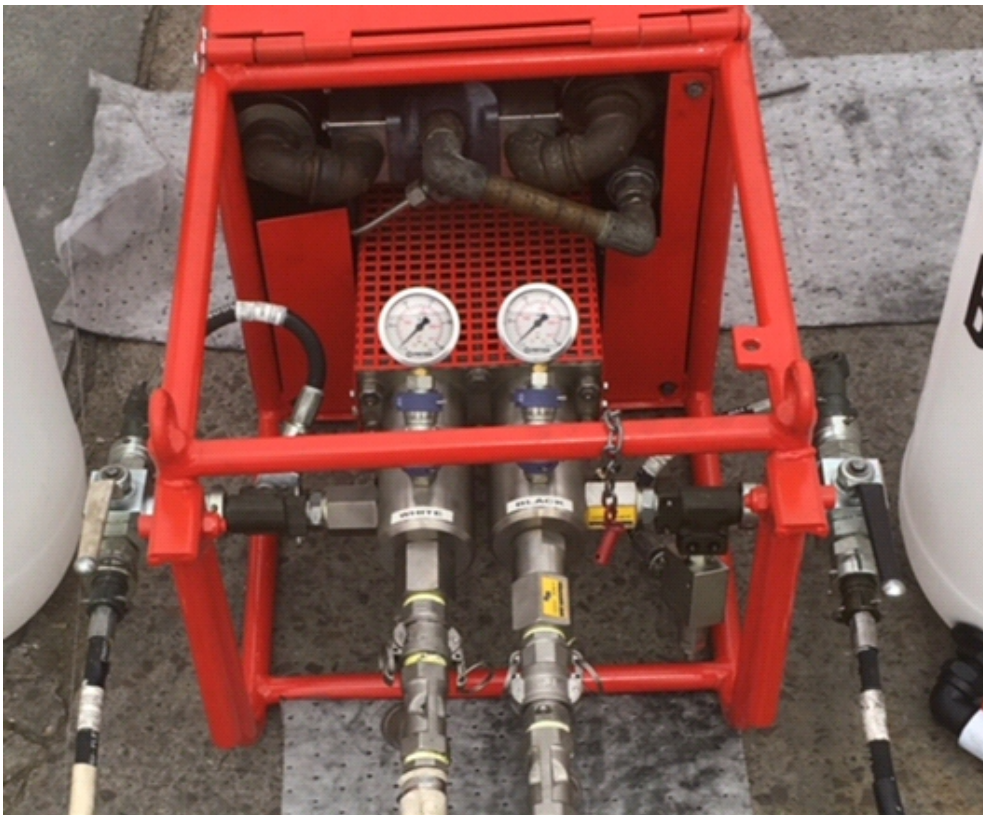
Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	42

## QDS Plate Both Ends



Example of chemical pod



Maximator DP40 pump

Risk Review Workshop – 8th June &amp; 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	43



Pump with holding tanks (used with 20ltr drums only)

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	44



## APPENDIX 2 - SIGNED ATTENDANCE SHEET



## DSI Underground

Polymeric Chemicals Application Licence - Risk Assessments  
28<sup>th</sup> July, 2017

Name	Position / Job Title	Company	Years Exp.	Signature
Anthony Runge	Systems leader	DSI	5	
Luke O'Grady	Laboratory Tech. Assisted	DSI	1	
Daniel McHewer	Operation Coordinator	DSI	9	
Scott TUSTON	Operations Coordinator	DSI	13	
Wayne Edwards	Operations Manager	DSI	22	
IAN YATES.	Manager G.C.	DSI	48	
Sally McPhee	Facilitator	Jim Knowles Group	21	

Risk Review Workshop – 8th June &amp; 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	45





## ACKNOWLEDGEMENTS

Nertney, R. J. , and M. G Bullock. February 1976. *Human Factors in Design*  
U.S. Department of Energy, Systems Safety Development Centre: EG&G  
Idaho falls.

Joy, J. *Workplace Risk Assessment and Control Manual (WRAC)* 1994  
CCH.

NSW Department of Mineral Resources, *Risk Management Handbook for  
The Mining Industry*. MDG 1010, May 1997.

NSW Department of Mineral Resources, *Guide to Reviewing a Risk  
Assessment of Mine Equipment & Operations*. MDG 1014, July 1997

## REFERENCE DOCUMENTS

### General

1. NSW Department of Primary Industries - Review Process for POLYMERIC CHEMICALS and SYSTEMS for use in underground coal mines; 5 August, 2008
2. NSW Department of Primary industries - MDG 40 Guideline for Hazardous Energy Control (Isolation or Treatment); January 2007
3. NSW Government: Coal Mine Health and Safety Regulation 2006 - Gazette No.132: 4. Risk assessment of equipment and application process

### DSI Documents

4. Safety Data Sheet - Strata-Bond HA Component A - Dywidag Systems International (PUR) (Ver 2.1 – 01 Mar, 2016)
5. Safety Data Sheet - Strata-Bond HA Component B - Dywidag Systems International (PUR) (Ver 2.1 – 01 Mar, 2016)
6. Safety Data Sheet – Strata Bond Compound - Dywidag Systems International (URS) (Ver 1.1 – 06 Jun 2016)
7. Safety Data Sheet - Mineral-Bond LV Component A - Dywidag Systems International (URS) (Ver 2.1 – 26 Feb 2016)
8. Safety Data Sheet - Mineral-Bond LV Component B - Dywidag Systems International (URS) (Ver 2.1 – 01 Mar 2016)
9. Safety Data Sheet - Mineral-Bond LV Cured Material - Dywidag Systems International (URS) (Ver 2 – 26 Feb 2016)
10. LOBA Arnsberg Approval for Strata Bond, September 19, 2014
11. LOBA Arnsberg Approval for Mineral Bond, September 19, 2014
12. DSI\_GC\_SWP\_001\_DP40 Pump Isolation Lockout and Energy Dissipation SWP
13. DSI\_GC\_SWP\_002\_Storage and Pumping of PUR\_USR
14. DSI\_GC\_SWP\_011\_Incoming Emergency Response Questions
15. F\_GC\_006 - Resin Injection Report
16. F\_GC\_011 - Supervisor's Checklist

Risk Review Workshop – 8th June & 28th July, 2017

File name:	Job No:	Date of Issue:	Version No	Document:	Page:
DSI_Polymeric resins_RA_rpt_ver04.doc	SM2017-1672	09.04.2018	04	FINAL REPORT	46