Technical Report

Title:	***Temporary Sealing of Boreholes DGR-5 and DGR-6***
Document ID:	**TR-09-10**
Authors:	**Steve Gaines, Sean Sterling and Dru Heagle**
Revision:	**0**
Date:	**April 6, 2011**

DGR Site Characterization Document
Geofirma Engineering Project 08-200

Geofirma Engineering Ltd

Geofirma Engineering DGR Site Characterization Document		
Title:	Temporary Sealing of Boreholes DGR-5 and DGR-6	
Document ID:	TR-09-10	
Revision Number:	0	Date: April 6, 2011
Authors:	Steve Gaines, Sean Sterling and Dru Heagle	
Technical Review:	Kenneth Raven; Dylan Luhowy (NWMO)	
QA Review:	John Avis	
Approved by:	 Kenneth Raven	

Document Revision History		
Revision	Effective Date	Description of Changes
0	April 6, 2011	Initial release

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1 Introduction

Geofirma Engineering Ltd. (formerly Intera Engineering Ltd.) has been contracted by the Nuclear Waste Management Organization (NWMO), on behalf of Ontario Power Generation, to implement the Geoscientific Site Characterization Plan (GSCP) for the Bruce nuclear site located near Tiverton, Ontario. The purpose of this site characterization work is to assess the suitability of the Bruce nuclear site to construct a Deep Geologic Repository (DGR) to store low-level and intermediate-level radioactive waste. The GSCP is described by Intera Engineering Ltd. (2006, 2008).

This Technical Report summarizes the type and location of production injection packers (PIPs) used to temporarily seal the two deep inclined bedrock boreholes (DGR-5 and DGR-6), as part of Phase 2B of the GSCP. At this time Westbay MP multilevel systems are not planned to be installed in DGR-5 or DGR-6, nor is permanent abandonment (i.e. grouting) anticipated for several years. Therefore, temporarily sealing is necessary to minimize borehole cross connection until either permanent abandonment or long-term monitoring is undertaken.

Work described in this Technical Report was completed in accordance with Test Plan TP-10-01 – Temporary Borehole Sealing of DGR-5 and DGR-6 (Intera Engineering Ltd., 2010a), and references Technical Report TR-09-11 Bedrock Formations in DGR-1 to DGR-6 (Geofirma Engineering Ltd., 2011).

Work described in this Technical Report was completed following the general requirements of the DGR Project Quality Plan (Intera Engineering Ltd., 2010b).

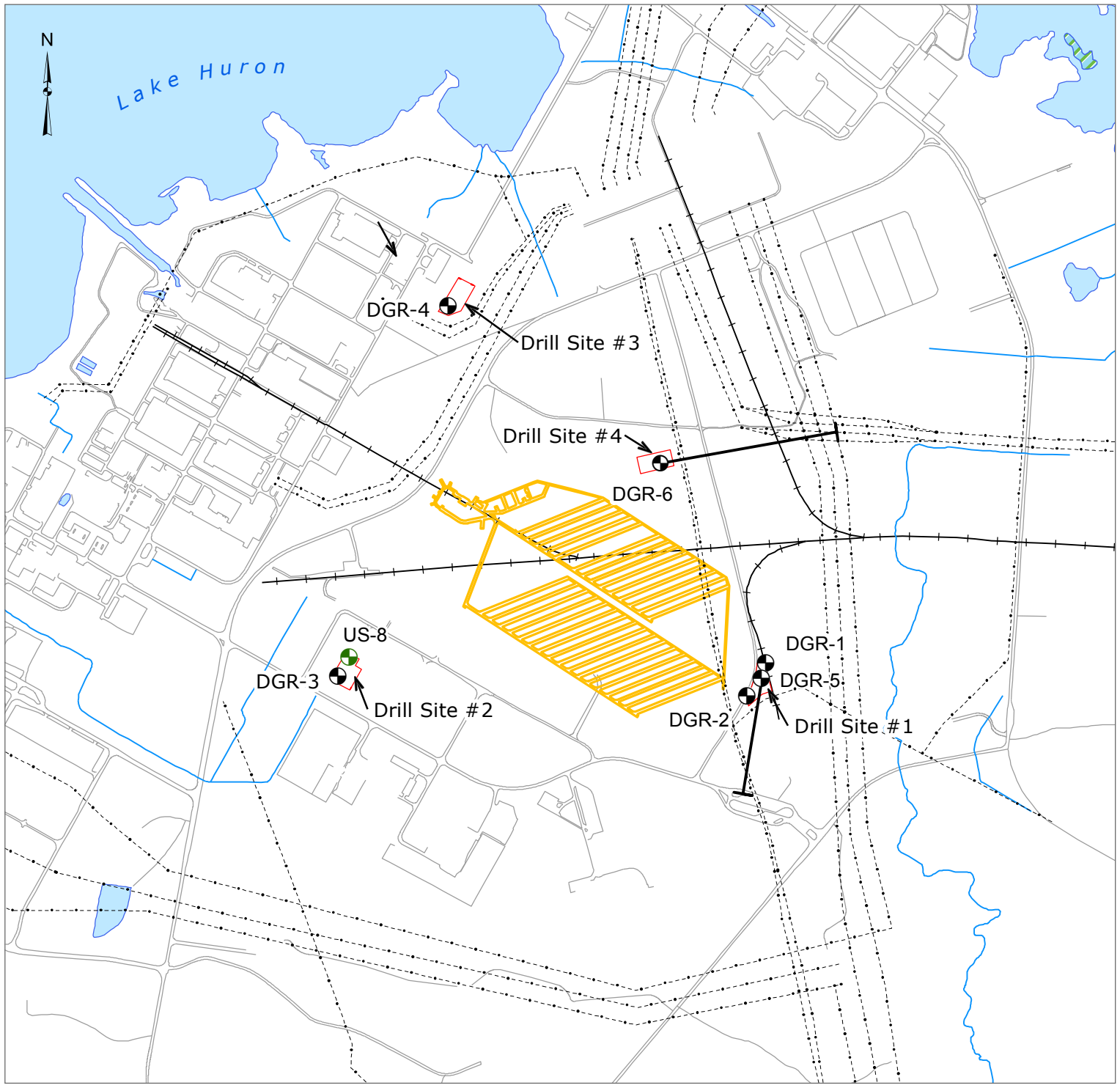
2 Background

The GSCP comprises two phases of borehole drilling and investigations. The Phase 1 GSCP is described by Intera Engineering Ltd. (2006) and included the drilling, logging and testing of two deep vertical 152 mm diameter boreholes (DGR-1 and DGR-2) to total depths of 462.9 and 862.3 metres below ground surface (mBGS) respectively, and the drilling and testing of one shallow borehole, US-8, to a total depth of 200 mBGS. Both of these deep DGR boreholes were drilled at one location (Drill Site # 1), approximately 40 metres apart from each other. The shallow borehole (US-8) was drilled at a second location (Drill Site # 2); both drill sites are located at the Bruce nuclear site as shown on Figure 1. Phase 1 drilling and testing was completed between December 2006 and December 2007.

The Phase 2 GSCP is described by Intera Engineering Ltd. (2008). Phase 2 is divided into two sub-phases, 2A and 2B. Phase 2A consisted of drilling, logging and testing of two deep vertical 143 mm diameter boreholes, DGR-3 (Drill Site #2) and DGR-4 (Drill Site #3) to total depths of 869.2 and 857.0 mBGS, respectively. Phase 2A was completed between March 2008 and September 2009. Phase 2B comprised the drilling, logging and testing of two deep inclined 143 mm diameter boreholes, DGR-5 (Drill Site #1) and DGR-6 (Drill Site #4). The Phase 2B drilling and core logging activities are described below. Phase 2B work was completed between December 2008 and June 2010.

The overall strategy for the borehole sealing can be defined by the following objectives:

- provide a borehole seal that will minimize the vertical cross connection of borehole fluids and pressures and effectively isolate over-pressurized bedrock formations from under-pressurized bedrock formations;
- provide an effective borehole seal that can remain in place over long period of time (i.e. 2 to 10 years); and,
- ensure the borehole seal is removable (i.e. temporary) such that at any given time the complete borehole column may be accessed for further testing or permanent abandonment.



LEGEND

- DGR Boreholes
- US Well
- Proposed Repository Outline
- Drilling Direction
- Transmission Line
- Roads
- Stream or Drainage
- Railways
- Drill Sites
- Buildings
- Waterbody
- Wetland Area, Permanent
- Pits or Landfills

Figure 1
Location of DGR Boreholes and US-8 at the Bruce Site

Scale 1:15,000

0 100 200 400 600 800
Meters

PROJECTION: UTM NAD 83 Zone 17N
SOURCE: NRVIS/OBM, MNR, OPG, NWMO

PROJECT No. 08-200 TR 09-10

PROJECT NWMO DGR
Site Characterization Project

DESIGN: NMP
CAD/GIS: NMP
CHECK: SNG
REV: 0B

DATE: 17/02/2011

Geofirma Engineering Ltd

P:\QMS_DGR\TR_WorkingFiles\TR-09-10 Temporary Sealing of Boreholes DGR-5 & DGR-6\Figures\TR-09-10_SiteLocationDGR1-6_R0B.mxd

3 Borehole Drilling

Davidson Drilling Limited (Davidson), based out of Wingham, Ontario, was retained by Geofirma Engineering Ltd. to complete the borehole drilling and permanent casing installation at DGR-5 and DGR-6.

Both boreholes were rotary drilled from surface to the Salina Formation F-Unit shale for casing installation, then continuously cored to depth. The angled boreholes had target plunges of 65° (DGR-5) and 60° (DGR-6) from horizontal and target azimuths of 190° (DGR-5) and 80° (DGR-6) from true north. DGR-5 was completed at Drill Site # 1, adjacent to DGR-1 and DGR-2 and DGR-6 was drilled at Drill Site # 4 (Figure 1).

During the drilling program of DGR-5 and DGR-6, Davidson had difficulty maintaining the required borehole orientation (azimuth and inclination) and as a result the objectives of borehole DGR-6 would not be met without directional drilling correction. Therefore, Geofirma contracted with Layne Christensen Canada Ltd. (Layne), based in Capreol, Ontario, in conjunction with International Directional Services (IDS), also based in Capreol, Ontario, to complete DGR-6 below a depth of approximately 516 mLBGS at the top of the Queenston Formation. Layne used conventional mineral exploration drilling equipment with the assistance of directional coring equipment (IDS) as necessary to meet the objectives of DGR-6.

Figure 2 shows the interpreted bedrock formation contact depths/elevations and subsurface nomenclature for the Bruce nuclear site based on the drilling and core logging activities completed at DGR-5 and DGR-6. The rational for these formation picks are described in TR-09-11 - Bedrock Formations in DGR-1 to DGR-6 (Geofirma Engineering Ltd., 2011). The main borehole diameter for each borehole was 5⅝ inches. DGR-5 was drilled 807.15 mLBGS into the Kirkfield Formation, a true vertical depth of 752 mBGS. DRG-6 was drilled 903.16 mLBGS into the Gull River Formation, a true vertical depth of 785 mBGS.

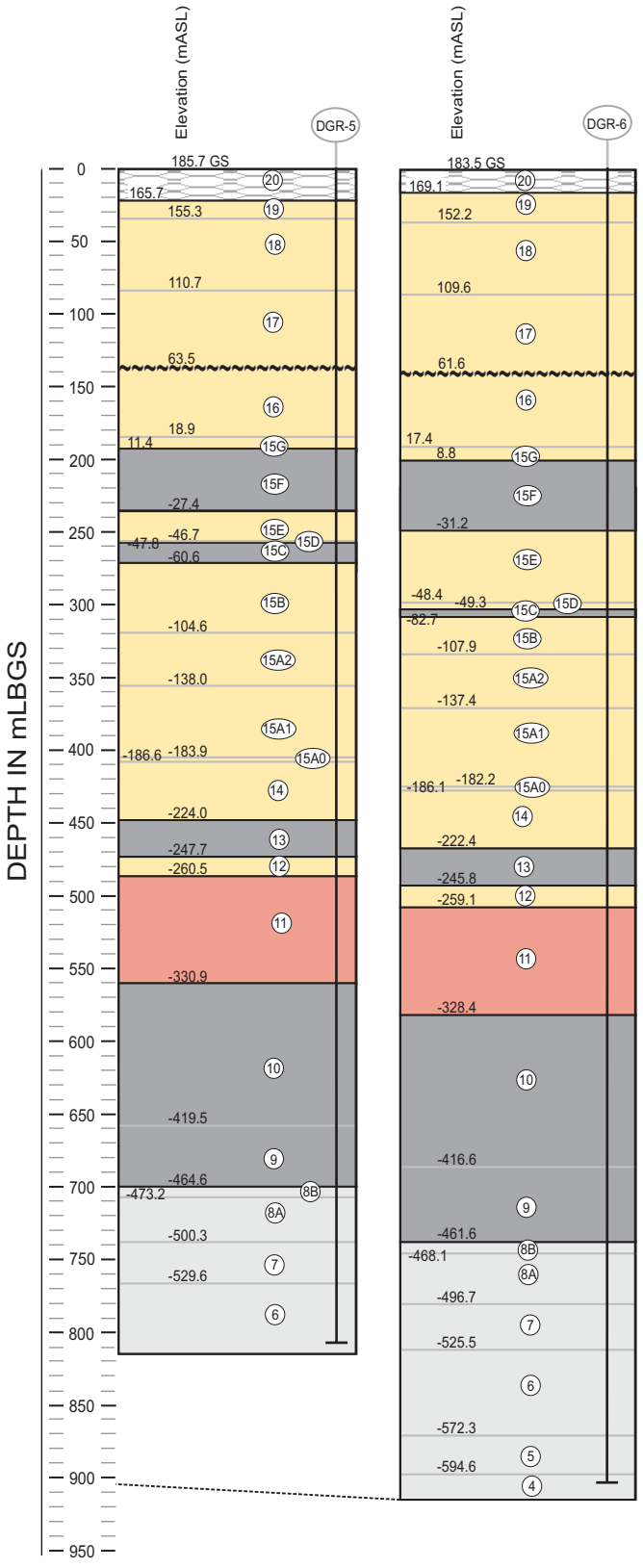
The total drilled depth of DGR-5 does not expose the over-pressurized Ordovician limestone formations; therefore a seal near the bottom of the borehole was not necessary. The total drilled depth of DGR-6 intercepted the Gull River Formation, which was over-pressured in DGR-2, DGR-3, and DGR-4. Therefore, a temporary seal was deemed necessary at the bottom of the Kirkfield Formation in DGR-6 in order to isolate the high pressure Coboconk Formation from the overlying relatively lower pressure Ordovician limestones.

4 Packer Installation

Boreholes were sealed to minimize the vertical cross connection of borehole fluids and pressures and effectively isolate over-pressurized bedrock formations from under-pressurized bedrock by installing bridge plugs or packers at the depths outlined in Table 1, where depth to top of packer indicates the top of the packer element or seal. Packers are identified using the borehole ID and the depth to the top of the packer in mLBGS.

Before the packers were installed, each packer was assembled with the steel plug, shear pin and on-off tool, and then pressure tested to 1200 to 1350 psi. Once the packers were lowered to their designed depths, each packer was inflated by slowly pumping in fresh Lake Huron water. Pumping continued until the tubing over balance pressure reached 500 psi. At this time the pressure was maintained for 10 minutes to allow the packer element to conform to the shape of the borehole. The pressure was then slowly increased, stopping every 500 psi for ten minutes to allow the element to conform to the shape of the borehole. When the packer inflation pressure reached 1200 psi the shear pin on the on-off tool released and the packer pressure was locked in by bleeding off the pressure as quickly as possible. Each packer was assured to be in place by pull testing the packers to 4000 to 5000 lbs above the string weight.

The following sections describe the installation of each packer in DGR-5 and DGR-6, respectively. Table 2 provides a summary of the packer installations. Schematic diagrams of packers installed in DGR-5 and DGR-6 are included in Figures A.1 and A.2, respectively, Appendix A. Photographs of packers installed in DGR-5 and DGR-6 are included in Appendix B and specification sheets are provided in Appendix C.



LEGEND - BRUCE SITE STRATIGRAPHY

PLEISTOCENE
- 20 SURFICIAL DEPOSITS

MIDDLE DEVONIAN
- 19 LUCAS FORMATION - DOLOSTONE
- 18 AMHERSTBURG FORMATION - DOLOSTONE

LOWER DEVONIAN
- 17 BOIS BLANC FORMATION - CHERTY DOLOSTONE

~~~~~~ SILURIAN / DEVONIAN DISCONTINUITY

UPPER SILURIAN
- 16 BASS ISLANDS FORMATION - DOLOSTONE
- 15 SALINA FORMATION
- 15G G UNIT - ARGILLACEOUS DOLOSTONE
- 15F F UNIT - DOLOMITIC SHALE
- 15E E UNIT - BRECCIATED DOLOSTONE AND DOLOMITIC SHALE
- 15D D UNIT - ANHYDRITIC DOLOSTONE
- 15C C UNIT - DOLOMITIC SHALE AND SHALE
- 15B B UNIT - ARGILLACEOUS DOLOSTONE AND ANHYDRITE
- 15A2 A2 UNIT - DOLOSTONE AND ANHYDRITIC DOLOSTONE
- 15A1 A1 UNIT - ARGILLACEOUS DOLOSTONE AND ANHYDRITIC DOLOSTONE
- 15A0 A0 - BITUMINOUS DOLOSTONE

MIDDLE SILURIAN
- 14 GUELPH, GOAT ISLAND, GASPORT, LIONS HEAD AND FOSSIL HILL FORMATIONS - DOLOSTONE AND DOLOMITIC LIMESTONE

LOWER SILURIAN
- 13 CABOT HEAD FORMATION - SHALE
- 12 MANITOULIN FORMATION - CHERTY DOLOSTONE AND MINOR SHALE

UPPER ORDOVICIAN
- 11 QUEENSTON FORMATION - RED SHALE
- 10 GEORGIAN BAY FORMATION - GREY SHALE
- 9 BLUE MOUNTAIN FORMATION - DARK GREY SHALE

MIDDLE ORDOVICIAN
- 8 COBOURG FORMATION
- 8B COLLINGWOOD MEMBER - BLACK CALCAREOUS SHALE AND ARGILLACEOUS LIMESTONE
- 8A LOWER MEMBER - ARGILLACEOUS LIMESTONE
- 7 SHERMAN FALL FORMATION - ARGILLACEOUS LIMESTONE
- 6 KIRKFIELD FORMATION - ARGILLACEOUS LIMESTONE
- 5 COBOCONK FORMATION - BIOTURBATED LIMESTONE
- 4 GULL RIVER FORMATION - LITHOGRAPHIC LIMESTONE
- 3 SHADOW LAKE FORMATION - SILTSTONE AND SANDSTONE

CAMBRIAN
- 2 CAMBRIAN SANDSTONE

NOTE:
1. SUBSURFACE STRATIGRAPHIC NOMENCLATURE AFTER ARMSTRONG AND CARTER (2006)

Bedrock Stratigraphy in Boreholes DGR-5 and DGR-6
TR-09-10 Temporary Sealing of Boreholes DGR-5 and DGR-6

FIGURE 2	Doc. No.: TR-09-10_Figure 2_R0.cdr	Prepared by: NMP Reviewed by: GDB Date: 7-Apr-2011

Geofirma Engineering Ltd
~~~~~~

Table 1 Summary of Packer Sealing Locations in DGR-5 and DGR-6

Borehole	*Unit or Formation*	*Depth to Top of Packer (mLBGS)*	*Rationale*
DGR-5	Top of Salina A0 Unit	405.1	Isolate over-pressurized Salina A1 Unit Evaporite from underlying Guelph Formation
DGR-5	Top of Queenston	486.6	Isolate over-pressurized Salina Formations from under-pressurized Ordovician shales below
DGR-6	Top of Salina A0 Unit	424.4	Isolate over-pressurized Salina A1 Unit Evaporite from underlying Guelph Formation
DGR-6	Bottom of Manitoulin	500.2	Isolate over-pressurized Salina Formations from under-pressurized Ordovician shales below
DGR-6	Bottom of Kirkfield	864.2	Isolate over-pressurized formations below Kirkfield Formation from overlying under-pressurized formations

Table 2 Summary of Packers and Packer Materials Installed in DGR-5 and DGR-6.

Packer	*Packer Manufacturer /Model*	*Depth to Top of Element (mLBGS)*	*Depth to Base of Packer Nipple (mLBGS)*	*Shear Plug Material*	*Shear Pin Material*	*Shear Pin Release Pressure (psi)*
DGR5-405.1	Baker/Single Set Production Injection Packer	405.1	403.64	Solid Steel	Solid Brass	2000
DGR5-486.6	Weatherford/Injection Production Packer, Single-Set Rotation Release	486.6	484.95	Solid Steel	Solid Brass	2000
DGR6-424.4	Weatherford/Injection Production Packer, Single-Set Rotation Release	424.4	423.05	Solid Steel	Solid Brass	2050
DGR6-500.2	Weatherford/Injection Production Packer, Single-Set Rotation Release	500.2	498.85	Solid Steel	Solid Brass	2050
DGR6-864.2	Weatherford/Injection Production Packer, Single-Set Rotation Release	864.2	862.85	Solid Steel	Solid Brass	2050

4.1 Packer Installation in DGR-5

The upper packer in DGR-5 was installed at 405.1 mLBGS on March 28, 2010. The packer has an element length of 1.05 m. The length from the top of the element to the base of the nipple, where the on-off tool attaches to the packer is 1.46 m (403.6 mLBGS). The shear plug is made of solid steel is held in-place with a 2000 psi solid brass shear pin. The packer was installed using a Baker L-10 on-off tool. No flow was recorded in the

borehole before or after the packer was installed at the top of the Salina A0 Unit.

The lower packer in DGR-5 was installed 486.6 mLBGS on March 24, 2010. The packer has an element length of 1.37m. The length from the top of the element to the base of the nipple, where the on-off tool attaches to the packer is 1.65 m (485.0 mLBGS). The shear plug is made of solid steel is held in-place with a 2000 psi solid brass shear pin. The packer was installed using a Baker L-10 on-off tool. No flow was recorded in the borehole before or after the packer was installed at the top of the Queenston Formation.

4.2 Packer Installation in DGR-6

The upper packer in DGR-6 was installed 424.4 mLBGS on July 19, 2010. The packer has an element length of 1.23 m. The length from the top of the element to the base of the nipple, where the on-off tool attaches to the packer is 1.35 m (423.1 mLBGS). The shear plug is made of solid steel is held in-place with a 2050 psi solid brass shear pin. The packer was installed using a Baker L-10 on-off tool. No flow was recorded in the borehole before or after the packer was installed at the top of the Salina A0 Unit.

The middle packer in DGR-6 was installed 500.2 mLBGS on July 16, 2010. The packer has an element length of 1.23 m. The length from the top of the element to the base of the nipple, where the on-off tool attaches to the packer is 1.35 m (498.9 mLBGS). The shear plug is made of solid steel is held in-place with a 2050 psi solid brass shear pin. The packer was installed using a Baker L-10 on-off tool. No flow was recorded in the borehole before or after the packer was installed at the bottom of the Manitoulin Formation.

The lower packer in DGR-5 was installed 864.2 mLBGS on July 12, 2010. The packer has an element length of 1.25 m. The length from the top of the element to the base of the nipple, where the on-off tool attaches to the packer is 1.35 m (862.9 mLBGS). The shear plug is made of solid steel is held in-place with a 2050 psi solid brass shear pin. The packer was installed using a Baker L-10 on-off tool. No flow was recorded in the borehole before or after the packer was installed at the bottom of the Kirkfield Formation.

5 Data Quality and Use

The selection and installation of packers presented in this Technical Report are based on standard techniques used in similar worldwide comprehensive deep drilling and testing programs, and the general requirements of the DGR Project Quality Plan (Intera Engineering Ltd., 2010b) and TP-10-01 (Intera Engineering Ltd., 2010a) . The types of packers were selected to provide an effective borehole seal that can remain in place over long period of time (i.e. 2 to 10 years), and, to ensure the borehole seal is removable (i.e. temporary) such that at any given time the complete borehole column may be accessed for further testing or permanent abandonment. Although the packers are intended to be left in the boreholes indefinitely, a periodic inspection is required to determine if replacement packers are necessary. The inspection frequency has been set at once every 3 years at a minimum. Inspection of the packers requires that the packers are deflated and removed from the borehole, as outlined in TP-10-01.

The length of drill pipe used to install the packers should be considered accurate to ±0.1m, not including possible stretching of the drill pipe. Changes in surface grading around the borehole may increase the error. Packer retrieval should only be carried out by individuals with significant experience installing, setting and retrieving bridge plugs. Pressure transducers were not installed in the intervals below the packers. Therefore, fluid pressure in the borehole will not be known when the packers are retrieved for inspection.

6 References

Armstrong, D. K. and T. R. Carter, 2006. An Updated Guide to the Subsurface Paleozoic Stratigraphy of Southern Ontario, Ontario Geological Survey, Open File Report 6191, 214 p.

Geofirma Engineering Ltd., 2011. Technical Report: Bedrock Formations in DGR-1 to DGR-6, TR-09-11, Revision 0, in preparation, Ottawa.

Intera Engineering Ltd., 2010a. Test Plan for Temporary Borehole Sealing of DGR-5 and DGR-6, TP-10-01, Revision 1, March 23, Ottawa.

Intera Engineering Ltd., 2010b. Project Quality Plan, DGR Site Characterization, Revision 5, December 6, Ottawa.

Intera Engineering Ltd., 2008. Phase 2 Geoscientific Site Characterization Plan, OPG's Deep Geologic Repository for Low and Intermediate Level Waste, Report INTERA 06-219.50-Phase 2 GSCP-R0, OPG 00216-PLAN-03902-00002-R00, April, Ottawa.

Intera Engineering Ltd., 2006. Geoscientific Site Characterization Plan, OPG's Deep Geologic Repository for Low and Intermediate Level Waste, Report INTERA 05-220-1, OPG 00216-REP-03902-00002-R00, April, Ottawa.

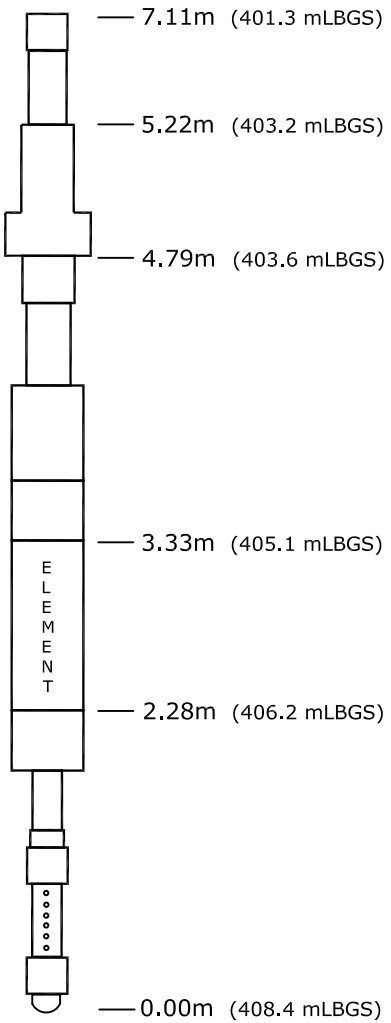
APPENDIX A

Schematic Packer Diagrams

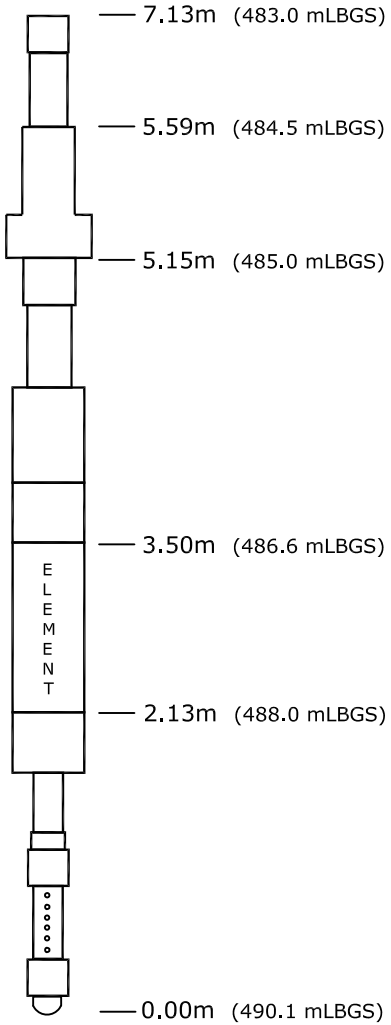
Figure A.1 – Schematic Diagram of Packers Installed in DGR-5

Figure A.2 – Schematic Diagram of Packers Installed in DGR-6

DGR-5 - 405.1



DGR-5 - 486.6

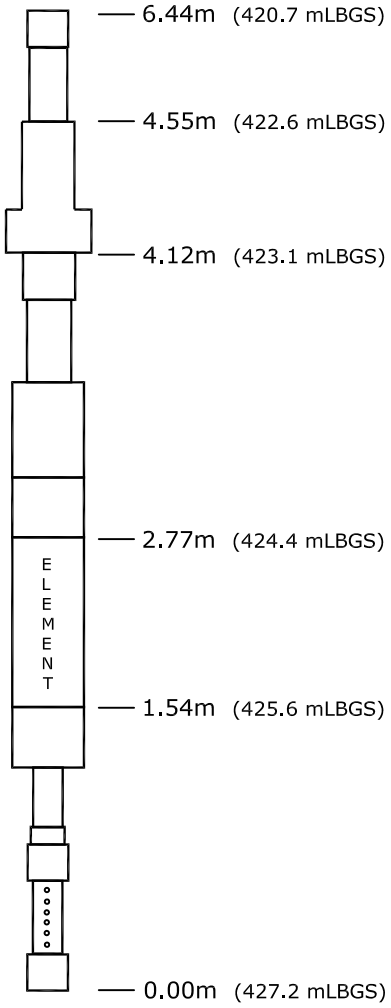


Schematic Diagram of Packers Installed in DGR-5 **TR-09-10: Technical Report - Temporary Sealing of DGR-5 & DGR-6**		Prepared by: NMP Reviewed by: DJH Date: 1-Nov-10
FIGURE A.1	Doc. No.: TR-09-10_Packer Diagrams_R0.dwg	

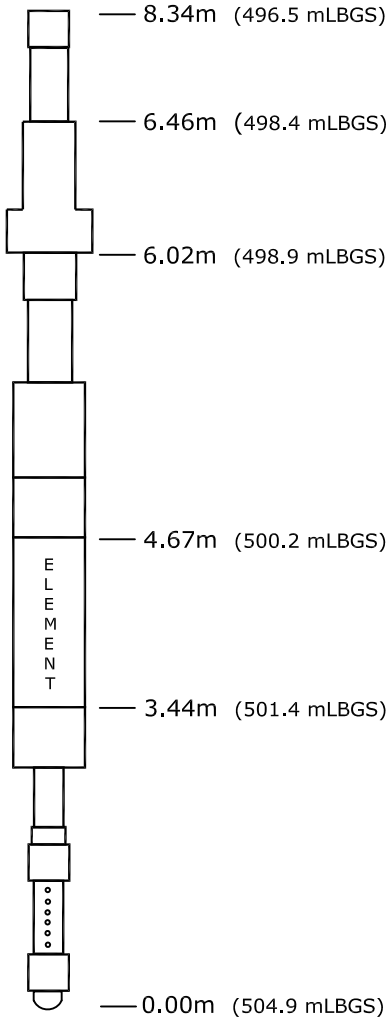
Drawing Not to Scale

INTERA

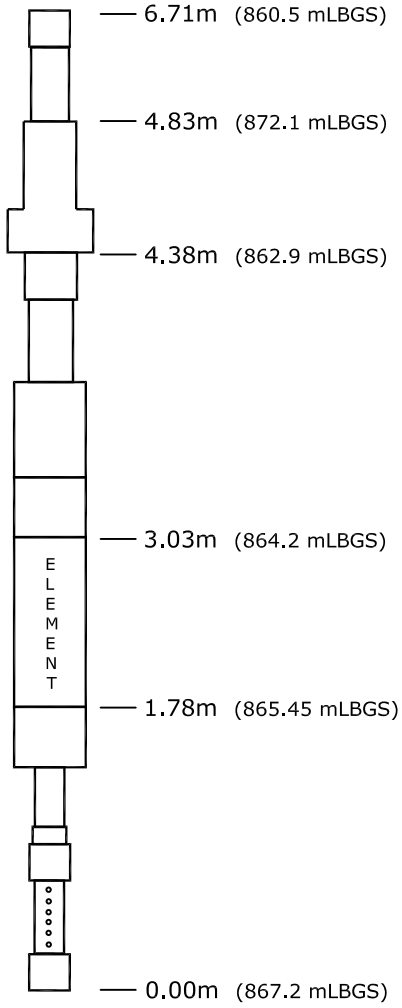
DGR-6 - 424.4



DGR-6 - 500.2



DGR-6 - 864.2



Schematic Diagram of Packers Installed in DGR-6
TR-09-10: Technical Report - Temporary Sealing of DGR-5 & DGR-6

FIGURE A.2	Doc. No.: TR-09-10_Packer Diagrams_R0.dwg	Prepared by: NMP Reviewed by: DJH Date: 1-Nov-10

Drawing Not to Scale

INTERA

APPENDIX B

Packer Photographs

DGR5-405.1 – Baker Packer

DGR5-486.6 – Weatherford Packer

DGR6-424.4 – Weatherford Packer

DGR6-424.4 – Weatherford Packer (shear pin)

DGR6-500.2 – Weatherford Packer

DGR6-864.2 – Weatherford Packer

On/Off Tool

On/Off Tool

APPENDIX C

Packer Specification Sheets

Weatherford®

Injection Production Packer (IPP™)

Single-Set Rotation-Release

Weatherford's single-set rotation-release injection production packer (*IPP*) is a field-proven and extremely versatile downhole service tool that can be installed in either cased or open hole, on a temporary or long-term basis. This packer is designed to be inflated, deflated, and retrieved one time per run; however, it can be redressed at the rig site for additional runs. With a relatively small OD, the packer can be run through restricted IDs and then set in larger openings. The standard elastomers are suitable for severe-service applications.

The packer is run in the well on threaded pipe (drillpipe or work string) and is inflated with application of work-string hydraulic pressure. To deflate and retrieve the tool, the work string is pulled upward and then rotated five turns to the right, allowing pressure between the element and the annulus above the packer to equalize. An additional pull causes the element to deflate into the tubing and annulus below the packer. When the element is completely deflated, the packer can be retrieved.

Applications

- Suitable for use in vertical, high-angle, or horizontal applications
- Can be used for open- or cased-hole zonal isolation
- Acts as a permanent or retrievable bridge plug
- Serves as a retainer for squeezing or treating formations below the tool
- Useful in locating casing or liner leaks
- Ideal for short-term production tests
- Useful for isolating casing patches

Weatherford International Ltd.
515 Post Oak Blvd., Suite 600
Houston, Texas 77027 USA
Tel: 713-693-4000
www.weatherford.com

Injection Production Packer (IPP™)

Single-Set Rotation-Release

Features, Advantages and Benefits

- Relatively small OD allows the packer to pass through restrictions so that it can be inflated and set in larger openings where mechanical packers and bridge plugs cannot be used.
- With a hydraulically activated inflation valve, the packer can be set without modification.
- Versatile design allows the packer to be run in open or cased hole.
- Elements are fully reinforced with strip or cable. The strip is standard for cased-hole use; when a portion of the ribs is exposed, it provides additional holding force. The strip element can be used in open hole as well, but cable reinforcement is preferred by many for its ability to achieve more settings.
- Elements can be inflated with cement for permanent installation.
- The packer can be redressed at the rig site for additional runs, saving time.
- Each element is manufactured from application-specific elastomers known for their superior strength and resistance to high temperatures and corrosive fluids and gases.
- Elements can be adapted to different mandrel sizes, making the packer suitable for a variety of applications.

Weatherford International Ltd.
515 Post Oak Blvd., Suite 600
Houston, Texas 77027 USA
Tel: 713-693-4000
www.weatherford.com

Injection Production Packer (IPP™)

Single-Set Rotation-Release

Specifications

Dimensions and Element Types

Element OD		Mandrel ID		Element Seal Length		Element Type (Cable/Strip)
(in.)	*(mm)*	(in.)	*(mm)*	(in.)	*(mm)*	
3.50	*89*	1.25	*32*	48.00	*1,219*	C/S
4.25	*108*	2.00	*51*	48.00	*1,219*	C/S
4.63	*117*	2.00	*51*	48.00	*1,219*	C/S
		2.50	*64*			S
5.00	*127*	2.00	*51*	48.00	*1,219*	C/S
5.50	*140*	2.00	*51*	48.00	*1,219*	C/S
		2.50	*64*			
6.25	*159*	2.00	*51*	48.00	*1,219*	C
		2.50	*64*			
6.75	*171*	2.00	*51*	48.00	*1,219*	C
		2.50	*64*			
6.88	*175*	2.00	*51*	48.00	*1,219*	S
		2.50	*64*	48.00	*1,219*	
7.50	*190*	2.50*	*64**	48.00	*1,219*	C/S
7.88	*200*	2.50*	*64**	48.00	*1,219*	C
9.00	*229*	2.50*	*64**	48.00	*1,219*	S
9.25	*235*	2.50*	*64**	48.00	*1,219*	C
10.50	*267*	2.50*	*64**	48.00	*1,219*	S

* Can be run on standard 2 1/2-in. ID chassis or heavy-duty 2 1/2-in. chassis.

Corresponding Chassis and Element Sizes

IPP Chassis ID		Element Size		Connections
(in.)	*(mm)*	(in.)	*(mm)*	
1-1/4	*31.8*	3.50	*88.9*	2 3/8-in. EUE box up × 2 3/8-in. EUE pin down
2	*50.8*	4.25 and larger	*108 and larger*	2 3/8-in. EUE box up × 2 7/8-in. EUE pin down
2-1/2	*63.5*	4.63 and larger	*118 and larger*	2 7/8-in. EUE box up × 3 ½-in. EUE pin down

Weatherford International Ltd.
515 Post Oak Blvd., Suite 600
Houston, Texas 77027 USA
Tel: 713-693-4000
www.weatherford.com

Injection Production Packer (IPP™)

Single-Set Rotation-Release

Options

- Elements are available in a variety of sizes, ranging from 3 1/2- to 10 1/2-in. OD, and can be changed to fit various hole sizes. (Weatherford also offers elements, ranging from 13 1/4- to 18 5/8-in. OD, for use with the heavy-duty version of this packer.)
- Elements can be constructed with fully covered or partially exposed steel rib reinforcement (strip) or fully covered cable reinforcement. Strip elements may incorporate an exposed rib section to provide anchoring in the wellbore when required.
- A delayed-opening feature, available for some sizes, allows the packer to be run where other hydraulic events will occur first.

Related Products

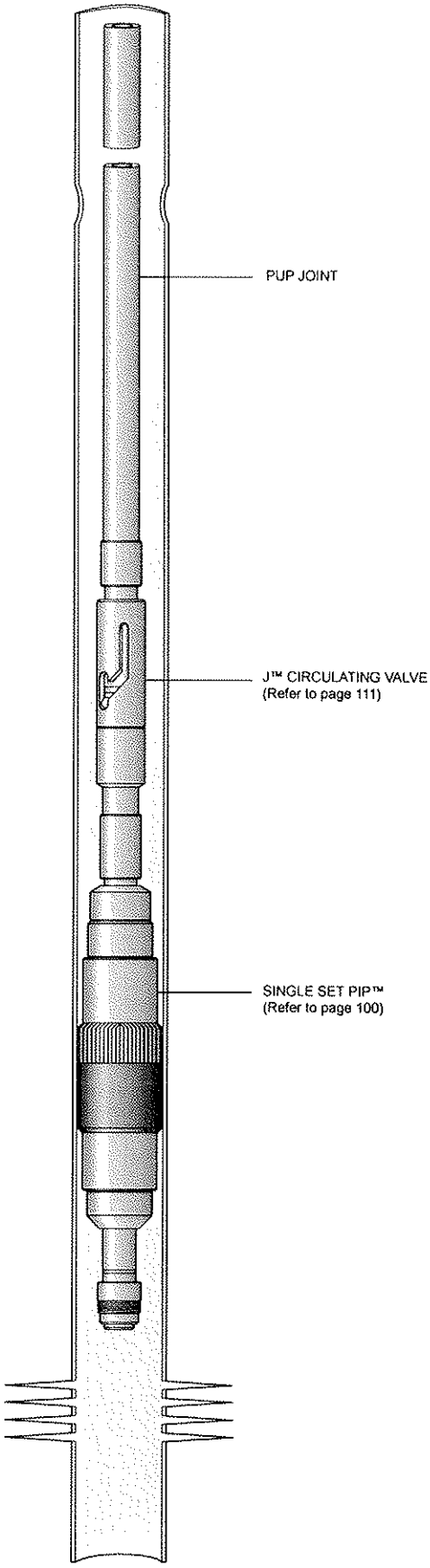
Weatherford provides a variety of complementary tools for use with this packer:

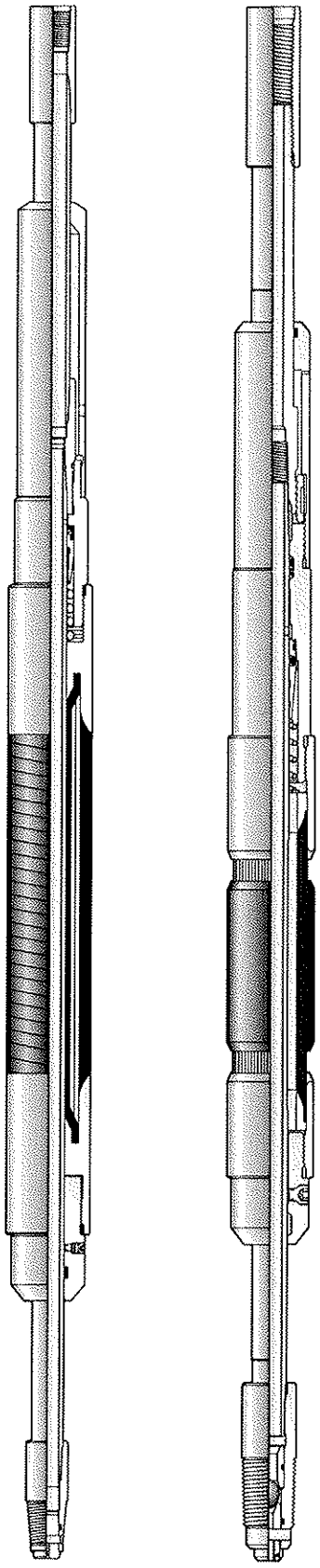
- Hydraulic disconnect with retrieval overshot
- J disconnect with retrieval overshot
- J circulating valves
- Bar/ball valves
- Rotation or tension/compression circulating valves
- Sleeve-type circulating valves
- Pump-down/shear-out plugs
- Solid-shear plugs
- Dump valve

Weatherford International Ltd.
515 Post Oak Blvd., Suite 600
Houston, Texas 77027 USA
Tel: 713-693-4000
www.weatherford.com

SINGLE SET PIP™/RESETTABLE

The Single Set Production Injection Packer (PIP™) is a retrievable, inflatable packer that may be run on drillpipe, threaded tubing or coiled tubing. It is best suited for performing zonal isolation in open hole or casing. Due to the inflatable elements large expansion characteristics, the packer can be run through restrictions in the wellbore whether planned or unplanned and set in the larger ID below. In this application the Single Set PIP or Resettable PIP is run through a casing restriction and set above a production zone. The treatment fluid is spotted to the J™ Circulating Valve. The valve is closed and the treatment fluid injected into the formation.





Single Set (SS) PIP™
Product Family No. H30001

Resettable (RS) PIP™
Product Family No. H30002

SINGLE SET (SS) PIP™

Product Family No. H30001

The Single Set (SS) Production Injection Packer (PIP™) is an ideal tool for performing zone isolation in open hole or casing. The PIP tool can be run through wellbore restrictions and set in washed out sections of open hole due to the large expansion capabilities of the field-proven inflatable element. The tool is ideal for treating, testing, production, injection and numerous other zone isolation applications. The single set PIP cannot be reset in the hole and must be brought to the surface for maintenance between settings.

FEATURES/BENEFITS

- Sets in casing or open hole
- Element OD sizes from 3-1/2" *(88.9 mm)* to 13-7/8" *(352.4 mm)*
- 66" *(1676.4 mm)* or 136" *(3454.4 mm)* element lengths
- Straddle packer configurations
- Set with pump pressure only (no tubing manipulation required)
- Standard right-hand rotation release or pull release option

RESETTABLE (RS) PIP™

Product Family No. H30002

The Resettable (RS) PIP is a multiple set packer designed for permanent or temporary use in both open hole and casing. The RS PIP tool can be run through wellbore restrictions and set in washed-out sections of open hole due to the large expansion capabilities of the field-proven inflatable element. The tool is ideal for treating, testing, production, injection and numerous other zone isolation applications.

FEATURES/BENEFITS

- Sets in casing or open hole
- Element OD sizes from 3-1/2" *(88.9 mm)* to 10-3/8" *(263.5 mm)*
- 66" *(1676.4 mm)* or 136" *(3454.4 mm)* element lengths
- Equalized prior to releasing with use of a J™ Circulating Valve
- Released with right-hand rotation and applied workstring tension
- Reset with drop ball and applied pump pressure coupled with workstring compression