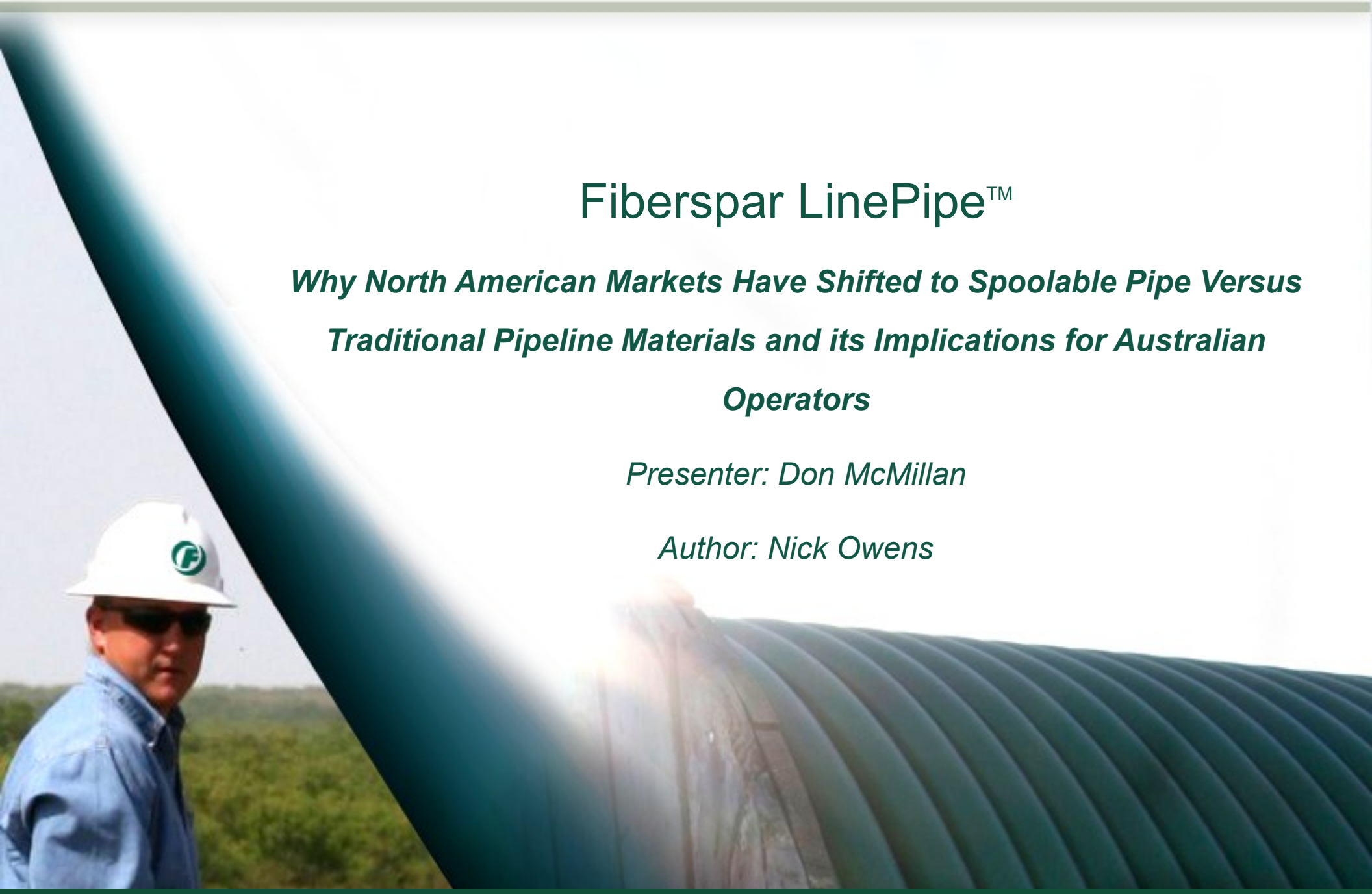

Fiberspar LinePipe™

Why North American Markets Have Shifted to Spoolable Pipe Versus Traditional Pipeline Materials and its Implications for Australian Operators

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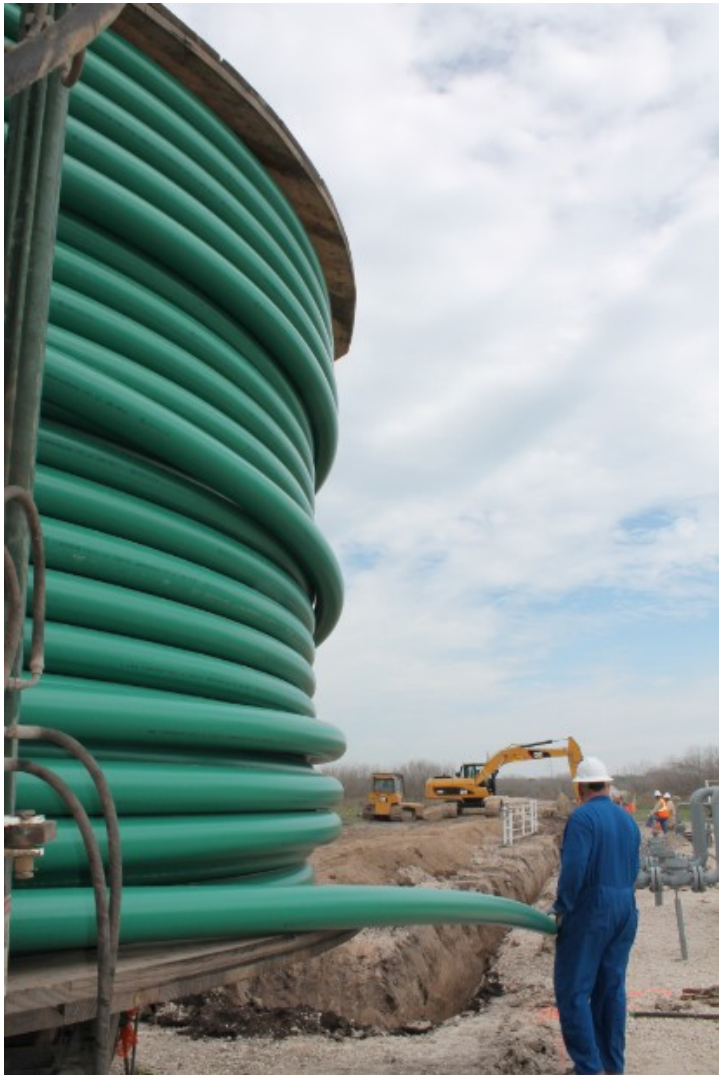
Author: Nick Owens

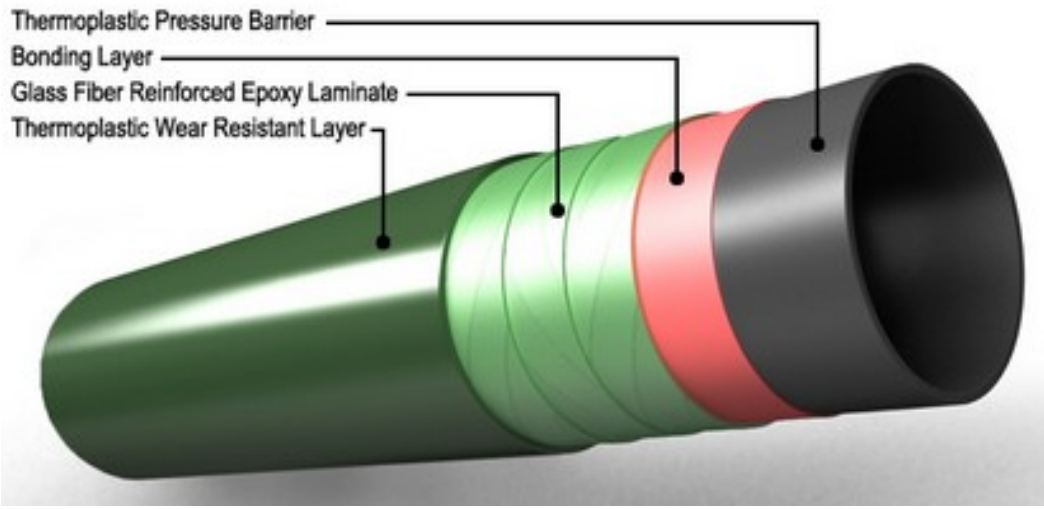
Background

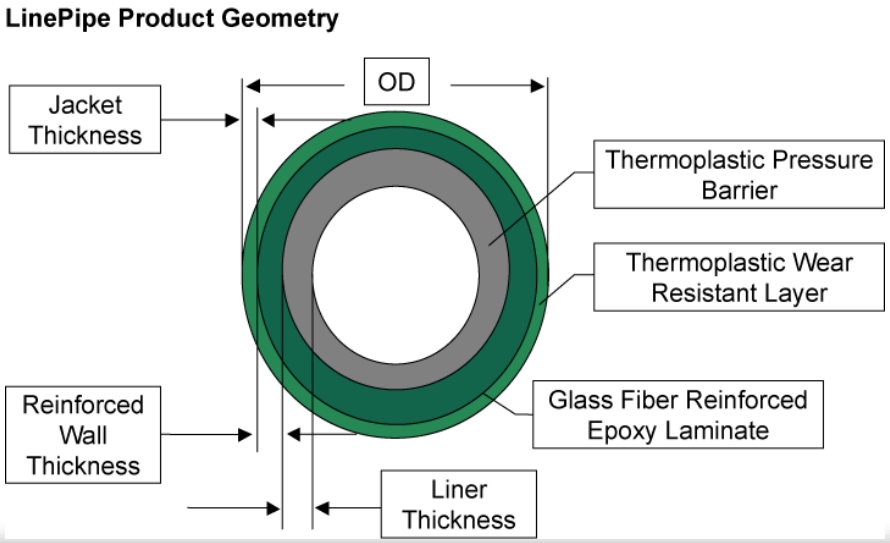
- More than 25,000 km of spoolable pipe has been installed in North America
- More than 450 operators
- Non-metallic pipe immune to corrosion
- Spoolable pipe encompasses 2 fundamentally different technologies:
  - Spoolable Glass Reinforced Epoxy pipe (SGRE)
  - Reinforced Thermoplastic Pipe (RTP)
- First SGRE installation in 1999



Spoolable Glass Reinforced Epoxy (SGRE)

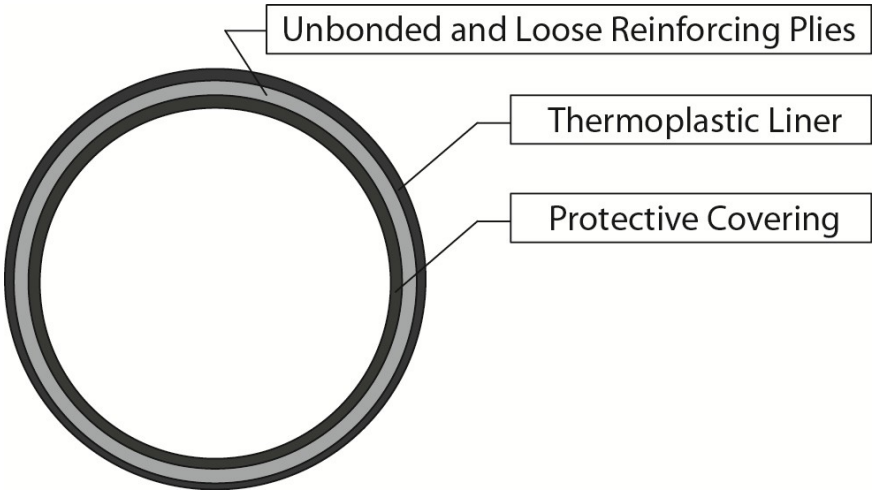
- Similar to existing stick fibreglass
- Fully bonded thermoplastic liner
- Liner acts as a fluid barrier
- GRE layer gives strength
- Exclusive and unique patented design
- Temperature rated to 60° C, 82° C & 95° C continuous operation
- Sizes up to 6.5”
- Full range of operating pressures – (750 - 2500 psi / 5.1 - 17.2 MPa)





Reinforced Thermoplastic (RTP)

- Structure with roots in standard, low pressure HDPE pipe
- Reinforcing layer wound around HDPE
- Different reinforcements available:
  - Steel wire (can corrode)
  - Loose glass fibre (cyclic issues)
  - Kevlar fibre (chemical & temp. limitations)
  - Polyester fibre (low pressure & temp.)
- Traditionally only available in lower temp. and pressure
- HDPE loaded at the connector interface



SGRE / Fiberspar LinePipe Evolution

- **1986** – Founded as a spin off from Massachusetts Institute of Technology
- **1989-2000** – Market Leader high tech sporting goods from advanced composite materials
- **1994-1996** – Joint Development with Conoco – initial focus was coiled tubing
- **1999** – First Commercial LinePipe
- **2003** – Full compliance with CSA Z662 (Canada)
- **2004** – Fiberspar LinePipe Canada created
- **2010** – capital investment – White Deer Energy
- **2011** – Fiberspar Australia created & 1st Australian Installation
- Leader in high pressure spoolable pipeline systems
  - Total installed base close to 15,000 Km (2011)
  - Installed more than 3,000 Km ft in 2010
- 1st installation 2,500 psi (17.2MPa) injection line in 1999 still in trouble free operation

Fiberspar LinePipe Can be Used for All Oilfield Applications

Applications

- Gas or oil gathering
- Water disposal
- Gas injection
- Water injection
- CO_2 injection
- Aromatic Service

Installation Methods

- Conventional trench
- Surface Lay
- Rehabilitation

Spoolable GRE Eliminates Corrosion and Increases Safety

- No risk of failure from corrosion
- Integrity monitoring and chemical treatment programs reduced/eliminated
- Rapid installation, minimum people and equipment at location, and minimal time spent in the ditch all significantly reduce safety risks during pipeline construction
- Smaller footprint
- Less ground disturbance
- Can also be used very effectively to remediate corroded steel pipelines at low cost without any ground disturbance

Unlike steel, Fiberspar does not corrode

Keys to North American Acceptance

- Lower overall installed cost
- Faster Installation
- Smaller Crew Size
  (3-5 people typically needed to install the pipe)
- Reduced Environmental Risk
  (spool lengths up to 2.7 km)
- Lower Safety Risks
  (less people required in the trench)
- Full API 15HR qualification
  (product is monogrammed)
- Simple Pipe connections

Pipe-to-Pipe or End Connector Information

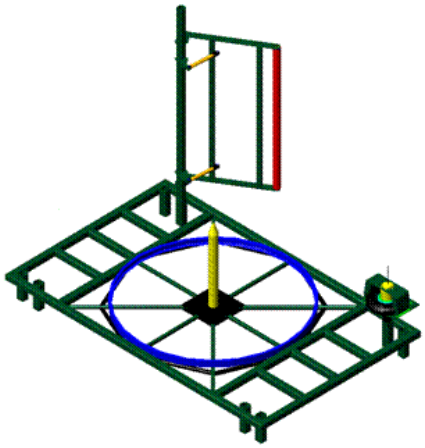
- Field installed in less than 30 min
- No glues or epoxies used
- Mechanical compression fitting
- O-Rings create internal seal
- Design safety factor **4x the pipe operating rating**
- Various configurations available
  - Welded on flanges—standard
  - Weld prep—standard
  - Threaded ends, hammer unions or as required

Aromatic Service

- Long history of Fiberspar in aromatic service in North America
- Spoolable GRE is suitable for hot aromatic service due to the following:
  - GRE layer is responsible for strength and is not affected by aromatics
  - HDPE only acts as a fluid barrier and does not provide pressure strength
  - HDPE is not loaded at connector interfaces
  - Fiberspar pipe and connectors have been tested at over 115 ° C
- Additional lab testing successfully conducted to simulate Australian conditions (82 deg.C and 25% aromatics)
- No product de-rating is required
- On going coupon field testing on first Australian installation

Fiberspar Installation Equipment

- Carousels:



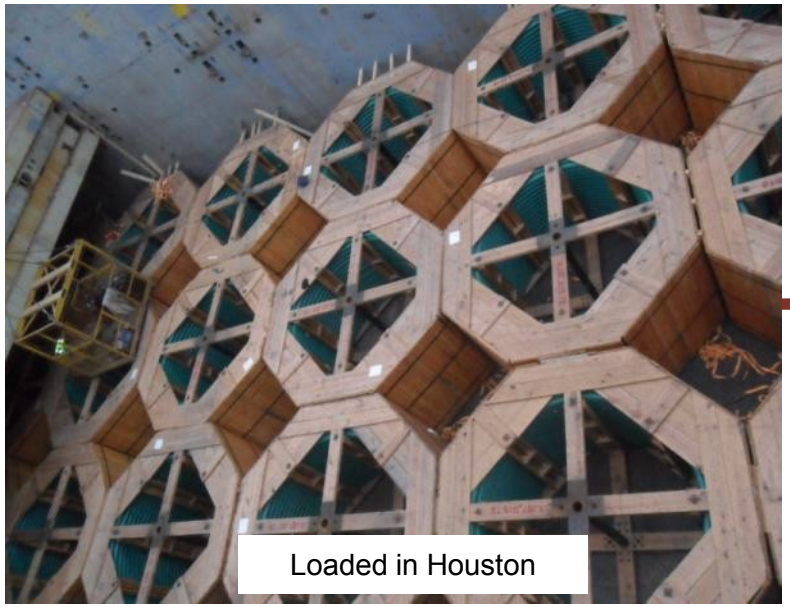
Installation methods – designed for speed and safety

- **Conventional open trench –** fast, minimal fittings, *less labor than jointed steel or stick pipe*
  - LinePipe installs in 1/3 the time with a 1/3 of the people of jointed pipe in many cases
  - Can be pulled through bore holes below grade for quick road and pipeline crossings
  - Long and continuous lengths eliminate need for welds, coatings and x-ray inspections
  - Install in a continuous length even in irregular trenches
  - Vertical or Horizontal Spools

Fiberspar in the Cooper Basin, Australia

- First Australian installation in 2011
- Approx. 50 km of 4.5” 1500 (X)
- High Aromatic gas line @ 75 ° C

Transportation – Plant to Site


Loaded in Houston

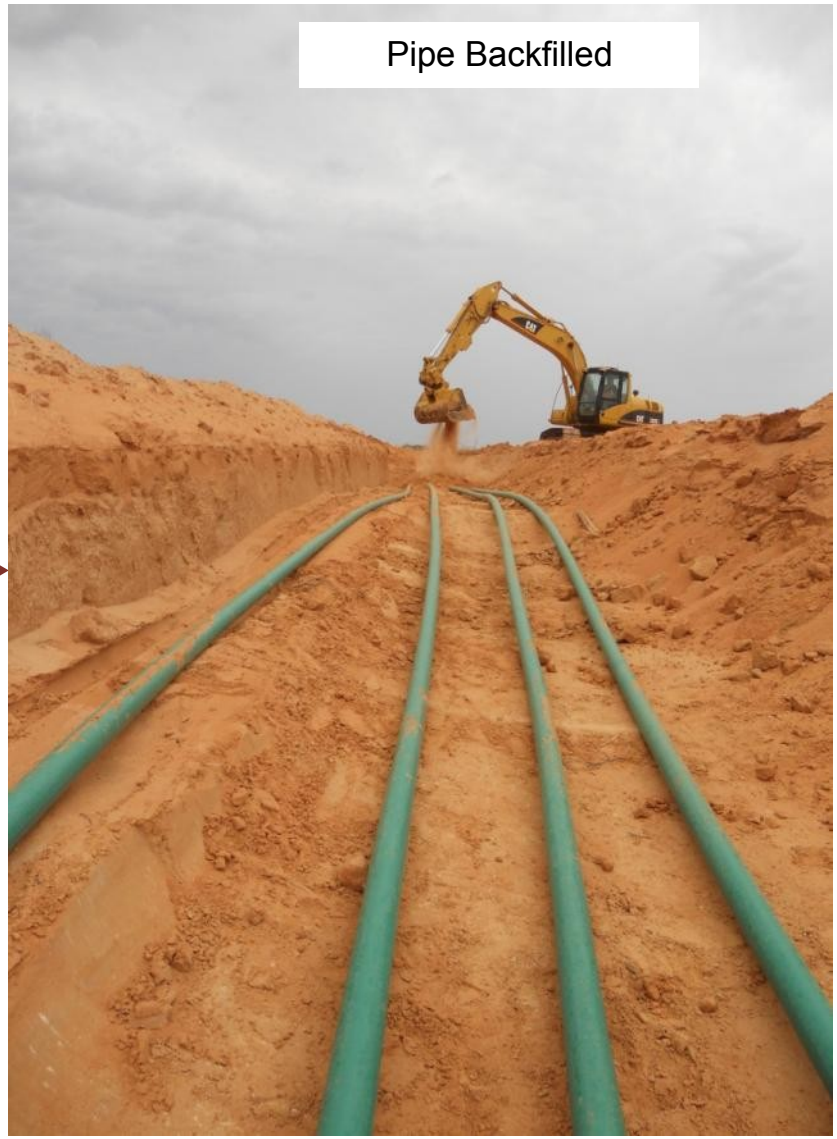

Shipped to Adelaide


Trucked to Moomba


Un-Loaded on Site

Installation (1)

Installation (2)



The Installation in Numbers

- **35** Number of spools shipped
- **1,372 m** Individual spool length
- **3,991 m** Average length of pipe laid per day
- **8,232 m** Maximum length of pipe laid per day
- **11 days** No. days to lay 48 km of pipe
- **6 days** No. Days to complete connectors and riser installation
- **2** The number of carousels used to deploy the pipe
- **2** The number of Fiberspar technicians present
- **Zero** The number of hydro-test failures (passed 1st time)

Implications for Australia

- 13+ years of service history
  - Samples taken after 13 years of service past manufacturing tests for new pipe
- The switch to SGRE is based on clear cost savings
- Benefits due to the remote nature of installations
- Dramatically reduces the need for skilled labour (welding crews etc).
- Reduced environmental impacted via fewer connections.
- No need for coatings or internal chemical treatments or inhibitors
- Suitable for a wide range of capacity and temperature requirements
- Can be pigged or hot oiled
- 100% Corrosion resistant

Conclusions

- North American operators have embraced spoolable composites for a number of years
- No longer regarded as a new technology
- Technology now being introduced Internationally
- The first Australian installation has been successfully completed
- It is believed that considerable benefits can be realised in the future in Australia