

# **MATRIX LGS<sup>®</sup>** **VIV & DRAG REDUCTION**

**FOR SUBSEA UMBILICALS RISERS & FLOWLINES (SURF) APPLICATIONS**



**LIGHTER • STRONGER • SMARTER**

# MATRIX LGS<sup>®</sup> SURF

The premise is simple: Matrix LGS<sup>®</sup> SURF solutions allow you to operate in environments where you couldn't normally. Designed for use across a range of cylindrical geometries in water currents, the system's passive and low profile disrupts boundary layer instability caused by vortex induced vibration (VIV), which reduces both amplitude and drag as well as VIV induced fatigue. Matrix LGS<sup>®</sup> is easily installed before or after field deployment, increasing operational flexibility whilst significantly reducing life cycle costs.

LGS is a registered trademark of AMOG Technologies Pty Ltd.



Significantly reduces vortex induced vibration and drag



Lower cross sectional drag profile compared to other VIV reduction solutions



Independently lab tested



ROV installable



No moving parts

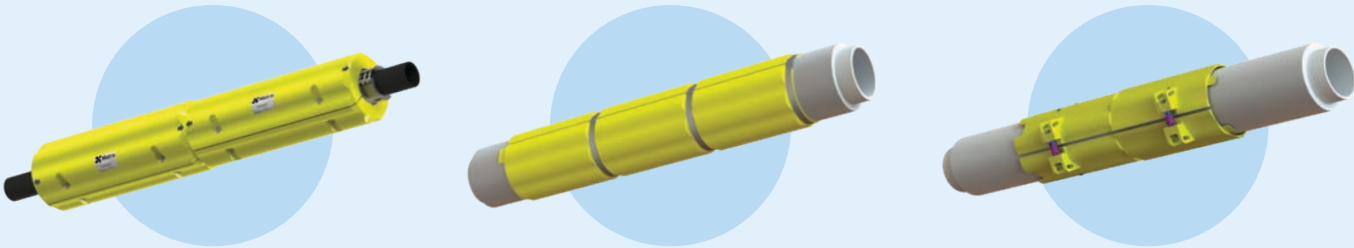


Designed & manufactured in accordance with relevant DNV and API 171 requirements

The revolutionary Matrix LGS<sup>®</sup> was inspired by the Saguaro cactus whose modest root system manages to keep the slender plant upright even when buffeted by the strongest of winds. It's the cactus' grooved profile that ameliorates the effect of high winds by interfering with the vortex formation process. This is exactly what the Matrix LGS<sup>®</sup> profile does in high currents and gives it its enviable performance characteristics.



# APPLICATIONS



| RIGID PRODUCTION RISERS & CAISSONS | FLEXIBLE RISERS & STEEL CATENARY RISERS | PIPELINES | MATRIX LGS <sup>®</sup> BENEFITS                                                                       |
|------------------------------------|-----------------------------------------|-----------|--------------------------------------------------------------------------------------------------------|
| ✓                                  | ✓                                       | -         | Lower riser deflections allows for simplified, more compact field layouts                              |
| ✓                                  | ✓                                       | -         | Smaller cross sectional area than helical strakes allows for smaller riser spacings                    |
| -                                  | -                                       | ✓         | Smaller cross sectional area than helical strakes allows for closer proximity to seabed topography     |
| ✓                                  | ✓                                       | ✓         | Incorporating profile into buoyancy reduces costs and requirements for secondary equipment attachments |
| ✓                                  | ✓                                       | ✓         | Subtle, robust profile facilitates easier defouling processes                                          |
| ✓                                  | ✓                                       | ✓         | Subtle, robust profile is deployment friendly                                                          |
| ✓                                  | ✓                                       | ✓         | LGS <sup>®</sup> profile can be incorporated into insulation moulding                                  |
| ✓                                  | ✓                                       | ✓         | Easily retrofittable                                                                                   |
| ✓                                  | ✓                                       | ✓         | Field proven                                                                                           |



# TESTING AND PERFORMANCE

## SUCCESSFUL LGS® FIELD DEPLOYMENT VALIDATES TECHNOLOGY

In 2018, field trial results from the Gulf of Mexico demonstrated that Matrix LGS® technology works as predicted in full-scale, real world operations. The results follow similar, large scale tank testing and four successful deployments in the Gulf. Analysis of the trial results show that the LGS system performed as expected and allowed for safe operations to continue during strong ocean current conditions where other alternatives would have proved inoperable.

Matrix and AMOG conducted field trials with 274 metres (900 feet) of LGS® at a depth of 1,828 metres (6,000 feet) in the Gulf of Mexico from July 2017. The trial validated, in an operational environment, the VIV and drag reduction characteristics derived from the high Reynolds number testing conducted at the National Research Centre in St John's, Canada.

Sensors used in the Gulf of Mexico trial captured movement and vibration data of the Matrix LGS® string. Matrix then compared the LGS® data with similar current profile data using a conventional, cylindrical buoyancy string. This allowed Matrix to further demonstrate the efficacy of the technology in strong current conditions.

Validated LGS model data confirms

High Reynolds number testing at National Research Centre, Canada

Lower drag coefficient than conventional cylindrical profile



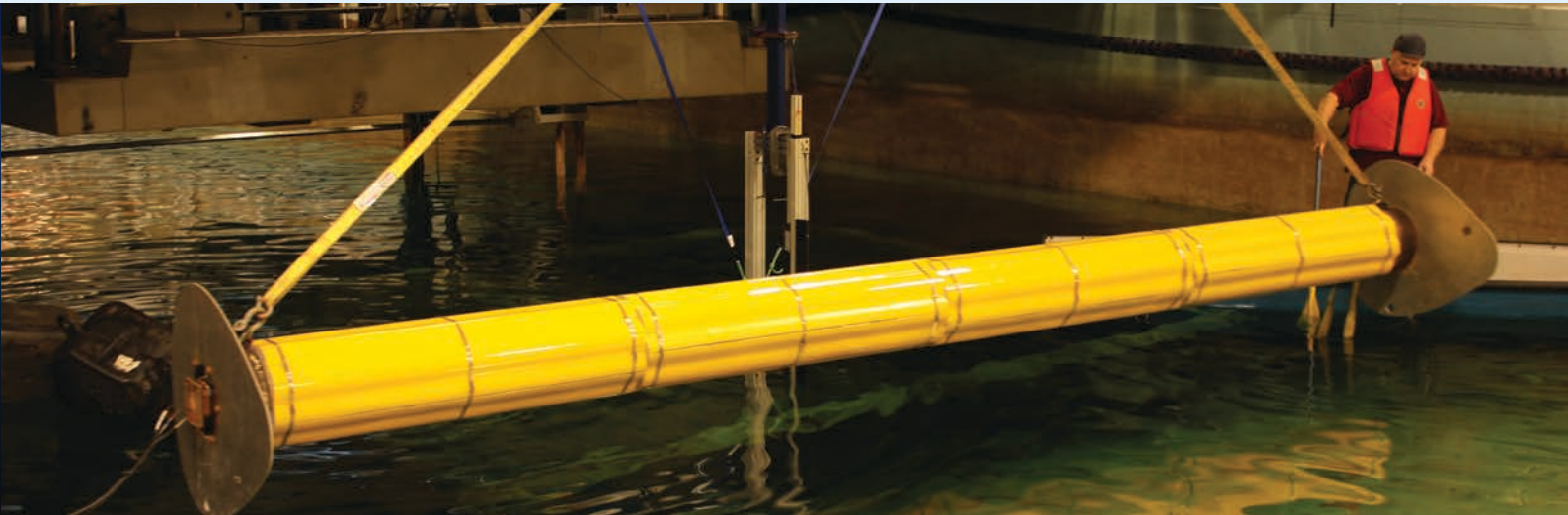
## LARGE SCALE TESTING AT CANADA'S NATIONAL RESEARCH COUNCIL

Large scale post-critical tests at Canada's National Research Council in St. John's, Newfoundland, Canada demonstrated that the LGS® system reduced both VIV amplitude and the resulting drag coefficient. The size of the St. John facility, largest of its kind in the world, enabled Matrix to test large scale models of LGS under high load and high speed conditions. Test outcomes exceeded predicted results from earlier small scale tests and surpassed the performance of current state of the art technologies.

Large scale prototypes were fabricated at the National Research Council in both profiles around test cylinders measuring approximately 5.88 mm long x 385 mm diameter. The prototypes were assembled onto a large test rig and dragged through a water filled test tank whereby the amplitude and vibration of the profiles were measured for a range of speeds under three different scenarios:

Over 75 tests were performed and benchmarked against a bare cylinder of the same dimensions. These tests supported findings of earlier smaller scale sub-critical testing. Importantly, the larger scale allowed the tests to work at higher Reynolds numbers (up to  $1.6 \times 10^6$ ). This is well into the post-critical flow regime that would be experienced offshore.

| FIXED MODE TESTS<br>- LOWER DRAG                                                                                                                                       | FREE VIBRATION TESTS - VIV<br>AMPLITUDE LESS THAN 0.25 A/D                                                                                                                                                                                                                                                                   | SUPERIOR PERFORMANCE IN<br>EXTREME CONDITIONS                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The fixed drag coefficient over a range of towing speeds averaged below 0.6.</p> <p>Level of drag is significantly lower than that achieved by a bare cylinder.</p> | <p>VIV during the tests was minimal. The typical VIV amplitude was less than 0.25 diameters, a significant reduction from the earlier sub-critical testing. The reduction in VIV amplitude further reduced the amplification of the drag coefficient. The maximum total measured Cd was 0.8 including VIV amplification.</p> | <p>A comparative evaluation of three identical risers in extreme current conditions clearly demonstrated the superior performance of Matrix LGS® when compared with fairings.</p> |





# PIPELINE FREE SPAN REMEDIATION

- CLIENT:** Operator
- PROJECT LOCATION:** North West coast of Australia
- PRODUCT:** ROV installable (Vortex Induced Vibrations) VIV and drag reduction covers
- TIME PERIOD:** July to Dec 2017
- KEY ACHIEVEMENTS:**
  - A new VIV and drag reduction technology product application
  - Rapid intallation rate
  - 40 year design life

### CHALLENGE

Seabed scour had elongated the free span lengths at buckle initiator (sleeper) locations along the production flowlines of our client’s asset. Engineering assessments showed that due to the uneven nature of the seabed, unacceptably long spans at some of the sleeper locations had resulted in spans not meeting the fatigue limit criteria due to excessive VIV.

The project involved several challenges including inconsistent and low clearances with the seabed, unique dimensional tolerances and physical features of the pipe, and a 40-year design life solution coupled with an agressive time frame for completion. The solution also required the VIV mitigation device to have a low drag profile due to the prevailing high currents which would result in unacceptably large lateral load scenarios.

### SOLUTION

Matrix engineers, with our client, used patented LGS® drag and VIV reduction technology to create a wrap-based shroud for pipelines. The solution is a fully ROV installable system. After extensive third-party scrutiny, our client and their review bodies were satisfied of an acceptable reduction in fatigue inducing VIV motions.

### OUTCOME

- The system that was developed featured:
- Greater linear coverage on the flow line due to LGS’s® low profile
  - A more robust and benign profile with relative immunity to seabed interactions
  - A much lower drag profile compared to helical strakes
  - No moving parts
  - An economically superior solution compared to other potential rectification methods
  - Effectively reduced VIV and fatigue
  - Subsea installation at a rate of approximately 2 m every 10 minutes.



# MATRIX COMPOSITES & ENGINEERING

Matrix is a leader in the design, engineering and manufacture of composite and advanced material technology. As a trusted partner, we work with our customers to deliver practical material science solutions to their unique challenges. Coupled with our commitment to R&D, Matrix helps our customers achieve the impossible.



World’s largest manufacturer of syntactic foams



ASX listed (MCE) since 2009



21 patents in multiple jurisdictions



Australia’s largest exporter of oil and gas equipment

### DESIGN & ENGINEERING

Matrix is committed to the research and development of technologies to help our customers, with R&D expenditures representing over 6.5% of turnover in 2018. Our global engineering network has offices in the USA and Australia, with representatives in 14 countries.

Over 25% of staff are degree qualified engineers or scientists.

### FACILITIES

Matrix’s primary facility and headquarters is in Henderson, Western Australia. The 80,000 m² site – with 22,000 m² under cover – has excellent access to sea (0.5 km), rail (20 km) and air (25 km) transport hubs and is licenced to store and process hazardous chemicals.

### CERTIFICATIONS

Matrix’s success is founded upon good processes. Both quality and health and safety systems have been certified to international standards.

Matrix was also one of the first Australian companies to be awarded “Trusted Trader” status.



# **MATRIX** **DELIVERING** **TO THE WORLD**

