

9 Sep 16

Project GRAID

STAGE 2 – DEVELOPMENT TESTING

SUCCESSFUL DELIVERY REWARD CRITERIA 9.2

Project Background

1. National Grid Gas Transmission (NGGT) and its partner organisations are engaged in an exciting project that is addressing the issue of how to inspect complex, below-ground pipework found at High Pressure Installations. The project is developing ground-breaking technology to provide the world's first robotic platform that will be able to provide real-time data on the condition of high pressure underground assets.
2. National Grid is collaborating with three British Small Medium Enterprises (SMEs) to develop ways to accurately assess the condition of its pipework assets that cannot currently be inspected via conventional Pipeline Inspection Gauges (PIGs). The complexity of pipework at High Pressure Installations (up to 94 Barg) presents a significant challenge for any robotic solution.
3. The solution being developed will enable NGGT to look inside their High Pressure Installations for the first time since their installation, in some cases going back nearly 50 years. The current asset management strategy for this pipework relies on above ground survey techniques, and is based on good design and construction practices having been applied to these assets. If corrosion is suspected the only way to confirm this presently is through excavation, which is both financially expensive and environmentally adverse. This project will enable a proactive, risk based approach to the management, maintenance and replacement of these ageing assets.

SDRC 9.2

4. Project GRAID SDRC 9.2 is as follows:

Successful Delivery Reward criterion	Evidence
(9.2) Development Testing completed by 9 September 2016: - robot access and inspection routes for all three trial sites development and validated including the formulation of Formal Process Safety Assessments; - the offline testing facility designed and distributed for competitive tender. Contract in place for its completion; - manufacture of a robotic platform primary	A report will be submitted by 9 September 2016 demonstrating that these measurable activities have taken place. Documentation for SDRC 9.2 uploaded to internal sharepoint site and project file, external version uploaded to website. Publish evidence of internal senior sign-off confirming successful completion of SDRC 9.2 no later than 19 December 2016.

<p>solution in order to test and further develop robotic design and meet the objectives of withstanding pressure of up to 100Barg whilst travelling 100m, negotiating two bends and taking visual and wall thickness measurements. This will involve successful bench testing (simulation) in a controlled environment of up to 6m with one bend;</p> <p>- launch and retrieval device manufactured to withstand pressure of 100Barg and minimise venting.</p>	
--	--

5. **Launch and Retrieval Device.** The project submitted a request to move the launch and retrieval device element from SDRC 9.2 to 9.3 on 26th July 2016. As such it will not form part of this report, but will appear on the SDRC 9.3 report which will be submitted on 30th April 2017.

Completion Evidence

6. The Project will be judged for the purposes of the NIC Successful Delivery Reward against the Successful Delivery Reward Criteria. The table below lists the activities that have taken place to meet SDRC 9.2 along with the documentation that evidences their completion. The documentation is held on the project's SharePoint site and requires an account to view. An account has been created for the Ofgem Project Officer.

Ser (a)	Activity (b)	Outputs (c)	Evidence (d)
1	Beta Robot Development – Overall Design Control Phase 1	Scope & specification check Budget control and resource System architecture drawing Design review	Synthotech Beta Phase Stage Gate 1 dated 15 th Mar 16
	Beta Robot Development – Overall Design Control Phase 2	Integration of all work packages Test schedule final assembly control Test report collation SDRC delivery compliance Full system testing of the robot in a short pipe Final design review and build reports Design for Manufacture reviews (DFM) Implement build modifications following DFM Demonstration day of the robot	Synthotech Beta Phase End Stage Report dated 7 th Sep 16
2	Beta Robot Development – Operator Control Systems Phase 1	Control systems review and architecture plan Control centre user interface mechanical design Control centre user interface Signal locator Failure mode identification system (warnings and alarms)	Synthotech Beta Phase Stage Gate 1 dated 15 th Mar 16
	Beta Robot Development – Operator Control Systems Phase 2	Control system for robot Control system hardware Control system software Control system for UMS Cable routing and management Slip rings for rotational parts Plugs and cable connectors Design review	Synthotech Beta Phase End Stage Report dated 7 th Sep 16

		Part procurement Bill of materials generation Robot circuit assembly Control centre assembly Robot circuit assembly final assembly Individual system tests Full control tests on the robot	
3	Beta Robot Development – Umbilical Management System Phase 1	Stakeholder engagement plan Management of design requirements with RMA/Premtech Calculations for power requirements Design of cable drum Design of link to outside recovery handle Design of tray loading system Quarterly technology tracker update Quarterly review of university research papers Quarterly patent tracker update Quarterly standards and regulations tracker update Design of cable pay out system Design of cable rotation system Design of cable systems Through wall connector Control System for control of motors Design review Cable harness/slip rings Design of connection plug to the robot	Synthotech Beta Phase Stage Gate 1 dated 15 th Mar 16
4	Beta Robot Development – Umbilical Management System Phase 2	Bill of materials generation Part procurement Support the production of G35 and related documentation UMS assembly Review and challenge operating procedures and method statements camera integration electrical wiring Quarterly technology tracker update Quarterly review of university research papers Quarterly patent tracker update Stakeholder engagement plan review final assembly Spool in and out test Electrical conductivity test Robot plug pull test Recovery mode test camera vision test	Synthotech Beta Phase End Stage Report dated 7 th Sep 16
5	Beta Robot Development – Robotic Inspection Device Phase 1	Vision systems Drive systems Non-destructive testing Secondary Sensors	Synthotech Beta Phase Stage Gate 1 dated 15 th Mar 16
6	Beta Robot Development – Robotic Inspection Device Phase 2	Vision systems Drive systems Non-destructive testing Secondary Sensors	Synthotech Beta Phase End Stage Report dated 7 th Sep 16
7	Standard Connections Drawings and	Under pressure connection drawings Shut down connection drawings Working area requirements	Premtech publication: PREM128-REP-0000-0206

	Report	Opportunities & Constraints Matrix Generic Risk Register (RR) Costings C&R meeting Report	
8	Robot insertion and extraction points report and drawings – Bacton	Connection option drawings – GA's Working area drawing Generic RR Launch site screening meeting Report	Premtech publication: PREM128-REP-1211-0210
9	Robot insertion and extraction points report and drawings – Wormington	Connection option drawings – GA's Working area drawing Generic RR Launch site screening meeting Report	Premtech publication: PREM128-REP-7260-0214
10	Robot insertion and extraction points report and drawings – Tirley	Connection option drawings – GA's Working area drawing Generic RR Launch site screening meeting Report	Premtech publication: PREM128-REP-4629-0212
11	Robot inspection route drawings and reports – Bacton	Go not Go drawings Areas of Interest Off Site trials matching Launch site screening meeting Report	Premtech publication: PREM128-REP-1211-0225
12	Robot inspection route drawings and reports - Wormington	Go not Go drawings Areas of Interest Off Site trials matching Launch site screening meeting Report	Premtech publication: PREM128-REP-7260-0226
13	Robot inspection route drawings and reports – Tirley	Go not Go drawings Areas of Interest Off Site trials matching Launch site screening meeting Report	Premtech publication: PREM128-REP-4629-0227
14	Connection Point – Cost Benefit Analysis – Bacton, Tirley & Wormington	Launch connection drawings Launch connection MTO G/19 or G/35 Assessment Process Safety Assessment Environmental Assessment Operational Risk Assessment Costings Launch site selection meeting Report Site visits Go not Go drawings Site laser scans Site connection drawings Off Site trials matching Generic RR FPSA Formulation	Premtech publications: PREM128-REP-0000-0228

		Costings	
		Report	
15	Stage 2 Report	Stage 2 Report	To follow

Stage 2 Report

7. Premtech and Synthotech submitted their individual stage 2 reports on the 9th Sep 16 as the final deliverable for stage 2 activities. These stage reports provide evidence of the work that has been carried out during stage 2 and bring together the publications listed above. The project's stage 2 report will be published along with evidence of internal senior sign-off no later than 19th December 2016 as per the SDRC evidence criteria.

Jon Lelliot
September 2016