Engineering Justification Paper

Integration Systems

Version: Final

Date: December 2019

Classification: Highly Confidential

Reference: SGN IT – 015 Integ EJPDec19

1 Table of Contents

2 Introduction

This paper provides architectural justification to support SGN's proposal to spend £1.1 million (over five years starting in April 2021) on maintaining our IT Integration platform.

SGN need to receive emergency and metering work, provide services and updates on our website, schedule work that has been received to assign to an Engineer, provide accurate location details for jobs, share information internally as well as externally with shippers and suppliers through Xoserve and many more.

SGN uses their integration platforms to handle these industry standard transactions. Following investment in GD1, our integration platform will require upgrade and refresh during GD2.

The operation of these systems underpins SGN's ability to run and maintain a safe and reliable network as required to meet the needs of its customers throughout the GD2 period. A failure in the systems could present significant risk to SGN and its customers leading to loss of life or licence.

It is important that our Integration Platform is maintained and patched.

2.1 General Background

SGN's integration platform is vital to the operation of the whole SGN Business. It is the component within our IT infrastructure which enables SGN, amongst other things, to:

- Receive emergency jobs from Cadent, and exchange information with National Grid
- Provide quotation information to customers
- Pay suppliers and staff.
- Share information with shippers through XOServe
- Exchange information between our Core Front Office Dispatch and Asset Management systems

Fundamentally it is the tool that enables SGN's IT Systems to pass data to one another internally, and also externally to 3rd parties.

In order to provide continuity of service for our customers and suppliers SGN needs to be able to maintain the current level of data exchange with industry partners. This is especially important for supporting inbound emergency work and scheduling services. This is essential to ensuring that we are able to meet our licencing conditions and regulatory outputs in order to run operations safely on a daily basis.

SGN intends to maintain and develop its integration capability to inter-party messages that must be delivered in a timely, secure and reliable manner. New services and data flows should be utilised with minimum impact and cost and changes to existing services can be effectively and efficiently managed. SGN will continue to deliver integrations as a service which reduces the impact of any step change on the system landscape, infrastructure and skills required to support these. This will however, require investment in maintaining the existing integrations and a provision for additional capacity.

This paper focuses solely on the minimum investment required to maintaining the current level of operation on our Integration platform and keeping that Integration platform operating and supported for GD2.

The funding will ensure that the Integration software and hardware is kept up to date in line with 3rd party support contracts and internal policy designed to ensure the business can operate with minimal risk of IT failure.

The operation of the Integration platform underpins SGN's ability to run and maintain a safe and reliable network as required to meet the needs of its customers throughout the GD2 period. A failure in the Integration platform could present significant risk to SGN and its customers leading to loss of life or licence.

In line with Customer and Stakeholder expectations this paper does not seek to justify enhancing or adding to functionality to those Core systems.

As with all IT systems, the 3rd party suppliers of those systems provide regular patches which must be applied to maintain the support agreement. It is vital that patching and maintenance is up to date to ensure that outages on those systems are minimised.

Upon reviewing our plan with the CEG group it was clear there was an expectation that SGN get independent validation of their IT investment plans to ensure proposed investment is in the correct areas and the value we are expecting to spend is in line with industry analyst predictions. The IT business plan has been validated by Gartner (report available as part of GD2 submission) and the proposed spend on integration replacement is within their accepted benchmark range.

Following our stakeholder workshops, it was clear that the areas important to our customers are Keeping the gas flowing and Providing excellent service and therefore maintaining our integration platforms is critical for SGN to maintain the service.

2.2 Site Specific Background

Our integration platform is hosted by the vendor as part of a Software as a Service agreement (SaaS). Therefore, it will not exist at any specific SGN site. All SGN offices, locations and staff will however be supported indirectly by this service.

3 Equipment Summary

Our Integration platform is a Software as a Service system called Mulesoft. This has recently been acquired by Salesforce. The software resides in the Cloud.

All the software is provided as high availability (99.95% uptime) with the ability to 'fail-over' should the primary service fail.

4 Problem Statement

The investment outlined in this paper is considered mandatory by SGN. It relates to the effort required to maintain Integration systems in order to continue to provide the current levels of operation that our business needs to undertake its licenced and statutory obligations.

The work is required to ensure that our Integration platform remains in support and continues to operate to the current levels. If we do nothing, there is a significant risk of delay or loss of data exchanged between systems, and also increased risk of complete outage. This will result in failure to meet standards and potential loss of life or damage.

Throughout GD2 SGN will need to ensure continued robust integration and the ability to exchange time critical information with Cadent, National Grid, Xoserve, HMRC and other third parties as well as our own internal systems.

Why are we doing this work and what happens if we do nothing?
The work is required to ensure that we can send messages between our systems and to the likes of NG. Without this, we will not receive notifications of emergency gas escapes.

If we do nothing, there is a significant risk of loss of our Integration systems for a long period of time. This will result in failure to meet standards and potential loss of life or damage to property due to our inability to attend gas escapes within our licensed condition and/or manage adequately the health of our underground assets.

What is the outcome that we want to achieve?
Continued support of our emergency gas escape, repair, maintenance and replacement operations.

How will we understand if the spend has been successful?
Our primary output measures will continue to be met. Retention of our License to Operate.

4.1 Narrative Real-Life Example of Problem

Failure of System Leading to Loss or Injury

The Integration systems ensure that data is transferred in a timely manner to our field-based systems. This enables us to ensure that our Engineers arrive safely on site in timely fashion, to deal with emergency gas escapes.

If we have outages as a result of software not being maintained, engineers may not be dispatched to jobs on time, or with the right information. This could lead to increased risk of gas escape explosion and therefore, damage to property, injury and/or loss of life.

An example would be a complete outage on our Integration platform resulting in loss of emergency job information from Cadent. A customer has called in a gas escape to the emergency gas escape telephone service. Cadent have captured the incident which would normally be sent to SGN within a few minutes. SGN must attend the incident within 60 minutes on 97% of occasions as part of its' licence conditions.

Due to the integration failure, data would either be lost or delayed. Therefore, the emergency job would not reach SGN and/or no engineer would be dispatched to the job. In the worst case, the

failure to resolve the incident within standard would result in significant damage to property, injury or fatality.

Security Breach

The Integration systems pass a mixture of critical asset data (where pipes are in the ground), and also customer personal data to enable us to engage with our Stakeholders.

Where essential maintenance of systems, including 3rd party patching, is not applied, there is an increased risk of security vulnerability and therefore data loss and/or disruption to services.

Therefore, if we do not maintain our systems, there is a high risk of Customer data loss which can result in GDPR fines of up to 4% of revenue. In the case of disruption or failure of our critical services due to a cyber breach. SGN would be liable under the Network Information Systems Directive to similar fines i.e. 4% of revenue.

4.2 Spend Boundaries

This paper focuses solely on the minimum investment required to maintain the current levels of operation on our Integration platform and keeping that Integration platform operating and supported throughout GD2.

5 Probability of Failure

SGN are committed to preventing failure of IT assets that underpin critical business services. Probability of failure is linked to technology roadmaps as defined by application and infrastructure providers. If we do not maintain our IT estate as contractually* required, applications become end of life, support becomes unavailable and SGN would be unable to meet its regulatory outputs due to critical process and system failures. SGN predict the probability of failure to be 100% if we do not maintain our Integration Platform in line with recommendation from 3rd party suppliers, SGN IT policy and agreed architectural principles.

*Contracts require applications to be upgraded prior to reaching the point where probability of failure indicates systems will fail in one of three ways (functional failure, technical failure or security failure)

5.1 Probability of failure assurance

IT industry bodies such as Gartner recognise the fact that the failure rate of systems increases significantly with time when systems are not maintained; this combined with changing security threats mean that we have no option but to maintain and refresh our applications.

6 Consequence of Failure

The following table outlines the consequence of failing to invest in ongoing support and maintenance of SGN IT assets.

Reason for failure	Consequence of Failure
Failure to carry out upgrade or replacement activity required within 3rd party contracts to remain in support	Critical process and system failures ultimately leading to leading to failure in emergency standards, gas explosion and loss of life (£16m loss of life, up to £100m/10% of turnover fine, unlimited HSE Penalty). Loss of licence to operate. Loss of gas supply to customers for extended periods.
Failure to carry out upgrade or replacement activity due to applications or infrastructure being deemed 'end of life' by 3rd party providers	
Failure to carry out upgrade or replacement activity driven by the need to remain secure against an ever-increasing cyber security threat	
Failure to carry out upgrade or replacement activity deemed critical by SGN to ensure we continue to meet our licence obligations and regulatory outputs	

7 Options Considered

7.1 Baseline – Do Nothing

This option is not viable. This would involve leaving the IT systems to go out of support. This would leave a 100% likelihood of failure on these critical applications.

This would ultimately leave SGN unable to function as a business. Operational and non-operational staff would not be able operate safely. SGN would breach our licence conditions.

7.2 Upgrade and refresh our integration platform

This is the most basic option and will simply enable our Integration platform to remain in support. SGN will ensure that regular patching is applied throughout the GD2 period in line with the 3rd party software suppliers requirement to remain in support. It is also expected that there will need to be one major upgrade throughout the GD2 period.

From a technical perspective this will involve applying appropriate patches and upgrades in line with the 3rd party releases, and SGN Architectural and Security policies and standards. The upgrades typically involve a design, configuration, build and implementation, release planning (allowing for

any outages internally and with associated third parties), testing with all other systems including 3rd party systems and warranty. A tender may need to be run to select a system integrator supplier.

SGN will continue to prioritise integration delivery on the existing platform averaging around 20-30 new, modified and merged integrations per annum incurring development and additional platform charges. Migration of the Mulesoft Platform to the latest release in 2024 in line with the current pattern of the suppliers end of life (EOL) announcements and based on SGN plans to migrate to the most current version pre GD2. Significant platform upgrades require changes to the integration code in order to maintain compatibility.

Solutions will be developed in line with SGN IT Strategy whilst ensuring architectural principles and security standards are adhered to unless a clear exemption is provided. SGN IT Strategy outlines a Cloud first, buy not build approach ensuring that the total cost of ownership of all solutions is the most appropriate for the size and scale of change.

Based on previous upgrades, a single major upgrade for Integration platforms takes 12 to 18 months and costs in the region of £750k. We would expect to run one major upgrade in GD2.

Minor patches can be applied in a handful of months. SGN is proposing around £150k per annum to remain on top of the patching needs outside of the major upgrade.

The benefit to this option is that it is the cheapest and simplest in order to maintain our current levels of service.

7.3 Complete replacement of SGN's integration platform and associated integrations

This will involve the selection, purchase and implementation of a different Integration Platform along with a rebuild of all of the current integrations.

The delivery would include analysis and configuration of the selected tools, and a complete implementation of the toolset and all integrations. Ongoing patching would still be required

The application selection would be handled through a regulated tender process.

From a technical perspective this option would require Architecture, Design, implementation and release planning (allowing for any outages), testing with all other systems, implementation and warranty. A tender would need to be run to select a partner.

On previous upgrades, costs have been in the region of £750k, so SGN would expect the purchase of a new tool, reimplementation and testing, so be significantly higher than that figure. SGN estimates that the cost of replacement would be around £1.5m and take 18 months to 2 years to complete. Patching and upgrades would still be required throughout GD2, estimated at around £150k per annum.

The benefits to this option are that SGN could look to move to integration technologies where professional services are less costly. This could provide cost reductions moving beyond GD2 on major upgrades.

7.4 Options Technical Summary Table

Table 1: Technical Options Summary

Option	First Year of Spend	Final Year of Spend	Volume of Interventions	Equipment / Investment Design Life	Total Cost
Baseline - Do Nothing	2025	2025	0	0	0.00
Refresh and enhance SGN's integration platform	2022	2026	10	5	1.10
Complete replacement of SGN's integration platform and associated integrations	2022	2022	9	8	2.55

Please note the costs outlined in the Options Technical Summary Table are based on the following assumptions:

Option 1 Assumptions:

- That it is possible to continue to refresh the Mulesoft Integration platform, and that the software provider does not cease support of their products.
- That the spend levels in GD1 are sufficient to fund the level of application refresh required in GD2.
- Asset life is assumed at 5 years, which is on the high end for an IT product.
- That SGN remains with its current integration platform throughout GD2. We will not replace it as we have not budgeted for a full replacement.

Baseline Assumptions:

- SGN manage its IT estate in line with the HSEs ALARP (as low as reasonably practicable) risk management principles. On that basis SGN have assumed a failure to invest in required (see engineering justification paper for more detail) upgrade, replacement or refresh activity for safety critical systems, would lead to catastrophic system failure as well as a lack of 3rd party support (based on support contracts, 3rd party roadmaps, architectural standards and internal policies, designed to ensure upgrade, replacement or refresh activity is carried out at the appropriate point in time to in order to prevent a non-recoverable functional, technical or security failure).
- SGN have assumed that a lack of investment combined with a lack of support would prevent the reinstatement of systems should they fail.
- SGN have assumed a catastrophic failure of safety critical systems and an inability to reinstate systems after failure would lead to an inability to respond to gas emergencies, an inability to know where our assets are and an inability to track performance and regulatory outputs.
- SGN have assumed an inability to respond to gas emergencies, an inability to know where our assets are and an inability to track performance and regulatory outputs would inevitably lead to a catastrophic incident e.g. explosion and loss of life (£16m). This assumption is supported by section 2 of the Health and Safety at work act which identifies scenarios that would result in loss of life.

- SGN have assumed an inability to respond to gas emergencies, an inability to know where our assets are and an inability to track performance and regulatory outputs would inevitably lead to an inability to operate. This would lead to a catastrophic breach of license conditions (up to £100m fine)
- SGN have assumed catastrophic failures in regard to loss of life (£16m), a breach of license conditions (up to £100m) will occur within a year of failing to adhere to support contracts, 3rd party roadmaps, architectural standards and internal policies designed to ensure upgrade, replacement or refresh activity is carried out at the appropriate point in time to in order to prevent a non-recoverable functional, technical or security failure

7.5 Options Cost Summary Table

Table 2: Option 1 Cost Summary

Option	Template	Cost Breakdown	Total Cost (£m)
Refresh and enhance SGN's integration platform	IT Capex	Resources	0.99
		Software	0.06
		Hardware	0.06
		Contingency	0.00
		Total	**1.10**

Table 3: Option 2 Cost Summary

Option	Template	Cost Breakdown	Total Cost (£m)
Complete replacement of SGN's integration platform and associated integrations	IT Capex	Resources	0.92
		Software	0.17
		Hardware	0.06
		Contingency	0.00
		Total	**1.15**
	IT Opex	Resources	1.26
		Software	0.14
		Hardware	0.00
		Contingency	0.00
		Total	**1.40**

8 Business Case Outline and Discussion

The Business Case here is based on the need to maintain our Integration platform so that it continues to operate at our current levels. If we do not do this, we are predicting a significant risk of loss of our Integration Platform for a long period of time. This will result in failure in emergency standards, gas explosion and loss of life (£16m loss of life, up to £100m/10% of turnover fine, unlimited HSE Penalty).

In addition, SGN could receive Penalties from failure to notice Highway Authorities on commencement, extension and finishing of works. There would also be disruption to society and stakeholders through no co-ordination of Streetworks by the Highways Authorities.

By investing in the maintenance of our Integration Platform, we will ensure that they remain in support and in good working order.

8.1 Key Business Case Drivers Description

Table 4: Summary of Key Value Drivers

Option No.	Desc. of Option	Key Value Driver
1	Upgrade and refresh our integration platform	Ability for SGN to respond to incidents. Emergency, Repair, Risk Reduction, Reliability and Customer Outputs maintained Protects our data – customer and asset Enables us to meet our outputs and license conditions
2	Complete replacement of SGN's integration platform and associated integrations	Ability for SGN to respond to incidents. Emergency, Repair, Risk Reduction, Reliability and Customer Outputs maintained Protects our data – customer and asset Enables us to meet our outputs and license conditions

Table 5: Summary of CBA Results

NPVs based on Payback Periods (absolute, £m)								
Option No.	Desc. of Option	Preferred Option (Y/N)	Total Forecast Expenditure (£m)	Total NPV	2030	2035	2040	2050
Baseline	Do Nothing / Do minimum	N	0.00	-117.73	**-117.73**	**-117.73**	**-117.73**	**-117.73**
1	Refresh and enhance SGN's integration platform **Absolute NPV**	Y	-1.10	-5.08	**-1.23**	**-1.88**	**-2.50**	**-3.56**
2	Complete replacement of SGN's integration platform and associated integrations **Absolute NPV**	N	-2.55	-8.17	**-2.39**	**-3.36**	**-4.37**	**-5.97**
1	Refresh and enhance SGN's integration platform **NPV relative to Baseline**	Y	-1.10	-5.08	**116.50**	**115.84**	**115.23**	**114.17**
2	Complete replacement of SGN's integration platform and associated integrations **NPV Relative to Baseline**	N	-2.55	-8.17	**115.34**	**114.36**	**113.36**	**111.76**

8.2 Business Case Summary

This project is driven by the potential loss for life following inability or delay in responding to incidents through a failure of our integration platform.

Table 6: Business Case Matrix

	Refresh and enhance SGN's integration platform	Complete replacement of SGN's integration platform and associated integrations
GD2 Capex (£m)	1.10	1.15
Number of Interventions	10.00	9.00
Carbon Savings ktCO2e (GD2)	0.00	0.00
Carbon Savings ktCO2e /yr	0.00	0.00
Carbon Emission Savings (35yr PV, £m)	0.00	0.00
Other Environmental Savings (35yr PV, £m)	0.00	0.00
Safety Benefits (35yr PV, £m)	17.73	17.73
Other Benefits (35yr PV, £m)	100.00	100.00
Direct Costs (35yr PV, £m)	-4.07	-6.72
NPV (35yr PV, £m)	113.65	111.01
High Carbon Scenario		
Carbon Emission Savings (35yr PV, £m)	0.00	0.00
High Carbon NPV (35yr PV, £m)	113.65	111.01

9 Preferred Option Scope and Project Plan

The preferred option is to Upgrade and Refresh our existing Integration Platform.

This option requires ongoing spend to patch and upgrade our Integration Platform throughout the GD2 period. SGN will assess when and how to implement the upgrades and patches once 3rd parties release their technical roadmaps and bundle the patches into appropriate releases. Each release will be cost justified.

As such, there is no fixed project plan.

9.1 Project Plan Outline

See above – this option requires ongoing patching throughout the GD2 period.

9.2 Asset Health Spend Profile

Table 7: Asset Health Spend Profile

Asset Health Spend Profile (£m)						
	2021/22	2022/23	2023/24	2024/25	2025/26	Post GD2
Refresh and enhance SGN's integration platform	0.15	0.15	0.15	0.50	0.15	Spend Profile to continue post GD2

9.3 Investment Risk Discussion

As previously discussed the recommended option assumes investment will be required at the same level in GD2 as GD1.

There is a risk that the phasing, effort and costs may change based on changing technology trends and requirements from the 3rd party software providers. This risk will be mitigated through timely analysis and delivery of technology Roadmaps and close engagement with those software providers. Dependent on the requirements, the complexity of delivery may also vary.

Table 8: Risk Table

Risk Description	Impact	Likelihood	Mitigation/Controls	Comments
Impact on Capital Expenditure	Capex expenditure	<=20%	Thorough Project Management, design and testing, risk and issue management. Appropriate budget assigned for delivery taking into account lessons learnt from previous upgrades.	Impact of upgrades on ability to operate business as usual processes and deliver regulatory outputs.
Impact on Capital Expenditure	Capex expenditure	>40% & <=60%	Investment in technology roadmaps, ensuring early sight of any changes.	Changing technology trends including operating systems and applications impact the cost and timelines for delivery of the option.
Impact on Capital Expenditure	Capex expenditure	>40% & <=60%	Investment in technology roadmaps, ensuring early sight of any changes.	Our integration platform provider (Mulesoft) may alter their roadmaps or completely withdraw their applications from service. The costs are based on the platform remaining available. Any product replacement would increase costs.

Table 9: CBA Sensitivities Table

	Low	Mid	High
GD2 Capex (£m)	1.05	1.10	1.65
Number of Interventions	10	10	10
Carbon Savings ktCO2e (GD2)	-	-	-
Carbon Savings ktCO2e /yr	0	0	0
Carbon Emission Savings (35yr PV, £m)	0.0	0.0	0.0
Other Environmental Savings (35yr PV, £m)	0	0	0
Safety Benefits (35yr PV, £m)	3.5	17.7	17.7
Other Benefits (35yr PV, £m)	20.0	100.0	100.0
Direct Costs (35yr PV, £m)	-3.9	-4.1	-6.1
NPV (35yr PV, £m)	19.7	113.7	111.6

SGN IT believe the preferred option is maintenance and refresh of our Integration platform. For the purpose of sensitivity analysis, the following has been applied to the preferred option of pre-emptive replacement:

Low Case: SGN have applied a reduction of 5% costs – The assumptions are that low cost assumes a decreased level of rigour e.g. governance, test, risk, but a greater risk of failure and may ultimately lead to increased cost as a result. The high cost assumes that the upgrade is more complex than anticipated and hence costlier. Furthermore, an 80% reduction has been applied to the Safety Benefits associated with the risk of a fatality and Other Benefits associated with the impact of a Breach of Licence Conditions.

Mid Case: no changes have been applied, this is the expected output required for the GD2 time period.

High Case: SGN have applied an additional 50% on the expenditure, as this is believed to be the potential cost increase if SGN are required as a result of the 3rd party's maintenance schedules to increase the number of releases of patches or upgrades.

Project payback has not been carried out as part of this analysis due to the effect of the Spackman approach. For a cash-flow traditional project payback period please see scenario 4 of our Capitalisation Sensitivity table.

Capitalisation Sensitivity

Consumers fund our Totex in two ways – opex is charged immediately though bills (fast money – no capitalisation) and capex / repex is funded by bills over 45 years (slow money – 100% capitalisation). The amount deferred over 45 years represents the capitalisation rate. Traditionally in 'project' CBA's the cashflows are shown as they are incurred (with the investment up front which essentially is a zero-capitalisation rate). Therefore, we have developed scenarios that reflect both ways of looking at the investment – from a consumer and a 'project'.

The scenarios are summarised as follows:

- Scenario 1 - we have used the blended average of 65%, used in previous iterations of this analysis.
- Scenario 2 - we have represented the Capex and Opex blend for the two networks, as per guidance.
- Scenario 3 - addresses our concerns on capitalisation rates whereby Repex and Capex spend is deferred (100% capitalisation rate) and Opex is paid for upfront (0% capitalisation rate).
- Scenario 4 - this reflects the payback period in 'project' / cash-flow terms and provides a project payback.

We have taken a view of the NPV in each of the scenarios, with the exception of scenario 4, at the 20, 35 and 45 Year points, to demonstrate the effect of Capitalisation Rate on this value.

Scenario	1	2 SGN	3	4
Capex (%)	65	41	100	0
Opex (%)	65	41	0	0
Repex (%)	100	100	100	0
Output				
NPV (20yr PV, £m)	115.48	115.13	116.00	
NPV (35yr PV, £m)	113.91	113.65	114.28	
NPV (45yr PV, £m)	113.12	112.94	113.38	
Payback	3.00	3.00	3.00	3.00

Appendix A - Acronyms

Acronym	Description
CNI	Critical National Infrastructure
NG	National Grid
CEG	Customer Engagement Group
SAAS	Software as a Service