GridGEM®

Unlocking Energy Potential

Constraints Management System for Distributed Generation

Value Proposition

Argand Solutions
1 Belsham Court
South Street
Totnes
Devon
TQ9 5FZ
W: www.argandsolutions.com
T: 01803 864706

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1 About Argand Solutions

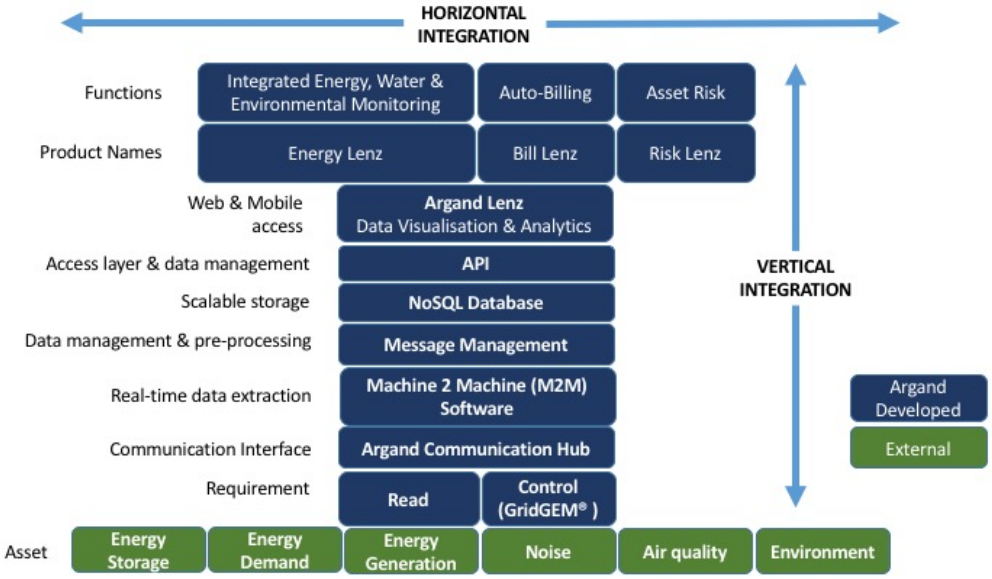
Argand Solutions is an Innovate UK-funded technology business focused on the energy and environmental sector.

GridGEM® is our constraints management solution that enables clients to connect distributed energy solutions to the Grid by managing constraints via:

a. export limitation,
b. Active Network Management (ANM),
c. private wire management,
d. import constraints & / or
e. National Grid constraint panel requirements.

We believe in the power of useful data and smart control to support the global transition to a low carbon future and are confident that our innovation and passion to deliver results will enable significant returns for our clients as a result of this proposal. Figure 1 below shows an overview of our business structure.

Figure 1: Argand Product and Business Structure



The GridGEM® has been used to successfully connect & manage projects with the following generation technologies, plus the integration of load management.

- Solar PV
- Onshore wind
- CHP
- Hydro

2 Meeting DNO Constraint Requirements

The **GridGEM®** is a constraints management solution that has had a 100% DNO sign-off on projects so far[1] across all the UK DNOs and 100% reliability.

2.1 Different Constraint Scenarios

The **GridGEM®** can be used to solve the following National Grid (NG) / DNO constraint requirements:

a) **Export limitation**
   a. static limit from zero upwards
b) **Timed constraints**
   a. tethering the system as required at specified months of the year and within specified hours of each day
c) **Active Network Management (ANM)**
   a. dynamically responding to active signals from the DNO
d) **National Grid constraints panels**
   a. DNO-managed and NG owned panels that will constrain sites with export > 500kW at unknown times of the year due to NG management signals
e) **Private Wire & Parallel Supply**
   a. DNO-approved method of connecting distributed generation to a site on a private wire with multiple connections.

2.2 G-100 Policy Requirements

The **GridGEM®** meets G-100 policy requirements by:

1. **Response Time**s: responding within 1 second for 1st response and will tether the whole system within the time as required by the network operator (5 seconds in the UK)
2. **Hard-wired**: The GridGEM® is a hard-wired solution meeting the G100 requirements
3. **Fail-Safe:** The GridGEM® will fail-safe in all situations as required by the DNO and can use either a specified contactor or integrate with existing auto-breakers.
4. **Power Quality:** The GridGEM® meets all the required power quality and emissions requirements as stipulated by the DNOs.
5. **Data:** The GridGEM® captures all control and power data to provide to the DNO should they require objective analysis that the system is performing as required.

[1] Argand's GridGEM® has not failed a single DNO witness test

3 GridGEM® Features & Client Benefits

3.1 Generation Tethering

The GridGEM® will tether the generation system dynamically to minimise energy losses from constraints – as opposed to disconnecting using contactors.

3.2 Load Management Pre-Tethering

The GridGEM® can be used to switch loads off prior to tethering any generation. This can be beneficial if the client has specific hot water / heating requirements that are non-essential and can be initiated at any time. This minimizes tariff losses and provides useful output for the client. There is no maximum limit to the number of loads that can be managed.

3.3 No Distance Constraints:

The GridGEM® constraints management system can work with inverter positions that can be any distance from the main incomer. Our furthest so far is over 2km.

3.4 High Voltage

The GridGEM® will work at both High Voltage (HV) and Low Voltage (LV) sites. We have worked up to 33kV so far.

3.5 Multiple Incomers:

On sites with multiple incoming points of connection, Argand's GridGEM® will provide a DNO-compliant solution – bringing all points of connection together into the control logic.

3.6 Generator Interlock

There are many sites which have backup generator systems should the grid fail. In these cases, there is a requirement that the distributed generation system is not able to back feed the system. Argand's GridGEM® can integrate with this requirement by ensuring that the generation system is switched off when the generator starts up and adds significant value at industrial sites over competitor products.

3.7 "No Shut Down"

Argand have developed CT solutions to enable no shut-down required at client sites which can be critical

3.8 Integration into complex physical sites:

The GridGEM® can be configured to meet the physical challenges of the different sites. See "engineering support".

3.9 Communication Solutions

Argand's GridGEM® will integrate with your required communications infrastructure to include security issues and type e.g. the integration of fibre optic communication.

3.10 Integrated monitoring
All data from the GridGEM® is available via Energy Lenz® in real time

3.11 Engineering support
Almost all sites with constraints requirements require electrical engineering support to enable all parties involved to integrate successfully and to guarantee the DNO sign-off in relation to the set constraints. Argand will support all projects to their successful conclusion.

3.12 Private Wire Optimisation
Argand's GridGEM® has a private wire solution that enables a generation plant to be connected to a client site via a private wire and its own Grid connection without breaking the DNO's requirements for non-parallel supply. This solution can give investors greater confidence at sites which will only enter into a short-term PPA as they will still be able to connect safely to their own connection.

3.13 Battery Integration
The GridGEM® can be used to integrate energy storage and batteries into the client site – developing the logic to optimize the battery usage.

4 Other Client Benefits of Working with Argand Solution
There are numerous other benefits of working with Argand that align with the GridGEM®.

4.1 Automatic Submission of Total Generation Meter (TGM) Readings
An MID approved TGM can be integrated with the GridGEM® to enable Argand to read generation data in real-time and automatically submit readings to the client's Feed-In-Tariff (FIT) energy supply business at the required frequency (e.g. quarterly.) This saves a significant amount of time and cost for the client.

4.2 Automatic "Net Metering" for PPA Calculation
Argand's GridGEM® comes with a main import / export meter as standard. If a TGM is integrated in addition to this, then Argand can calculate the energy used on-site by the solar PV system through "net metering".

This will enable the PPA owner to automatically calculate the amount of energy to bill the site owner for if required and removes the headache of manually working through excel spreadsheets.

4.3 Automated Billing
Argand Solutions have developed an automated billing platform which integrates with all of the data processing described above. The system will automatically calculate the energy to be billed, apply a billing tariff and then effect a direct debit from the site owner to the PPA provider.

This will remove significant manual time, errors, eliminate bill disputes and late payment issues and is of significant value to all involved.

4.4 Real-Time Asset Risk Management

Argand's real-time asset risk management solution utilizes 30-40x more metering data per meter to determine the probability of failure of electrical assets.

This is critical for industrial and commercial clients that have critical assets that need to ensure smooth and reliable operations.

The GridGEM® comes with a high quality industrial grade power quality meter that is installed on the client's main incomer. As a starter at sites where there is one main asset (pumping sites etc.) this will provide an excellent opportunity to initiate risk management on their main operational assets.

If a GridGEM® for constraints management is not required, the client can still install a meter on its own to undertake asset risk management analysis. More detail on this product is attached as a separate document.

4.5 Grid Balancing Services

The clients may wish to, now or in the future, engage in Grid balancing services to generate additional revenue from assets that have the capacity to be managed (turned off, reduced etc.) for short or longer periods of time.

The GridGEM® can be retrospectively used as the control hub for Grid balancing services should the client require. This can include:

a) Energy storage (batteries)
b) Demand Side Response (DSR)
c) Generation reduction (demand turn-up)

These can be controlled from the same GridGEM® system subject to firmware / control logic upgrades.

5 Requirements for GridGEM® Installation from Client

Our working model is that all GridGEM® solutions are designed and built by Argand with the installation generally completed by the client's EPC – yet with the option for Argand to undertake this work. This installation requires that the client provide specific elements for the project.

5.1 Additional Hardware & Installation

The following will need to be supplied by the client.

a) Additional Hardware

a. Provision of inverter manager unit(s) to interface with the GridGEM® e.g. Huawei Smart Logger
    i. These need to be configured (see below) which can be done by Argand for a fee if required.
b. Appropriately sized and rated "fail-safe" contactor(s) in IP rated enclosure(s) and 2-core cable to connect into the GridGEM® control hub.
    i. Argand can provide this. We can also use an existing trip circuit with an auto-breaker.
c. CAT5 cable to connect the main metering unit and the GridGEM® control hub
d. CAT5 cable to connect the GridGEM® control hub to the inverter manager

b) Installation Requirements

a. Installation of Argand's main metering unit on the client's main incomer(s)
b. Installation of voltage references into the main metering unit(s) so that it can:
    i. Power itself
    ii. Calculate real power to enable functionality
c. Installation of current transformers (CT) onto main incomer
d. Installation of "fail safe" contactor / connection of auto-breaker to GridGEM®
e. Connection of all CAT5 cabling
f. Parametisation of inverter managers with correct IP addressing and settings to enable GridGEM® to communicate and undertake action.
    i. This can be done by Argand for a fee (see pricing section.)

5.2 Metering Unit & GridGEM®

The metering unit and the GridGEM® unit have to be purchased together. The GridGEM® will not work if another metering unit is used due to networking and communication requirements.

CTs will need to be installed and connected to the meter with voltage references. This needs to be done by an experienced installation engineer.

The metering unit is an IP based meter which means that it is very easy to "plug & play" into the GridGEM® unit on-site with RJ45 connectors – ensuring easy installation. This requires CAT5 cable that is not included in the price and must be supplied by the contractor – see "Client Requirements" section.

5.3 Remote Communications

The GridGEM® prices (see next page) all include the ability for Argand to communicate remotely with the GridGEM®. This will ensure that, should there be installation issues on-site, we are able to remotely diagnose. We will not supply the GridGEM® without this capability to ensure the integrity of our product, it's reputation and to protect the network operator's requirement for systems that do what they say they will do.

6 Next Steps

Thank You and we look forward to potentially working with you more closely in 2017.

Fraser Durham
Commercial Director
E: fraser@argandsolutions.com

Alastair Gets
Lead Analytics Engineers
E: alastair.gets@argandsolutions.com