ENSTORE

Topic ………………… A smart flexible energy system a call for evidence with data from Enstore – Q3

Identification ……. Response ID "ANON-BJ6H-GNMS-Y".

Version ……………. 001

Date ………………… 07/ 01 / 2017

Issued to …………. BEIS and Ofgem with no restrictions on the use of the data

Signed by ………… *E A Lewis* and *P M Lewis* …. Company directors

Anacronyms

- EFR. Enhanced Frequency response.
- ESS. Energy storage system.
- Fast Fault current. The provision of AC current in to an AC fault for a defined time period.
- SBSPM. Second by second performance monitoring.
- SM1 & 2. Meters for recording the SBSPM.
- PM1 & 2. Meters for recording instantaneous and average AC grid power.
- PWM. Pulse Width Modulation
- VSM. Virtual Synchronous Machine implemented in a control system

Contents

To understand this data, you need a copy of my data for Questions 1 and 2.

3. Removing policy and regulatory barriers Enabling Storage

Have we identified and correctly assessed the issues regarding storage and network charging?

No.

Do you agree that flexible connection agreements could help to address issues regarding storage and network charging?

Yes.

Please provide evidence to support your views, in particular on the impact of network charging on the competitiveness of storage compared to other providers of flexibility.

All Energy Storage Stems "ESS" have lost power due to many causes including:

- Loss in transformers like TRS1.
- Losses in cabling.
- Losses in the inverter.
- Losses in powering the Auxiliary systems.
- Losses inside the battery where energy output is less than energy input, called the round-trip loss.

The problem of incorrect network charging for energy storage systems is illustrated on Figure 3.1 which shows one way to provide the energy losses of an ESS.

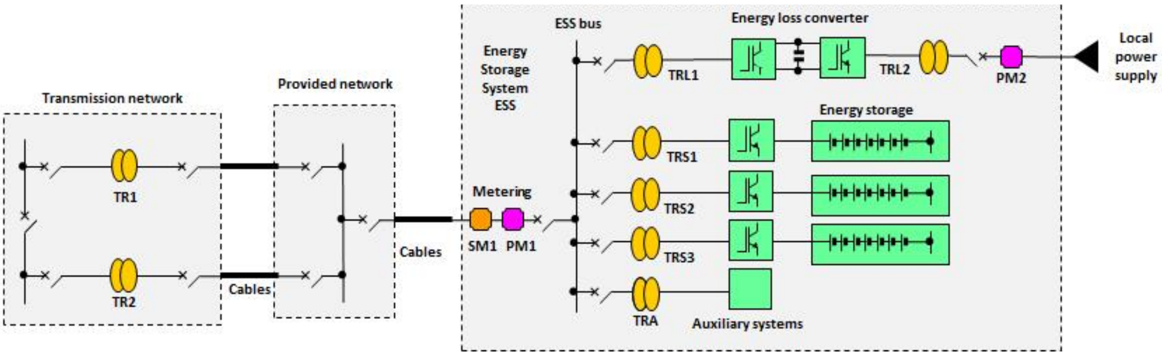

Figure 3.1.

The Figure 3.1 has the following features:

- One extra Energy loss converter that takes power from a local supply to supply all the losses of the ESS.
- The Energy loss converter is exactly the same as used for a wind turbine.
- The local power supply could be from either on site diesel or a connection to a distribution network

With this design the following actions will take place:

- The losses of the ESS are typically 5 to 10 % of the ESS primary rating for an EFR duty.
- The losses of the ESS can accurately be measured by the meter PM2.
- The cost of the lost energy can be paid either in diesel fuel or to the local distribution network supplier.
- The meter SM1 and PM1 will only record the actions needed to meet the EFR duty.
- The power meter will experience large positive and negative values but over any significant period the PM1 meter will read zero as the battery is constantly aiming to operate at a 50% value of its stored energy.

For this design the charging cost rate for the PM1 meter have no real meaning as the meter averages zero.

Having a demand charge for the meter PM1 based on the peak rating of the input power is clearly wrong as the maximum power only happens to correct the AC grid and should not be penalised.

Having a demand charge for the meter PM1 based on the peak power in a Triad period is also clearly wrong as the ESS is helping to reduce the total grid Triad power demand and the ESS should be on and not disconnected.

It would also be wrong to charge the ESS input and output power demands at the meter PM1 at different rates for energy input and energy output as this is penalising the ESS for no valid reason.

The only significant cost is the reading of the PM2 meter and the PM1 meter should not be charged.

Overall as the system is providing Benefits to the National Grid the logic should be that no costs are levied on the main power connection PM1 and that only the costs of the meter PM2 should be levied based on the rating and energy used by the low power Local supply if taken from a distribution network.

The Figure 3.1 is definitely an option for EFR type systems and must be a permitted design.

The problem of charging arises if the design is like Figure 3.2 with all the power from one supply.

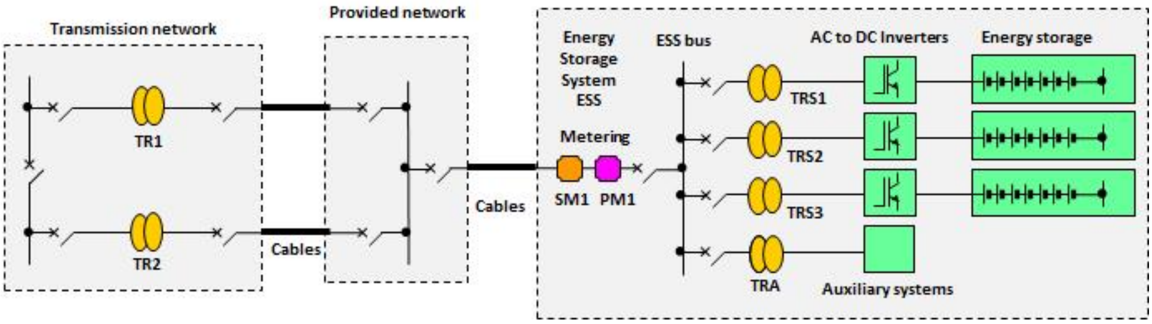

Figure 3.2.

The Figure 3.2 has the following features:

- The circuit as described in section 2and only one meter PM1 records all the power and energy flows listed for Figure 3.1
- The power meter will experience large positive and negative values but over any significant period the PM1 meter will read the losses the same as would be recorded on the PM2 meter of Figure 3.2.

The Enstore recommendation is that systems of the Figure 3.2 type that are only providing Benefits for the operation of the National Grid should be charged on the same basis as the Figure 3.1. This is that the averaged costs of the meter PM1 should be levied based on the rating and energy used by the low power Local supply as if were if taken from a distribution network. Enstore calls this Method 1 ESS charging.

This concept is directly applicable to the Benefit 2 Type 1 designs as shown on Figure 1.2. This also applies to Benefit 2 Type 2 designs projects if all of their power complies with the Benefit 2 Type 2 definition.

There are also uses for energy storage that provide advantages for their operators that do not directly provide Frequency responsive power towards the operation of the AC grid this is the **Benefit 2 Type 3 designs**. For example, adding an Energy Storage System to a renewable energy system can have uses that:

- **Use 1.** Enable accurate pool price bidding without wasting any renewable energy.
- **Use 2.** Store renewable energy for later use to avoid paying constraint payments.
- **Use 3.** Store renewable energy at low pool prices to sell at higher pool process.

For this type of ESS then the charges should be based on paying for the input and output energy based on the normal charging rates for AC grid systems including pool price variations and Triad costs. **Enstore calls this Method 2 ESS charging.**

This type of system could also supply some of the 2- 9 **Benefits** listed to assist the National Grid but they should then benefit for similar fixed rewards but pay still pay the **Method 2 ESS charging**.

There are also Energy Storage systems that can be used for the benefit of their operators that that are not providing any of the **Benefits** 2 to 9 for example:

- A home-based Energy Storage System to keep a house system operating with a large disturbance in the AC grid. These could demand a power change in opposition to the EFR profile.
- A home-based Energy Storage System to store solar energy for use at night could demand a power change in opposition to the EFR profile.

This type of system should not receive any payment of the for the fixed rewards but should still pay a rate like the **Method 2 ESS charging**. **Enstore calls this Method 3 ESS charging. This is the simplest allowed design for an ESS.**

There are many variations of ESS and the Figure 3.3 shows the 4 main variations with an overall summary.

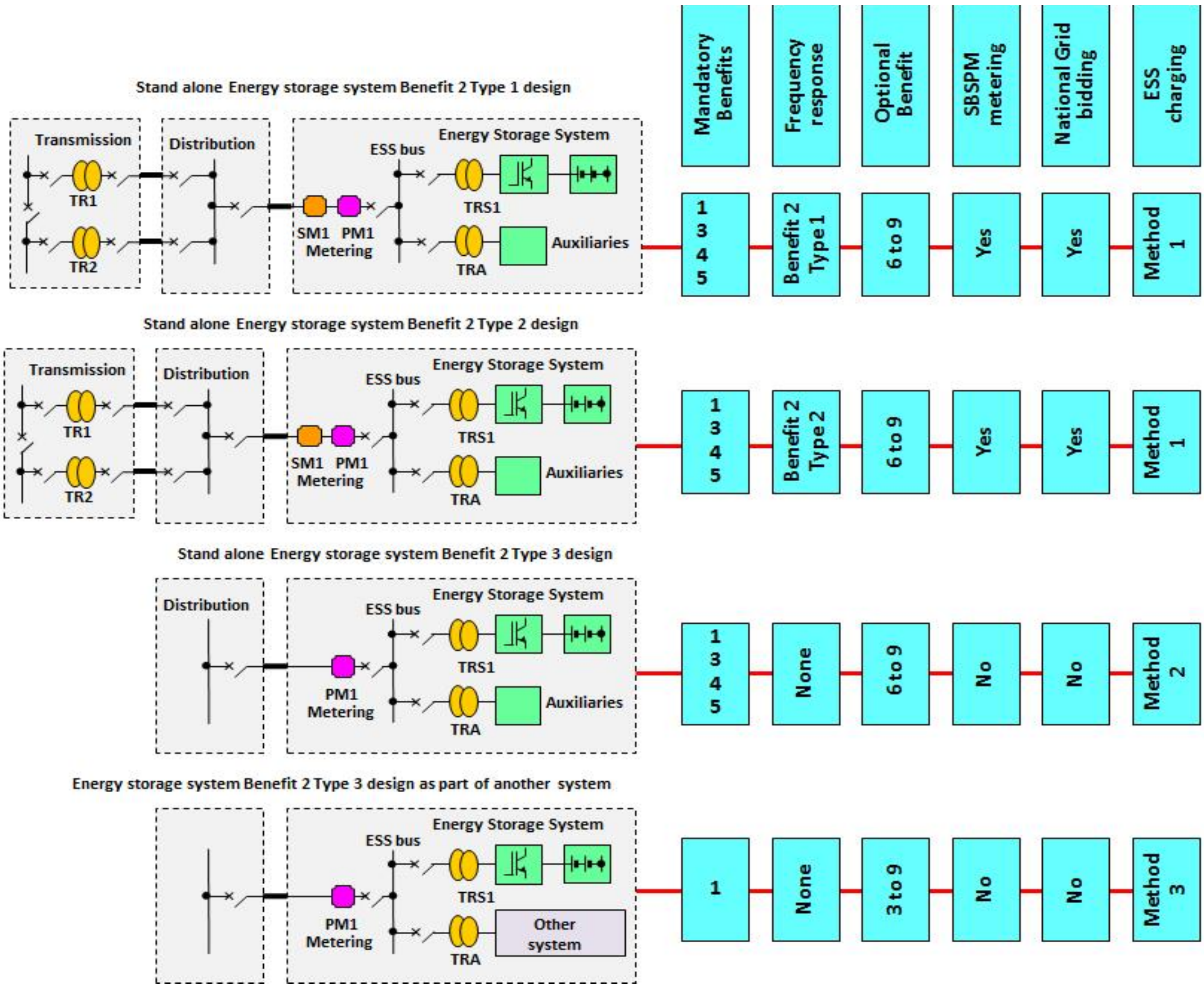

Figure 3.3.

The four main variations in Energy storage systems are shown on Figure 3.3 are used for:

- **Stand alone Energy storage system Benefit 2 Type 1 designs.**

  This is to bid for an ESS supplying a transmission connected EFR type design in the future with a defined set of the listed extra benefits. The **Benefit 2 Type 1 designs** can also be distribution connected with a suitable agreement.

- **Stand alone Energy storage system Benefit 2 Type 2 designs.**

  This is to bid for an ESS supplying a transmission connected general energy storage system in the future that is fully compatible with other generators with a defined set of the listed extra benefits. The **Benefit 2 Type 2 designs** can also be distribution connected with a suitable agreement.

- **Stand alone Energy storage system Benefit 2 Type 3 design.**

  This is to supply a distribution connected general Energy storage system that does not have a frequency responsive action and does not need the SBSPM meters.

  The ESS can have some of the listed extra benefits defined in its contract. The **Benefit 2 Type 3 design** is very unlikely to be transmission connected.

- **Energy storage system Benefit 2 Type 3 design as part of another system.**

  This is to supply a general Energy storage system that is an integrated part of another system like either a wind farm or an industrial process.

ENSTORE

This does not have a frequency responsive action and does not need the SBSPM meters as the action of the energy storage system is not directly connected to the AC grid.

The ESS can have some of the listed extra benefits defined in its contract.

This **Benefit 2 Type 3 design** is very unlikely to be transmission connected unless it is an internal part of a wind power or solar power system.