The DR BOB project (01/03/16 - 28/02/19) is co-funded by the EU's Horizon 2020 innovation programme under grant agreement No 696114

DR-BOB

DEMAND RESPONSE IN BLOCKS OF BUILDINGS
DELIVERABLE: D4.2 INSTALLATION REPORT

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Project Consortium

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Deliverable Administration & Summary			
D4.2 Installation Report **Lead Beneficiary: Teesside University**			
Due Date:	30/09/2017	**Date of submission**	29/09/2017
Month of project	Month 19	**Month of submission**	Month 19
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Editor			
DoA	Task 4.2 – Installation Report Task Leader: Teesside University Task Contributors: R2M, NBK, GRID, DW, FP, SERV, TUCN, SIEMENS For each site this task will: • Engage with / recruit the solution users • **Implement the strategy developed in T4.1 for the implementation and testing of the solutions selected and integrated in WP3 in the context of the pilot sites** • Run the demonstration for 17 months from m20 to m36 • Conduct training sessions with the users of the solution at the pilot • Collect the data required for the evaluations conducted as part of the work of WP5: a 12 months period (m20-m31) is considered for evaluation in WP5 Within this report, the installation of the required systems to run the demonstration is described		
	D4.2 – Installation reports (m19) This deliverable will describe the installation and commissioning process that was followed at each of the four demonstrations, including an evaluation of any challenges and user feedback from the installations.		
Contribution of partners	TU coordinated this deliverable and the task. TU, TUCN, FP and NBK co-ordinated each site installation development, hardware and metering procurement and led the process towards meeting the requirements for demonstration. Richard Charlesworth (SIEMENS) provided technical lead and site configuration development of the		

	system architecture. TU developed LEM and wrote the report. GP and NBK integrated their respective technologies into the energy management solution. SIEMENS provided the templates for each site to develop as per D4.1. TU, R2M, SERV, NBK, TUCN and FP recruited and updated the information for the site templates. DW participated in the communication strategies and recruitment strategies for the different roles.

Document change history

Date	Authors	Description
31/07/2017	John Broderick and Sergio Rodriguez (Teesside University)	Table of contents circulated for partners' contribution.
15/09/2017	Sergio Rodriguez with contributions from all the partners involved	Outline draft
15/09/2017	Sergio Rodriguez with contributions from all the partners involved	Draft for quality assessment i.e. internal or external peer review.
27/09/2017	Sergio Rodriguez with contributions from Sean Williams and Mihaela Cretu as peer reviewers	Draft which addresses comments from the quality assessment process which is submitted to the project co-ordinator
29/09/2017	Sergio Rodriguez	Prepares final draft ready for submission to the commission
29/09/2017	Vladimir Vukovic	Final edits and submission

EXECUTIVE SUMMARY

Purpose: This deliverable describes the installation and commissioning process that was followed at each of the four demonstrations, including an evaluation of any challenges and user feedback from the installations.

Methodology: This report documents a structured description of the different BMS and system upgrading process, needed to implement the integrated system to enable demonstration of DR within DR-BoB project. As such it builds on the scenarios of work package 2 detailed in D2.2 and integrates with the technical work in the other tasks of work package 3, Integration, described in the reports D3.1, D3.3 and D3.4. It also develops the strategies described in D4.1.

The process consisted of establishing the DRTRL for each of the sites, as described in D3.2. This process was carried out within the previous months, and was based on fact find interview, site surveys and user requirements, with high level commitment from the Facility Management teams at the different sites. This activity by site managers and technology providers identified the site infrastructure that needed to be improved to enable the DR-BoB solution functionality.

The DR-BoB site managers along with the Facility managers at the different sites have carried out the installation and started development of the communication strategies within the different sites, in order to enable the implementation of the DR-BoB technologies developed within WP3. These installation activities and coordination with the technology providers in DR-BoB are the main output of this report.

Key Findings and Conclusions: This report explains the upgrading works carried out to enable adaptation of the DR-BoB technology components. These works have been delivered in parallel for all of the sites, but the UK site served as the primary site for testing of the whole integrated system. For this reason, the testing of the different scenarios has been delivered just for the UK site for now, and the rest of the testing will be done within October and November 2017 for the rest of the sites, after the integration has been successfully achieved at the UK site.

The installation has been tailored to each site specific characteristics and requirements as stated in D2.3, and hence each site documentation reflects the detailed process in a slightly different structure, according to its state of completion. This won't hamper the development and implementation of the technical solution and the demonstration of the different buildings and scenarios defined within D2.2 and subsequent documentation updates.

The complete final implementation of the different components required to run the DR-BoB solution at the different demonstration sites will be achieved gradually. This will allow the deployment of ME, LEM, VEP[1], and CP at each site at different stages, and will allow lessons learned from one site to be applied at the others.

The different sensor reading sources and configurations in the different BMS have represented a significant barrier to establish stable communication with the LEM. As well, different security protocols applied at specific sites (UK, TUCN) made apparent the need for tailored system implementation and therefore each of the sites will have a different system

[1] Also referred to as DEMS

architecture which is found in D3.1, D3.2, D3.3 and D3.4. Application of DR-BoB technology solution depends on the specific site DRTRL and BMS and meter readings configuration.

The system integration was tested at the UK demonstration site and it is expected that the UK site is fully implemented in September 2017. The different meter channels (meter readings, meter forecasts and recommendations) will be implemented during October for the French, Italian and Romanian sites in DEMS and LEM. By October 2017, the Italian site implementation will have delivered its LEM deployment and testing done. This site has already established a stable and coordinated in format communication with LEM in the IT FTP server, to be later migrated to the Ruggedcom device along with the Italian LEM (November 2017). The French site has almost finished the commissioning and upgrading of its BMS systems, and integration of BMS data within the different buildings will be achieved during October 2017. The testing will start during October 2017, according to the specific plan. The Romanian site has started the LEM implementation after the BEMS has been commissioned and the metering points have been enabled (September 2017). Further work is required to test the configuration of its respective LEM once implementation begins. Tasks 4.3, 4.4 and 4.5 have continued their advance and complete implementation will be achieved during November 2017.

Lessons Learned: The document describes the installation process for the required BMS and BEMS upgrading needed to perform DR adequately within DR-BoB project solution. For each demonstration site, specific challenges in terms of system upgrading have been faced. Each specific site with each specific boundary conditions (as per Blocks of buildings, market regulations and BMSs particularities) requires a thorough analysis to enable them participating in DR programs. This has proven the hypothesis stated in D2.3 and validated the DRTRL methodology (Crosbie et al., 2017). It has also confirmed the need to collate sensitive building automation and energy performance information for blocks of buildings in relation to their ability to conduct DR actions as single capacity providers, and the required investment to make this possible, in order to boost the EPBD (Energy Performance Building Directive) objectives achievement in the long term.

The installation at the different sites has unveiled organisational and system interoperability barriers in terms of BMS and metering services at all the sites, which have been the major impeding force for the implementation of the solution at the different sites.

Nevertheless these barriers have not undermined the development within the blocks of buildings. The versatility of the DR-BoB solution has allowed a tailored implementation to the site specifics and market conditions, and proves that adaptability becomes a major driver when working with different blocks of buildings. Upgrading of buildings' metering and controlling systems in existing BMS is a prerequisite for successful operation under Demand Response contracts and schemes.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

DNO	Distribution Network Operators
DR	Demand response
DREG	Distributed renewable energy generation
DRTRL	Demand Response Technology Readiness Level
EPC	Energy performance contract
ESCo	Energy Service Company
HVAC	Heating Ventilation and Air Conditioning
LEM	Local Energy Manager
SSM	Supply Side Management
TNO	Transmission network operators
ME	Market Emulator
LEM	Local Energy Manager
CP	Consumer Portal
VEP	Virtual Energy Platform
DEMS	Distributed Energy Manager System

GLOSSARY

Block of buildings (BOB) has been defined in the DR-BOB project context as a group of real buildings (minimum, 3 buildings); sharing a common energy governance; used the whole year or during the workdays by multiple schedules of occupancy; served by the same Distribution Network Operator (DNO).

Demand response (DR) provides an opportunity for consumers to play a significant role in the operation of the electric grid by reducing or shifting their electricity usage during peak periods in response to time-based tariffs or other forms of financial incentives.

Demand Side Management (DSM) is commonly used to refer to demand side electrical load management. It involves actions that influence how much energy is used or when energy is used. The goal of DSM is to encourage users to use less energy during peak hours, or to move the time of energy use to off-peak times such as night-time and weekends.

Distribution Network Operators (DNOs) are often also referred to as Distribution System Operators (DSO). They are responsible for the transport of electricity at a regional level and as such they transport electricity at gradually reducing voltages from national grid supply points to final customers, both residential and none residential. Throughout the EU, electricity distribution is a regulated monopoly business.

Dynamic electricity tariffs often referred to as real-time pricing. Prices change usually on an hourly basis reflecting the cost of generating and/or purchasing electricity at the wholesale level at the time of delivery.

Distributed Renewable Energy Generation (DREG) or local, decentralized renewable energy production involves solar photovoltaic (PV), small hydroelectric, small-scale biomass facilities, and micro-wind.

Electrical Load management, often referred to as simply load management, is achieved through controlling the power flow in the electric system at the generating end (supply side management) or the customer end (demand side management).

Electricity Supply is the process of buying electricity in bulk and selling it on to the final customer. Electricity supply in most EU counties is a competitive market.

Energy Suppliers buy electricity and /or gas in bulk and sells it to final consumers.

Energy Service Company (ESCO) is a company that offers energy services which may include implementing energy-efficiency projects (and other sustainable energy projects). The energy services supplied by ESCOs can include a wide range of activities such as energy analysis and audits, energy management, project design and implementation, maintenance and operation, monitoring and evaluation of savings, property/facility management, energy and/or equipment supply, provision of service (space heating/cooling, lighting, etc.) advice and training,

Energy Performance Contract (EPC) is a contractual arrangement between the beneficiary and the provider of an energy efficiency improvement measure, verified and monitored during the whole term of the contract, where investments (work, supply or service) in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement or other agreed energy performance criterion, such as financial savings.

Energy Supply Contract, the key element in this type of contract is the efficient supply of energy. The contracting partner provides products/services such as supplying electricity, gas, heat. Financing, engineering design, planning, constructing, operation and maintenance of energy production plants as well as management of energy distribution are often all included in the complete service package. For example district heating providers are is the most widely implemented example of energy supply contracting in the residential sector.

Explicit Demand Response is where a signal or request is made, usually, by a utility for the consumer to shed or shift load at a given time, for a given duration.

Implicit Demand Response is where there is no external signal or request, the consumer optimises energy consumption based on other factors such as tariff, CO_2 etc.

Local renewable energy sources includes solar PV, wind and hydro power, as well as other forms of solar energy, biofuels and heat pumps (ground, rock or water) that is generated within 100 kilometres of the neighbourhood.

Private wire networks are local electricity grids that although connected to the local distribution networks that are privately owned.

Supply Side Management (SSM) is commonly used to refer to supply side electrical load management. It refers to actions taken to ensure that energy generation, transmission distribution and storage are conducted efficiently, on the supplier's side of the energy supply chain.

Time-based pricing is a pricing strategy where the provider of a service or supplier of a commodity, may vary the price depending on the time-of-day when the service is provided or the commodity is delivered. Therefore dynamic electricity tariffs are a form of time-based pricing. The rational background of time-based pricing is expected or observed change of the supply and demand balance during time.

Transmission Network Operators (TNOs) are responsible for the bulk transport of electricity by high voltage power lines from power stations to grid supply points. The transmission system is generally referred to as the national grid. Throughout the EU Transmission is a regulated monopoly business.

Utilities industry in its broad sense refers to electricity, gas and water supply companies and integrated energy service providers. The term is most often used to refer to the companies involved in the generation, transmission and distribution of energy.

1 INTRODUCTION

1.1 AIMS AND OBJECTIVES

This document´s aim is to describe the integration and implementation of the different technical components, including hardware and software with the energy management systems at each site and with the other technologies of the DR-BoB solution.

As part of it, one of the first aims of this deliverable is to define and identify the Demand Response Technology Readiness Level for each site and the necessary modifications required to enable the DR-BOB trial.

After that, the customized implementation of the operative solution at each site is described in separate sections.

The target group for this report is an internal audience and it aims to document the requirements and describe the integration and configuration of the solution for their benefit. It will share knowledge amongst the project partners and with the Commission and is therefore confidential.

1.2 RELATIONS TO OTHER ACTIVITIES IN THE PROJECT

The interoperable overall infrastructure, includes the Market Emulator (ME), the Virtual Energy Plant (VEP) central solution, the Consumer Portal (CP), and the Local Energy Managers (LEM) prepared for each pilot site. Their development and configuration is respectively described in D3.3, D3.1, D3.2, and D3.4.

This report describes the implementation of the combined technology components, adapted to the different demo sites´ configuration.

This report also details the ancillary or secondary works needed to adapt the demonstration sites to trial the DR-BoB solution. This includes BMS upgrades and new metering and controlling infrastructures enabled by BACnet IP and MODBUS communication protocols.

1.3 REPORT STRUCTURE

A LEM solution (hardware-software combination) is configured for each demonstration site and interacts with the other elements as per the system architecture shown in Figure 1, below. The Market Emulator, for the DR-BoB trial, is standing in place of a Transmission System Operator, Distribution System Operator or an aggregator, and generates demand response events. The Virtual Energy Plant (VEP) allocates these requests to the LEM at each site, while the Consumer Portal manages interactions with the facilities manager and building occupants. This report describes the LEM hardware, software and interfaces in turn with particular emphasis on the energy management and metering systems. As regards to LEM, it will also incorporate the capabilities of generating events in the context of the different scenarios at the different demonstration sites, enhancing the system versatility and operability options.

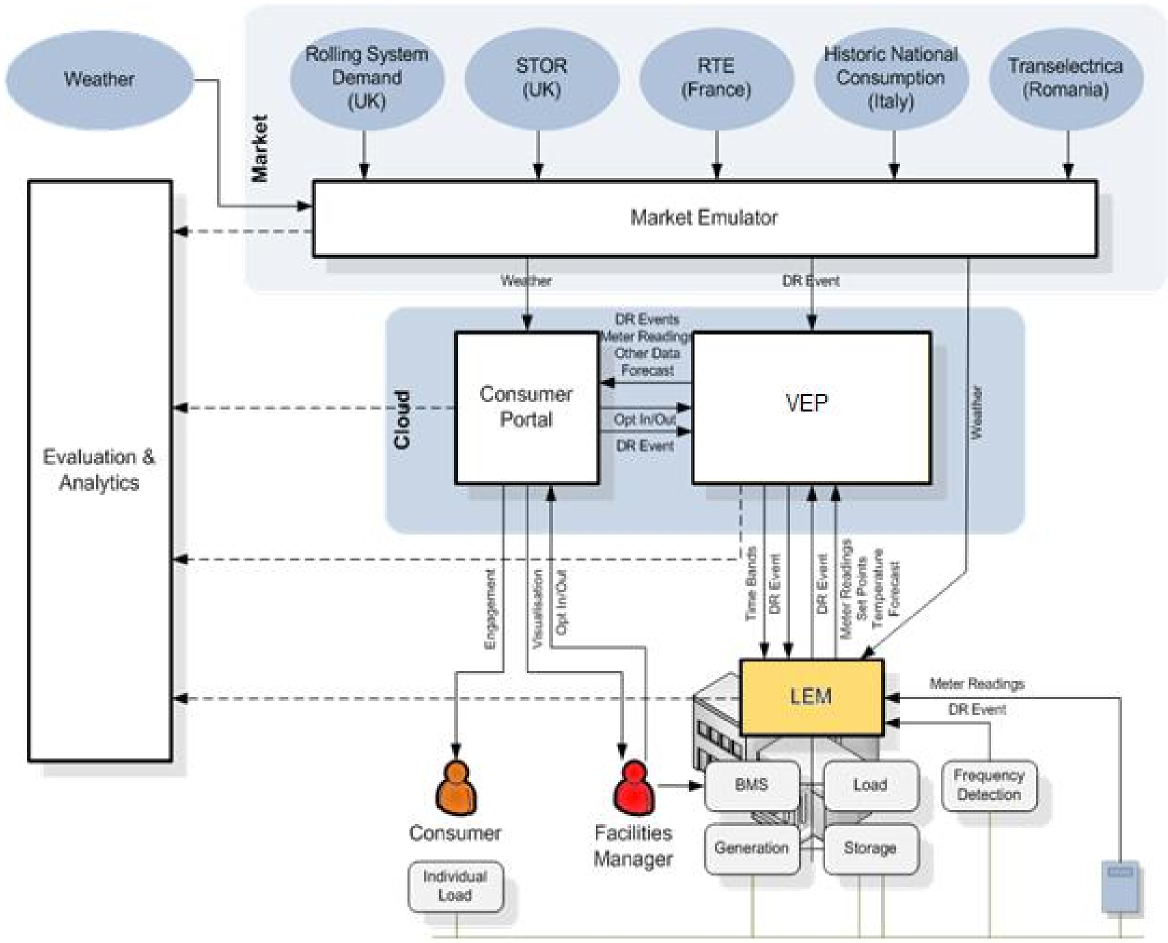


FIGURE 1. THE SITUATION OF THE LEM AND ITS ASSOCIATED INTERFACES WITHIN THE DR-BOB SOLUTION

The first technical section, Section 2, outlines the Demand Response Technology Readiness Levels assessment that has been applied to the demonstration sites. This activity by site managers and technology providers identified the site infrastructure that needed to be improved to enable the DR-BoB solution functionality.

Section 3 defines the implementation and installation report for the UK site. The following sections 4, 5 and 6, describe respectively the French, Italian, and Romanian sites´ implementation.

The final section establishes the conclusions of the installation report for the different sites.

2 APPRAISAL OF SITES FOR INSTALLATION - DEMAND RESPONSE TECHNOLOGY READINESS LEVELS

Following on from the activities of WP3, the next step consists of the implementation of the DR-BoB technologies into the different demonstration environment. The first stage of DR-BoB site LEM integration is appraisal of site energy management system capabilities. The degree to which the DR-BoB solution can increase the ability of any given site to participate in DR events is dependent upon its current energy systems i.e. the energy metering, the telemetry and control technologies in building management systems, and the existence/capacity of local power generation and storage plant, if existing. To encourage participation in DR by the owners and managers of blocks of buildings, a method of assessing and validating the technology readiness to participate in the DR energy management solutions at any given site is required. This section describes the Demand Response Technology Readiness Levels (DRTRLs) for the implementation encountered in this project's locks of buildings. Further dissemination of the DRTRL concept has been recently presented in Sustainable Places Conference 2017, and will be shortly published in a special issue of Buildings magazine. (Crosbie et al, forthcoming)

2.1 DRTRL EXEMPLIFIED BY THE DR-BOB PROJECT DEMONSTRATION SITES

The DR-BoB solution will be trialled at four demonstration sites from October 2017. The four sites, have different uses, physical forms, market and climatic contexts. The pilot sites include two public university campuses, one in the UK and one in Romania, a technology park in France and a hospital block in Italy (see figure 2). Each block of buildings had a unique configuration of assets, metering and management largely encountered at the start of the project at DRTRL 1. As such, all sites have required some degree of investment, predominantly in metering, to be able to deliver DR-BoB functionality and measure impact effectively.

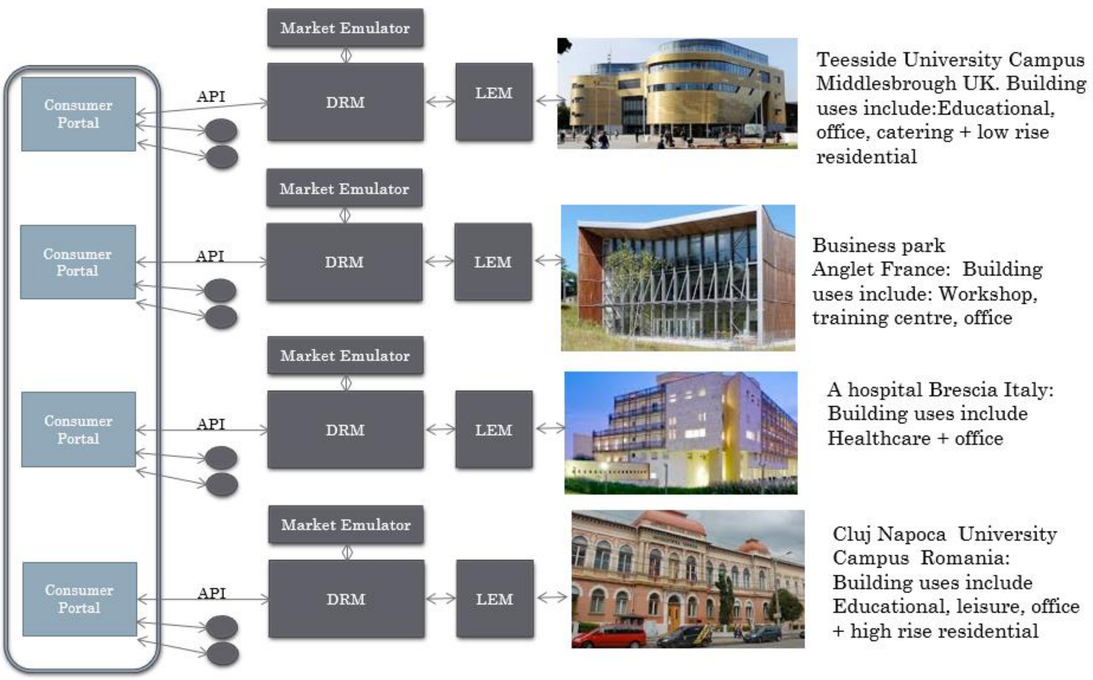


FIGURE 2. DR-BOB ARCHITECTURE IMPLEMENTED AT FOUR PILOT SITES

The demonstration sites were surveyed for assets during WP2 and for energy management systems during WP3. The different surveys and fact find questionnaires taken into place elucidated the capabilities and improvements needed to carry out the system deployment and the different scenarios running and

The applicability of the DR-BoB energy management solution to any given block of buildings depends on the technologies deployed in the buildings and their building management systems, the controllable assets within the buildings (including energy generation/storage), and the availability of wider communications interfaces to enable telemetry and telecontrol signals with the DR sponsor2.

The table below summarises the assets at each site, the initial DR and the implemented DRTRL.

Site	Building Uses	Controllable Assets	Initial DRTRL	Implemented DRTRL
Teesside University, UK	Educational, office, catering + low rise residential	Chilled water system, fan coil units, EV charging stations, CHP, backup generator and UPS for servers	1	3 – Metering system upgraded to reduce latency, BMS upgraded to enable control over standard (BACnet) protocol.
Business Park, Anglet, FR	Workshop, training centre, office	Microgrid, heat pumps, RES (PV), UPS for servers, wood chip heating system	1	3 – One additional meter required at FCMB workshop. Additional meters at the different buildings to be able to put into practice coordinated DR actions
Fondazione Poliambulanz a Hospital, IT	Healthcare + offices	Chilled water system, CCHP (trigeneration), food carts, laptops	1	2 – Metering system upgraded to improve resolution and reduce latency. CCHP trigeneration system and integration within
Technical University of Cluj-Napoca, RO	Educational, leisure, office + high rise residential	Chilled water system, washing machines, swimming pool pumps	1	2 – Building Energy and Management System required to enable control over standard protocols and export of data.

TABLE 1. DRTRL ASSESSMENT FOR DR-BOB DEMONSTRATION SITES

2.2 DISCUSSION

The DRTRL scale discussed in this section is applicable to the assessment of the technical readiness of a block of buildings for the implementation of the DR-BoB energy management solution.

The concept of DRTRLs presented here maybe expanded, to offer a useful, common way to measure the preparedness of a building's energy systems for DR participation….

2 DSO, TSO, DR aggregator etc. offering the demand response product.

It was also noted that some sophisticated building management systems may not allow third party integration, impairing and hindering the ability of the DR-BoB solution to coordinate a response. This is unlikely to be solved by DR solution providers in general given the proprietary nature of such BMS firmware and software. There may therefore be a role for regulatory bodies, e.g. through subsidiary policies to the Energy Performance in Buildings Directive (EPBD) and relevant national building codes, to facilitate the wider involvement of the built environment in energy system management through standardising the interoperability of infrastructure. Such regulation would reduce future transaction costs and increase the scope and scale for participation in DR programmes as they are developed by electrical system operators.

3 INSTALLATION AT UK SITE

3.1 SITE SCENARIO UPDATE

As stated in D2.2, the DR BOB solution will be trialled in each demonstration sites within specific scenario conditions. In the Teesside University demonstration site, this will reflect the UK market and adapt to the specific boundary conditions to the varied DR programmes and actions. During the project development, adjustments to the buildings selected to participate in the demonstration have been done. The buildings of this demonstration site are governed by a single owner, and managed with a centralised BMS (Satchwell Sigma legacy), although the metering and billing system are disparate and complex. The initial and implemented list of buildings that are going to intervene in the different established DR scenarios within DR-BoB after these adjustments are described below.

The buildings included in the different scenarios demonstrating DR actions within the DR-BoB project are:

- The Middlesbrough tower, which assets will take part into UK SC2 and SC3a and SC4
- The Clarendon building, which assets will take part into UK SC1 and SC3a
- The Stephenson building, which will take part in UK SC2
- The Phoenix building, which assets will take part into UK SC3a
- The Middlesbrough tower car par, which accounts for 4 EV chargers, will take part in UK SC3a and SC3b.
- The Constantine building is tentatively included in the demonstration for UK SC1, SC3a and SC2, pending on the necessary BMS upgrading metering and actuating points takes place in the required time frame. For the time being, this building is excluded from the demonstration.
- The main site electricity consumption, which will take part in UK SC1, SC2, SC3a, SC3b and SC4.

The updated main figures within the buildings involved are as indicated in the next table:

Building	Gross Internal Area (m^2)	EUI ($kWh/m^2/yr$)	Consumption (kWh/yr)	Occupants (people)
Middlesbrough Tower	11398.95	137.31	3130278.00	1500
Constantine (including film archive)	4875.01	172.62	841523.00	1100

Clarendon Building	8562.63	182.71	1564494.00	1040
Phoenix Building	4296.00	173.19	744026.00	1050
Stephenson building	8106.00	178.80	1449239.00	1500
Middlesbrough Tower car park (EV chargers)	100	62.63	6263.00[3]	20
Total	37238.00	107.36	8768529.22	6240

TABLE 2. UK DEMONSTRATION SITE UPDATED FIGURES

The technical requirements and site limitations within the UK site have been defined in D2.3, through site surveys. In total the building surface involved within the project is 37238.m^2, the power capacity involved is 764 kW and the occupants involved within these buildings are 6210.

As is common across the DR-BoB solution ME, DEMS and CP will be deployed and implemented centrally hosted by cloud service providers. The configuration to support the Teesside University scenarios will vary from the other sites. These variations are provided in this document.

Teesside University will operate predominantly explicit demand response which exists in the UK. All manually controlled assets will require that the CP will provide the notification in an appropriate manner to the Facility managers, and the end users of equipment in the scenarios that consider the occupant as an active party in the solution.

There are four buildings and EV charging posts at Teesside University. The control strategy for this site is outlined in D3.1 and D4.1.

For control and monitoring, the individual assets have been grouped into what has been termed Virtual Assets. This term simply refers to a single asset, or group of assets, that we measure, forecast and control as a single unit. Controlling individual assets is not always the best approach and could lead to inefficient BMS systems, i.e. in the case of HVAC units any independent control signal could cause conflict with the BMS and other controllers. Establishing simplified and grouped orders, help reducing the possibility of system failure. Grouping them as a single unit (virtual asset) mitigates the appearance of potential control and communication channels dysfunction.

The following diagram illustrates the top-level view of the virtual assets currently available and their corresponding connected devices.

[3] PV Generation

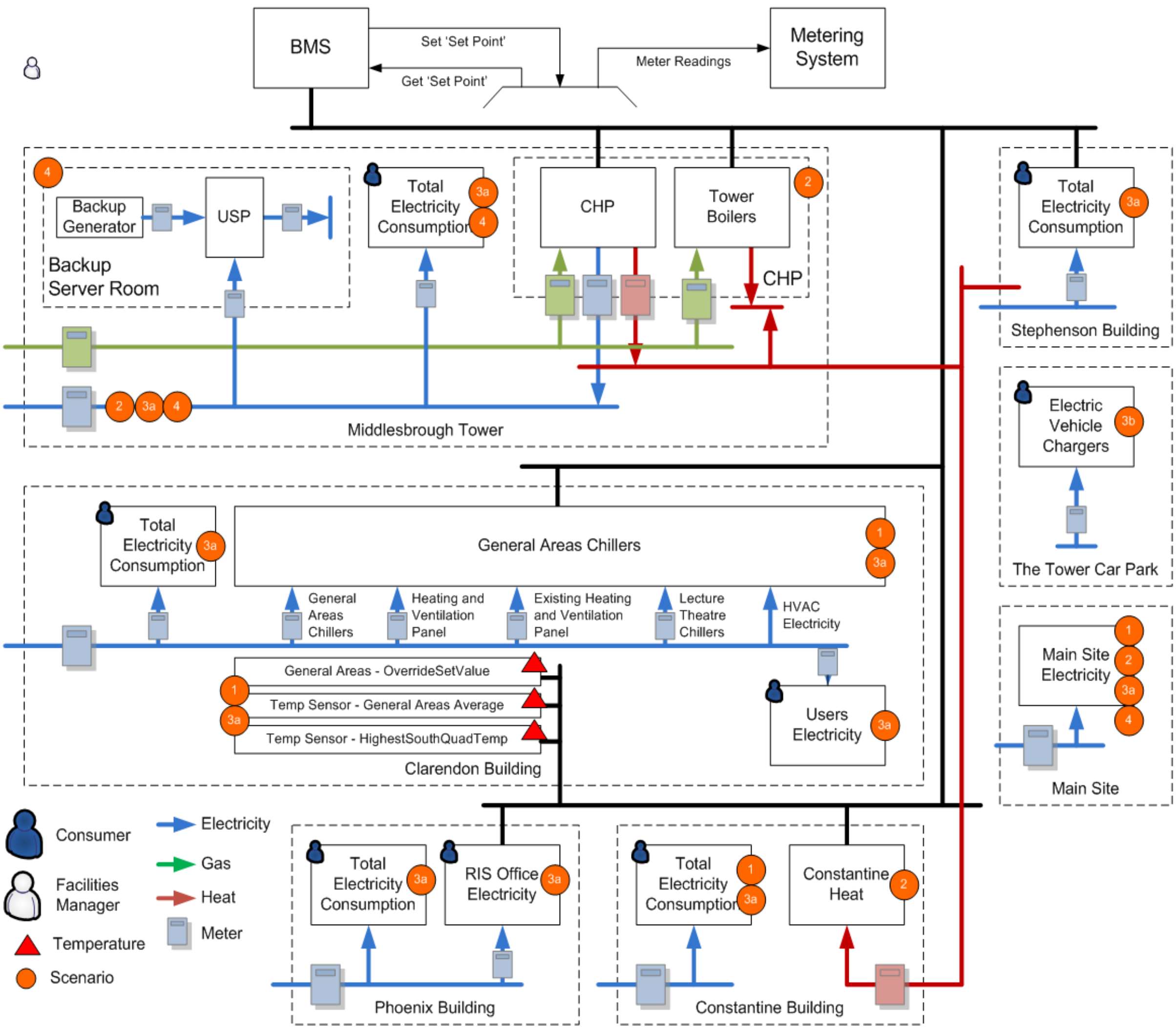


FIGURE 3. VIRTUAL ASSET LOCATIONS

Due to the specifics of the Teesside University Campus buildings, the connectivity limitations of the BMS and the existing points of measurement, several decisions have been made in order to consolidate a feasible demonstration case study that covered the whole scheme of scenarios defined in D2.2.

At Teesside University the LEM has been deployed centrally to act as a controller across all assets, whether they will be controlled automatically or manually by users or Facility managers. The LEM has been deployed alongside the BMS on the BACnet LAN, which will allow the LEM to read and write set points as needed to control the assets under the control of the BMS.

Teesside University will operate predominantly explicit demand response which exists in the UK. Where the scenarios make use of automation the LEM will be used to control the assets based on a signal from ME. The exception to this will be Scenario 4, where a very low latency signal is expected and will be handled directly by the LEM in response to the grid frequency balance requirements.

In the UK the virtual assets are listed in the table below for the sake of the system architecture defined in D3.1. These virtual assets are fed by different meter and temperature readings, forecast values and simulated values provided by the LEM's different functionalities. The meter readings are retrieved using two different sources: the BACnet /IP connection to the BMS using new and existing temperature and electricity metering points. These aspects are described in section 3.2 within this report. The second source of meter readings values comes from the centralised Meter Reading Service. The data is acquired at the Gateway PC, where the LEM is hosted for the UK site.

Virtual Assets		Scenarios	
Location/Premise	Virtual Asset	Scenarios	Control Man/Auto
Middlesbrough Tower	Electricity Import	2, 3a, 4	None
	Total Electricity Consumption	3a, 4	Manual
	Backup	4	Automatic
	CHP	2	Automatic
Stephenson Building	Total Electricity Consumption	3a	Manual
Clarendon Building	General Area Chillers	1, 3a	Automatic
	Users Electricity	3a	Manual
Constantine Building	Total Electricity Consumption	1, 3a	Automatic
	Constantine Heat	2	Automatic
The Tower Car Park	Electric Vehicle Chargers	3a, 3b	Manual
Phoenix Building	Total Electricity Consumption	3a	Manual
	RIS Office Electricity	3a	Manual
Main Site	Main Site Electricity	1,2,3a,4	None

Table 3. DR-BoB virtual assets at Teesside University Campus

3.2 CONFIGURATION OF BMS

3.2.1 SIGMA HARDWARE MIGRATION TO STRUXUREWARE

As stated in D3.1 and D3.3, Teesside University metering assets will be retrieved in two ways: via a cloud connection to a remote metering service (https://teamsigmacloud.com/) that gathers meter readings over a 3G/4G connection with the site. The second source of meter reading data is the BMS at the Middlesbrough Tower, in which LEM can retrieve the data from the meters in the Clarendon building through MODBUS and BACnet/IP. Upgrading for the BMS was needed in order to allow BACnet/IP control of HVAC assets required to operate as in DR scenarios and new meters were needed in order to monitor and analyse the results within the controlled assets. Migration from the existing Satchwell sigma BMS system to Schneider StruxureWare BMS have been delivered in order to provide the BMS with the needed features to operate automated DR actions within the system architecture. The metering company server uploads meter readings every 15 minutes, as csv files, to a FTPS server located on the gateway PC (**Error! Reference source not found.**). These data have time stamped filenames, and time series in the ISO-8601 format, UTC timezone, for ingest and processing by the LEM.

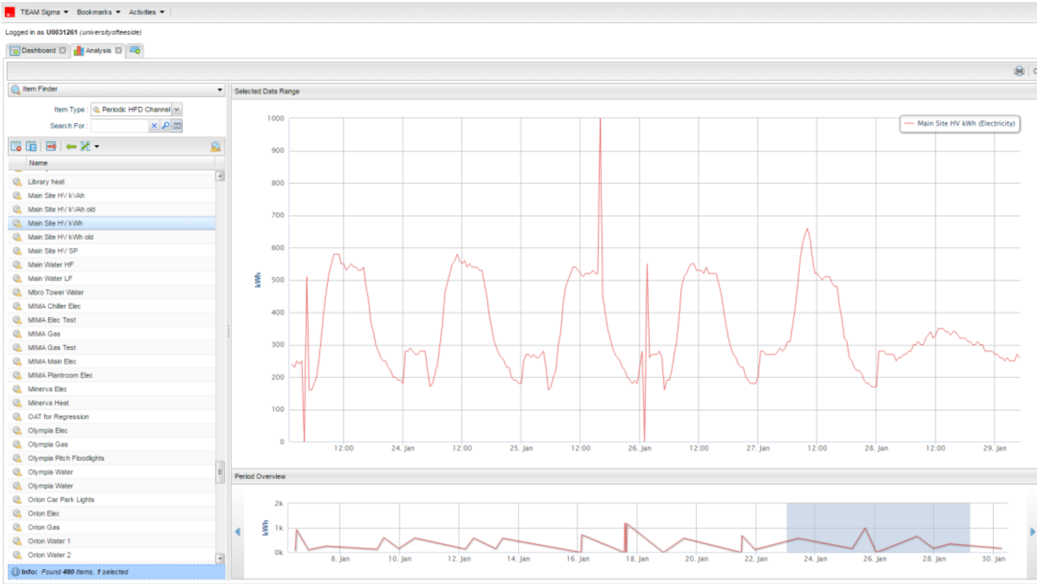


FIGURE 4. EXISTING TEESSIDE UNIVERSITY ACCESS TO TEAMSIGMACLOUD ENERGY METERING SYSTEM

Due to requirements for the LEM to be able to control the assets and override set-points, the TU team has agreed that the Clarendon building will substitute the Stephenson building in the scenario 1 and 3a. This is due to impossibility to add the necessary control points to the HVAC layout in the Stephenson building. The new control equipment for this project is housed in the existing Clarendon building roof top plant room Mechanical Control Panel (CP1) and a new enclosure mounted in the LV switch room.

TU have commissioned a Schneider Electric fully licenced Struxureware Enterprise server and Workstation Pro on a new PC supplied by the University. The Existing Sigma system has been fully transitioned into the Struxureware Enterprise server. The transition enables the Sigma BMS system to be available via BACnet/IP.

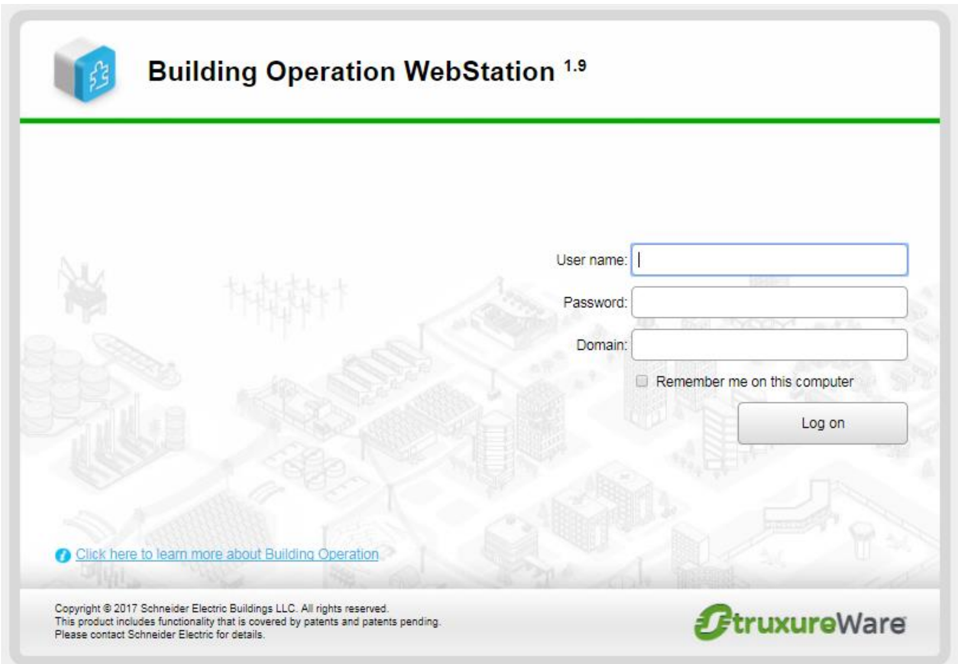


FIGURE 5. TEESSIDE UNIVERSITY ACCESS TO STRUXUREWARE SYSTEM MIGRATION FROM SIGMA FOR DR-BOB PROJECT

A new Schneider Electric Struxureware Automation Server 24 (ASB24) Controller has been installed in the existing Clarendon building roof top plant room Mechanical Control Panel (CP1). The controller acts as the BACnet gateway between the LEM and the Struxureware/Sigma BMS.

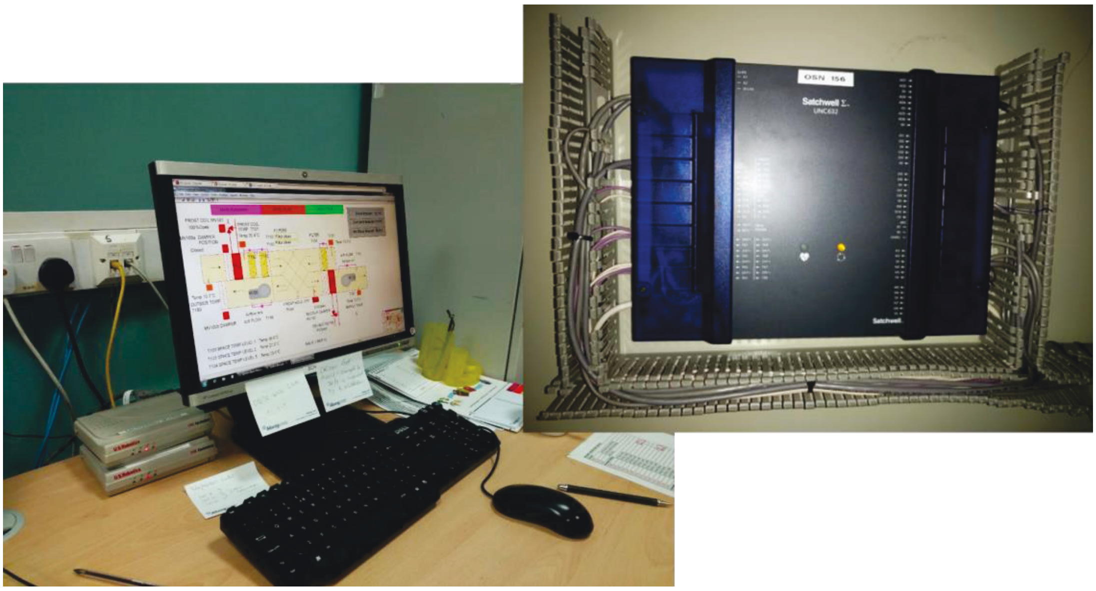


FIGURE 6. LEFT; LEGACY SIGMA BMS SERVER SHOWING MODEM COMMUNICATIONS. RIGHT; LEGACY SIGMA CONTROLLER HARDWARE LEFT IN PLACE IN CLARENDON BUILDING WITH CONFIGURATION PORTED TO STRUXUREWARE SERVER

In order for the LEM to override and monitor various plant and conditions in the Clarendon building, new software has been created in the Sigma Building Management system. The software points have been exposed to BACnet in the (CP1) ASB24. A new Schneider Electric Struxureware Automation Server 24 (ASB24) Controller has been installed in new enclosure mounted in the LV switch room. 5 new Schneider electric PM5110 Electric meters have been installed in the LV switch room by the University to monitor the energy usage of the HVAC and CHW plant.The controller acts as the MODBUS gateway to the PM5110 Electric Meters.

There are four AHU's in the Clarendon Building which are fitted with two stage DX Cooling coils and serve various locations in the building. The AHU software has not been altered as part of this project. The AHU's are enabled on demand from their own individual time schedules.

3.2.1.1 DR-BOB Plant / Conditions Monitoring

Various existing, and new room temperature calculation points (Highest, Lowest and Average temperature for each quadrant) are monitored by the LEM System. For example, a (BACnet Analog Input Value) in the LEM System is connected via BACnet/IP to a (BACnet Analog Value) in the Struxureware ASB24 controller, housed in CP1.

The ASB24 BACnet Analog Value is bound to the existing Sigma point via the global values bindings table in the Struxureware Enterprise server PC, in the Estates team Office. These values are read only and do not affect the control of the Sigma System.

The existing and new monitoring points are detailed in table 4 below these lines

EXISTING CALCULATION POINTS	PROG			TYPE	
TCL_1NWOPT163	170	163	CAL	Average	Space
TCL_1NWOPT164	170	164	CAL	Lowest	Space

TCL_1SWOPT152	171	152	CAL	Average	Space
TCL_1SWOPT153	171	153	CAL	Lowest	Space
TCL_1SWSOC151	171	151	CAL	Average	Space
TCL_1NEOPT036	172	36	CAL	Average	Space
TCL_1NEOPT037	172	37	CAL	Lowest	Space
TCL_1NEREC035	172	35	CAL	Average	Space
TCL_1SEOPT121	174	121	CAL	Average	Space
TCL_1SEOPT122	174	122	CAL	Lowest	Space
TCL_1SEFOYAVR	174	183	CAL	Foyer	Room
TCL_2NWOPT135	175	135	CAL	Average	Space
TCL_2NWOPT136	175	136	CAL	Lowest	Space
TCL_2SWOPT116	176	116	CAL	Average	Space
TCL_2SWOPT117	176	117	CAL	Lowest	Space
TCL_2SWSOC115	176	115	CAL	Average	Space
TCL_2NEOPT115	177	115	CAL	Average	Space
TCL_2NEOPT116	177	116	CAL	Lowest	Space
TCL_2NEFOY140	177	140	CAL	Room	Temp
TCL_2NEREC145	177	145	CAL	Room	Temp
TCL_2SEOPT121	178	121	CAL	Average	Space
TCL_2SEOPT122	178	122	CAL	Lowest	Space
TCL_2SE005153	178	153	CAL	Room	Temp
TCL_2SE007162	178	162	CAL	Room	Temp
NEW READ ONLY CALCULATION POINTS					
TCL_1NWOPT250	170	250	CAL	Highest	Space
TCL_1SWOPT248	171	248	CAL	Highest	Space
TCL_1NEOPT052	172	52	CAL	Highest	Space
TCL_1SEOPT128	174	128	CAL	Highest	Space
TCL_2NWOPT252	175	252	CAL	Highest	Space
TCL_2SWOPT206	176	206	CAL	Highest	Space
TCL_2NEOPT207	177	207	CAL	Highest	Space
TCL_2SEOPT208	178	208	CAL	Highest	Space

TABLE 4. TEESSIDE UNIVERSITY. CLARENDON BUILDING TEMPERATURE MONITORING NEW AND EXISTING CALCULATION POINTS.

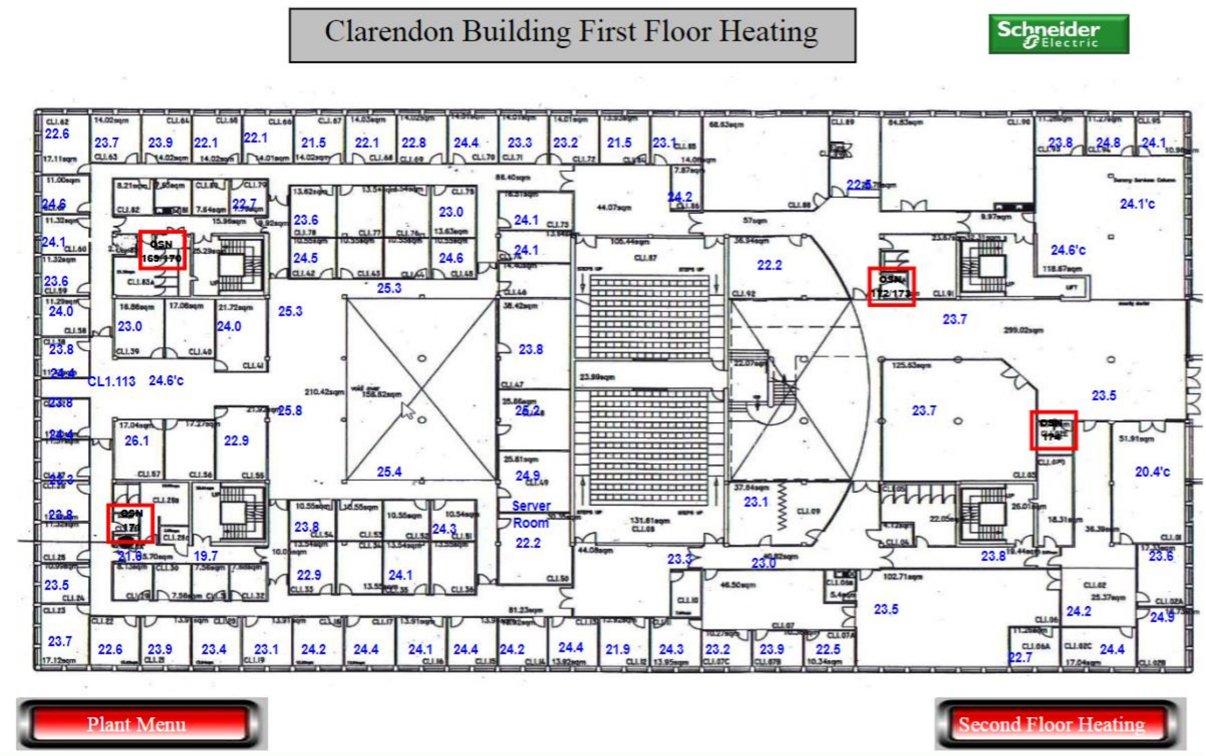


FIGURE 7. TEESSIDE UNIVERSITY STRUXUREWARE SIGMA INTERFACE. CLARENDON BUILDING REAL TIME TEMPERATURE MONITORING AND CONTROL ACCESS.

3.2.2 IDENTIFYING SPECIFIC AREAS FOR DR-BOB CONTROL

As was mentioned before, the existing layout of Stephenson building hampered the implementation of the requested upgrading to support DR-BoB technologies and enable overriding of the chillers within the Stephenson building assets. In search of a substitute, the Estates Department identified the Clarendon building as suitable for this adaptation, due to its current configuration, although some improvements on the metering system were required as it has been described along these sections. Within the Clarendon building the chillers have been identified as controllable, as well as the FCUs and the heat pumps.

3.2.2.1 FCU Chillers

There are two chillers on the roof of the Clarendon Building which serve fan coil units in various locations on the first and second floor. The Chiller software has not been altered as part of this project. The Chillers are enabled on demand from temperature conditions and time schedule. If the Chiller time schedule is on, the and the outside air temperature is greater than or equal to 9°C and the maximum value of the following average zone room temperatures is greater than 20°C, then the Chillers will be enabled.

3.2.2.2 Control Strategy

When a demand request is received from the grid, or in the case of DR-BoB scenarios in the UK, from the ME by the LEM, the scenario starts running as established in D3.1. When the scenario is initiated, and the FM has opted in (or has not opted out, as for D3.4), the LEM sends a request (BACnet Digital Output Value) and (BACnet Analog Output Set Point Value) via BACnet/IP to a (BACnet Digital Value) and (BACnet Analog Value) in the Struxureware ASB24 controller, housed in CP1. The ASB24 BACnet Values are bound to the new Sigma points via the global bindings table in the Struxureware Enterprise server PC, in the Estates team office.

Location	Id	Control set point
First Floor	West Fan Coil Units	Average Space Temperature.
First Floor	North East Fan Coil Units	Average Space Temperature.
First Floor	South East Fan Coil Units	Average Space Temperature.
Second Floor	North West Fan Coil Units	Average Space Temperature.
Second Floor	South West Fan Coil Units	Average Space Temperature.
Second Floor	North East Fan Coil Units	Average Space Temperature.
Second Floor	South East Fan Coil Units	Average Space Temperature.

TABLE 5. CALCULATION POINTS USED IN STRUXUREWARE

3.2.2.2.1 Fan coil units FCUs

The "DR BOB OVERRIDE" overrides each individual existing FCU Cooling set point from the list below, to "REM" remote reference point condition. The remote reference point is referenced to the new "DR BOB SETPOINT". The new "DR BOB SETPOINT" is set to two different values by the LEM System. On initial demand the set point will be (20°C adjustable) for the first 30 minutes. This is the "pre-cool period", after which the set point is raised to (26°C adjustable) there will now indirectly be no demand to the chiller and the rooms should hold their temperature. This is the" Low power period". Once the power is restored the LEM system will disable the "DR BOB OVERRIDE" and the system will be restored to automatic.

FIGURE 8. TEESSIDE UNIVERSITY STRUXUREWARE SIGMA INTERFACE. BACNET CONTROL POINTS.

During the heating season, the set-points will be the opposite. 26°C adjustable as for the pre-heating period, and 20°C "Low power period" for the heating strategy. The adjustable values will be established as part of the optimisation strategy in the LEM.

FCUs Set-points overridden by DR BoB	Rooms in Clarendon building
1. CLARENDON BUILDING 1FL North West Ht	CL1.39 Control
2. CLARENDON BUILDING 1FL North West Ht	CL1.41 Control
3. CLARENDON BUILDING 1FL North West Ht	CL1.42 Control
4. CLARENDON BUILDING 1FL North West Ht	CL1.45 Control
5. CLARENDON BUILDING 1FL North West Ht	CL1.47 Control
6. CLARENDON BUILDING 1FL North West Ht	CL1.48 Control
7. CLARENDON BUILDING 1FL North West Ht	CL1.49 Control
8. CLARENDON BUILDING 1FL North West Ht	CL1.59 Control P

FCUs Set-points overridden by DR BoB	**Rooms in Clarendon building**
9. CLARENDON BUILDING 1FL North West Ht	CL1.60 Control P
10. CLARENDON BUILDING 1FL North West Ht	CL1.61 Control P
11. CLARENDON BUILDING 1FL North West Ht	CL1.62 Control P
12. CLARENDON BUILDING 1FL North West Ht	CL1.63 Control P
13. CLARENDON BUILDING 1FL North West Ht	CL1.64 Control P
14. CLARENDON BUILDING 1FL North West Ht	CL1.65 Control P
15. CLARENDON BUILDING 1FL North West Ht	CL1.66 Control P
16. CLARENDON BUILDING 1FL North West Ht	CL1.67 Control P
17. CLARENDON BUILDING 1FL North West Ht	CL1.68 Control P
18. CLARENDON BUILDING 1FL North West Ht	CL1.69 Control P
19. CLARENDON BUILDING 1FL North West Ht	CL1.70 Control P
20. CLARENDON BUILDING 1FL North West Ht	CL1.71 Control P
21. CLARENDON BUILDING 1FL North West Ht	CL1.72 Control P
22. CLARENDON BUILDING 1FL North West Ht	CL1.73 Control
23. CLARENDON BUILDING 1FL North West Ht	CL1.74 Control
24. CLARENDON BUILDING 1FL North West Ht	CL1.75 Control
25. CLARENDON BUILDING 1FL North West Ht	CL1.78 Control
26. CLARENDON BUILDING 1FL North West Ht	CL1.79 Control
27. CLARENDON BUILDING 1FL North West Ht	CL1.85 Control P
28. CLARENDON BUILDING 1FL North West Ht	CL1.84 Control P
29. CLARENDON BUILDING 1FL North West Ht	CL1.89 Control P
30. CLARENDON BUILDING 1FL North West Ht	CL1.86 Control
31. CLARENDON BUILDING 1FL North West Ht	CL1.92 Control
32. CLARENDON BUILDING 1FL North West Ht	CL1.113 Inner
33. CLARENDON BUILDING 1FL South West Ht	CL1.17 Control P
34. CLARENDON BUILDING 1FL South West Ht	CL1.18 Control P
35. CLARENDON BUILDING 1FL South West Ht	CL1.19 Control P
36. CLARENDON BUILDING 1FL South West Ht	CL1.20 Control P
37. CLARENDON BUILDING 1FL South West Ht	CL1.21 Control P
38. CLARENDON BUILDING 1FL South West Ht	CL1.22 Control P
39. CLARENDON BUILDING 1FL South West Ht	CL1.23 Control P
40. CLARENDON BUILDING 1FL South West Ht	CL1.24 Control P
41. CLARENDON BUILDING 1FL South West Ht	CL1.25 Control P
42. CLARENDON BUILDING 1FL South West Ht	CL1.26 Control P
43. CLARENDON BUILDING 1FL South West Ht	CL1.27 Control P
44. CLARENDON BUILDING 1FL South West Ht	CL1.29 Control
45. CLARENDON BUILDING 1FL South West Ht	CL1.31 Control
46. CLARENDON BUILDING 1FL South West Ht	CL1.33 Control
47. CLARENDON BUILDING 1FL South West Ht	CL1.54 Control
48. CLARENDON BUILDING 1FL South West Ht	CL1.51 Control
49. CLARENDON BUILDING 1FL South West Ht	CL1.35 Control
50. CLARENDON BUILDING 1FL South West Ht	CL1.37 Control P
51. CLARENDON BUILDING 1FL South West Ht	CL1.38 Control P

FCUs Set-points overridden by DR BoB	Rooms in Clarendon building
52. CLARENDON BUILDING 1FL South West Ht	CL1.55 Control
53. CLARENDON BUILDING 1FL South West Ht	CL1.57 Control
54. CLARENDON BUILDING 1FL South West Ht	CL1.58 Control P
55. CLARENDON BUILDING 1FL South West Ht	CL1.113 Outer P
56. CLARENDON BUILDING 1FL South West Ht	Social Area Control
57. CLARENDON BUILDING 1FL North East Ht	CL1.93 Control P
58. CLARENDON BUILDING 1FL North East Ht	CL1.94 Control P
59. CLARENDON BUILDING 1FL North East Ht	CL1.95 Control P
60. CLARENDON BUILDING 1FL North East Ht	Reception Area P
61. CLARENDON BUILDING 1FL South East Ht	CL1.01 Control P
62. CLARENDON BUILDING 1FL South East Ht	CL1.02 Control
63. CLARENDON BUILDING 1FL South East Ht	CL1.02A Control P
64. CLARENDON BUILDING 1FL South East Ht	CL1.02B Control P
65. CLARENDON BUILDING 1FL South East Ht	CL1.02C Control P
66. CLARENDON BUILDING 1FL South East Ht	CL1.03 Control
67. CLARENDON BUILDING 1FL South East Ht	CL1.06 Control P
68. CLARENDON BUILDING 1FL South East Ht	CL1.06A Control P
69. CLARENDON BUILDING 1FL South East Ht	CL1.07 Control
70. CLARENDON BUILDING 1FL South East Ht	CL1.07A Control P
71. CLARENDON BUILDING 1FL South East Ht	CL1.07B Control P
72. CLARENDON BUILDING 1FL South East Ht	CL1.07C Control P
73. CLARENDON BUILDING 1FL South East Ht	CL1.09 Control
74. CLARENDON BUILDING 1FL South East Ht	CL1.10 Control
75. CLARENDON BUILDING 1FL South East Ht	CL1.11 Control P
76. CLARENDON BUILDING 1FL South East Ht	CL1.12 Control P
77. CLARENDON BUILDING 1FL South East Ht	CL1.13 Control P
78. CLARENDON BUILDING 1FL South East Ht	CL1.14 Control P
79. CLARENDON BUILDING 1FL South East Ht	CL1.15 Control P
80. CLARENDON BUILDING 1FL South East Ht	CL1.16 Control P
81. CLARENDON BUILDING 1FL South East Ht	Foyer Control
82. CLARENDON BUILDING 2FL North West Ht	CL2.11 Control
83. CLARENDON BUILDING 2FL North West Ht	CL2.12 Control
84. CLARENDON BUILDING 2FL North West Ht	CL2.13 Control
85. CLARENDON BUILDING 2FL North West Ht	CL2.16 Control
86. CLARENDON BUILDING 2FL North West Ht	CL2.23 Control
87. CLARENDON BUILDING 2FL North West Ht	CL2.28 Control P
88. CLARENDON BUILDING 2FL North West Ht	CL2.29 Control P
89. CLARENDON BUILDING 2FL North West Ht	CL2.33A Control
90. CLARENDON BUILDING 2FL North West Ht	CL2.33B Control
91. CLARENDON BUILDING 2FL North West Ht	CL2.33C Control
92. CLARENDON BUILDING 2FL North West Ht	CL2.33D Control
93. LARENDON BUILDING 2FL North West Ht	CL2.34 Control P
94. CLARENDON BUILDING 2FL North West Ht	CL2.35 Control P

FCUs Set-points overridden by DR BoB	Rooms in Clarendon building
95. CLARENDON BUILDING 2FL North West Ht	CL2.36 Control P
96. CLARENDON BUILDING 2FL North West Ht	CL2.37 Control P
97. CLARENDON BUILDING 2FL North West Ht	CL2.38 Control P
98. CLARENDON BUILDING 2FL North West Ht	CL2.39 Control P
99. CLARENDON BUILDING 2FL North West Ht	CL2.45 Control P
100. CLARENDON BUILDING 2FL North West Ht	CL2.45A Control P
101. CLARENDON BUILDING 2FL North West Ht	CL2.46 Control P
102. CLARENDON BUILDING 2FL North West Ht	CL2.47 Control
103. CLARENDON BUILDING 2FL North West Ht	CL2.48 Control
104. CLARENDON BUILDING 2FL North West Ht	CL2.50 Control
105. CLARENDON BUILDING 2FL North West Ht	CL2.53 Control
106. CLARENDON BUILDING 2FL North West Ht	CL2.54 Control
107. CLARENDON BUILDING 2FL South West Ht	CL2.10 Control P
108. CLARENDON BUILDING 2FL South West Ht	CL2.21 / 2.24
109. CLARENDON BUILDING 2FL South West Ht	CL2.20 Control P
110. CLARENDON BUILDING 2FL South West Ht	CL2.26 Control P
111. CLARENDON BUILDING 2FL South West Ht	CL2.26A Control P
112. CLARENDON BUILDING 2FL South West Ht	CL2.25 Control P
113. CLARENDON BUILDING 2FL South West Ht	CL2.25A Control P
114. CLARENDON BUILDING 2FL South West Ht	CL2.27 Control P
115. CLARENDON BUILDING 2FL South West Ht	Social Area
116. CLARENDON BUILDING 2FL North East Ht	CL2.59 Control P
117. CLARENDON BUILDING 2FL North East Ht	CL2.61 Control
118. CLARENDON BUILDING 2FL North East Ht	CL2.64 Control P
119. CLARENDON BUILDING 2FL North East Ht	CL2.65 Control P
120. CLARENDON BUILDING 2FL North East Ht	CL2.66 Control P
121. CLARENDON BUILDING 2FL North East Ht	Reception Foyer
122. CLARENDON BUILDING 2FL North East Ht	Reception Control P
123. CLARENDON BUILDING 2FL South East Ht	CL2.01 Control P
124. CLARENDON BUILDING 2FL South East Ht	CL2.02 Control
125. CLARENDON BUILDING 2FL South East Ht	CL2.02A Control P
126. CLARENDON BUILDING 2FL South East Ht	CL2.02b Control P
127. CLARENDON BUILDING 2FL South East Ht	CL2.02c Control P
128. CLARENDON BUILDING 2FL South East Ht	CL2.05 Control P
129. CLARENDON BUILDING 2FL South East Ht	CL2.06 Control P
130. CLARENDON BUILDING 2FL South East Ht	CL2.07 Control P
131. CLARENDON BUILDING 2FL South East Ht	CL2.09 Control

TABLE 6. CLARENDON BUILDING. ROOMS AND FCUS CONTROLLED BY BMS AND DR-BOB OVERRIDE

3.2.2.2.2 Gas fired cooling coils

There are four AHU's in the Clarendon Building which are fitted with two stage DX Cooling coils and serve various locations in the building. The AHU software has not been altered as part of this project. The AHU's are enabled on demand from their own individual time schedules.

DX Cooling Coils

The DX are enabled if the AHU supply air flow switch detects air flow, the outside air temperature is greater than or equal to 9°C and the Supply air temperature is 4°C greater than the Supply Air set point (22°C adjustable).

When DR BoB scenario 1 and 3a run, these set-points are overridden as like the FCUs controls.

3.2.2.2.3 Heat Pumps

There are 11 heat pumps which serve various locations in the Clarendon Building. The Heat pumps are enabled on demand from their own individual time schedules. There are no remote set-points associated with this plant.

When DR BoB scenario 1 and 3a run, these heat pumps are overridden and set off. After the scenarios finish, the automatic control is restored. Table below shows the rooms affected by the heat pump override

Heat pump number	Level	Room	units
1	1	188	(1&2)
2	1	192	-3
3	1	190	(4&5)
4	1	103	
5	2	249	
6	2	251A	
7	2	251	
8	2	256	
9	2	257	
10	2	258	
11	1	F125	(6,7,8,9)

TABLE 7. CLARENDON BUILDING HEAT PUMPS CONTROLLED BY DR-BOB OVERRIDE.

3.2.2.3 DR-BOB Override Software

The new programming point “DR BOB OVERRIDE” and set points “DR BOB SETPOINT” have been created in the Sigma system and are referenced to various existing Sigma programs and set points in the Clarendon building Sigma software. When the “DR BOB OVERRIDE” program is not enabled the Sigma BMS acts normally and has not changed. When the “DR BOB OVERRIDE” program is enabled in several plants, and set points are overridden as the “DR BOB SETPOINT” becomes active.

Lack of integration of HVAC assets in Stephenson building triggered the decision to adapt the initial plan and deploy the DR-BoB solution using the Clarendon Building. Within this building automated control of the assets described can be carried out with a minor investment described within the financial report of DR-BoB.

Brittan building demolition as part of the University Masterplan have as well deterred investment in BMS control and participation within the DR-BoB project.

3.2.3 ASSETS UNDER AUTOMATED CONTROL

Within DR-BoB automated (using LEM and manual through Estates Department Satchwell sigma interface) actions will control different assets within different Demand response scenarios and programs. The list of assets involved are:

Building	Plant Description	Location	Area Supply	Make	Model	Indoor /Outdoor	Sensible Cooling	Cooling (KW)
Clarendon	DX Coil In AHU (1998) Packaged Unit	Rooftop Area	AHU No 1	Airedale	CUS6HI	Outdoor + DX	13.5	18

Clarendon	DX Coil In AHU (1998) Packaged Unit	Rooftop Area	AHU No 4	Airedale	CUS7.5MH I	Outdoor + DX	5.62	7.5
Clarendon	DX Coil In AHU (1998) Packaged Unit	Rooftop Area	AHU No 3	Airedale	CUS5HI	Outdoor + DX	11.25	15
Clarendon	DX Coil In AHU (1998) Packaged Unit	Rooftop Area	AHU No 2	Airedale	CUS6HI	Outdoor + DX	13.5	18
Clarendon	Split System (Cassette) (1998)	Rooftop Area	Class Room 2.49	Mitsubis hi	PUH-4YKSA	Outdoor	7.8	10
Clarendon	Split System (Cassette) (1998)	Rooftop Area	Class Room 2.58	Mitsubis hi	PUH-4YKSA	Outdoor	7.8	10
Clarendon	Split System (Cassette) (1998)	Rooftop Area	Class Room 1.03	Mitsubis hi	PUH-6YKSA	Outdoor	9.38	14
Clarendon	Split System (Cassette) (2008)	Rooftop Area	Server Room 1.50	Mitsubis hi	PUHZ-RP100YHA 3	Outdoor	7.8	10
Clarendon	Split System (Cassette) (1998)	Rooftop Area	Class Room 2.57	Mitsubis hi	PUH-4YKSA	Outdoor	7.8	10
Clarendon	Split System (Cassette) (1998)	Rooftop Area	Class Room 2.56	Mitsubis hi	PUH-2.5VKA	Outdoor	4.5	6
Clarendon	Split System (Cassette) (1998)	Rooftop Area	Class Room 2.51	Mitsubis hi	PUH-1.6VKA	Outdoor	2.9	3.5
Clarendon	Split System (Cassette) (1998)	Rooftop Area	Class Room 2.51A	Mitsubis hi	PUH-2.5VKA	Outdoor	4.5	6
Clarendon	Split System 2 x Indoor(Cassette)(1998)	Car Park Area	Room 1.90	Mitsubis hi	PUH-6YKSA	Outdoor	9.38	14
Clarendon	Split System (Cassette) (1998)	Car Park Area	Class Room 1.88	Mitsubis hi	PUH-6YKSA	Outdoor	10.36	14
Clarendon	Split System (Cassette) (1998)	Car Park Area	Class Room 1.92	Mitsubis hi	PUH-2.5KVA	Outdoor	4.5	6
Total							136.39	183.00

TABLE 8. TEESSIDE UNIVERSITY. LEM CONTROLLABLE ASSETS IN CLARENDON BUILDING.

During the implementation of the DR-BoB chiller 2 unit was replaced for a newer one, which has a better performance and utilises a higher and more stable supply air flow temperature than chiller 1.

3.2.4 METER CONFIGURATION

There are 5 new Schneider electric PM5110 Electric meters installed in the LV switch room by the University to monitor the energy usage of the following equipment:

- FCU Chiller No.1
- FCU Chiller No.2
- CP1 HVAC Control Panel
- CP2 HVAC Control Panel
- Lecture Theatres Chillers 1 & 2

The Lecture Theatre set points will not be under DR-BoB control so as not to compromise "the student experience", as detailed in D2.2 Demonstration Scenarios, however isolating their consumption will allow a better understanding of patterns of consumption and future DR potential. They may also come under control when the technology is proven to the satisfaction of the university administration. General building user load (lighting and plug load) is also calculated as the residual of the building meter and the collected HVAC sub-meters.

The New Sturxureware system monitors all available points in the electric meters through individual Smart struxure Smart widget Graphics. The new Schneider Electric Struxureware Automation Server 24 (ASB24) Controller installed in the LV switch room, acts as the MODBUS gateway to the PM5110 Electric Meters via rs485 twisted pair wired network. The Controller is connected to the University's IP network and can be accessed remotely via web station, via

Workstation software directly to the device or via Workstation software into the Enterprise Server. Some issues were reported as to the configuration of the meters connectivity:

Modbus Meters; after checking the meters connection to the graphical bindings some incorrect registers were identified and corrected and bound to the graphics display in the Sigma interface. A kWh trend chart was created to monitor the concordance of the meters and the display. The Modbus values, graphics and logging are functional at the University BMS workstation.

BACnet; values not changing in the BACnet folder was reported. This was due to the value prefix not being the same in both the Modbus folder and the BACnet folder so that the values were not updated. This was rectified and the values are updated in the BACnet folder to match that of the Modbus folder.

3.2.4.1 Meters

The meters installed by Schneider electric are PM5110 series, below described. They are installed in the Clarendon building switch room. These meters measure 5 items and are connected via MODBUS and BACnet /IP to the BMS. The product data sheet is found online[4] x 1 and a screenshot of one of the meters is shown in figure 10. The measured items are:

- Energy
- Active and reactive power
- Voltage
- Current
- Frequency
- Power factor

Below these lines, the electrical layout for the 5 new meters within the general layout, switches and control points.

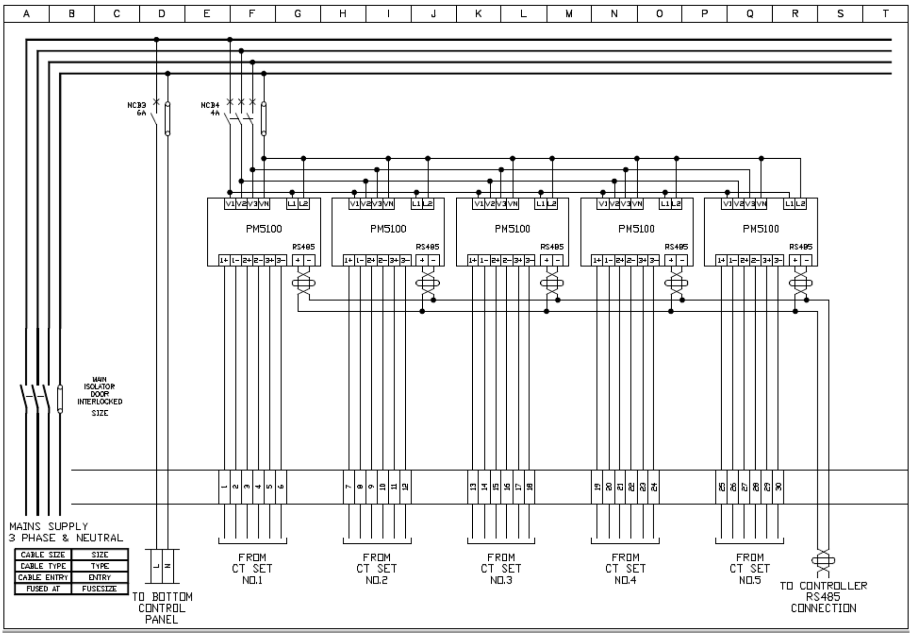


FIGURE 9. CLARENDON BUILDING NEW METERS LAYOUT SCHEMA.

[4] http://www.schneider-electric.com/en/product/METSEPM5110/pm5110-powermeter-w-modbus---upto-15th-h---1do-33alarms---flush-mount/

FIGURE 10. PM5110 SERIES INSTALLED

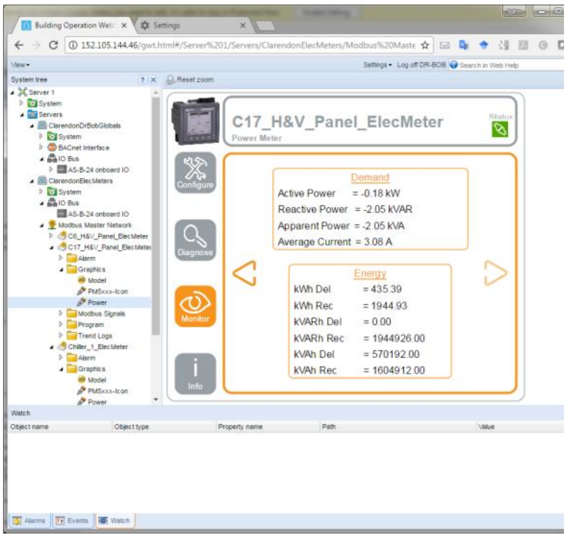


FIGURE 11. HIGH FREQUENCY METERING DATA FOR HVAC ASSETS AT UK SITES VISIBLE WITH STRUXUREWARE BMS

3.2.5 DR-BOB OVERRIDE IMPLEMENTATION

The first strategy established the override of the different HVAC assets in the Clarendon buildings using the tentative temperature set-points of 22C for precooling and 24C for preheating. After a series of conversations with the energy managers at the Estates Department, it was decided to swop to 20C for precooling, as 22C would be not enough, given the time foreseen for precooling, to gain advantage of it, and discomfort was foreseen as a result. One of the advantages of the system is that it allows customisation and therefore, establishing new set-points for the override as the tests advance in order to fine tune the actions.

3.2.6 INITIAL TESTING AND FAULT FINDING

During the initial tests run for scenario 1, the DR-BoB technical staff and the Campus facilities detected several minor incidences. One of the control points that DR-BoB Override was operating. There were two rooms within the Clarendon building which had not being identified as hosting sensible equipment (like IT servers).

Rooms 2.51 and 2.51a were identified during the first test. The FM team took back control of the system and deactivated DR-BoB override as they had been reported of an IT server being disconnected unexpectedly. That led to the identification of Server room 2.51 and 2.51a within the DR-BoB override and their exclusion from it.

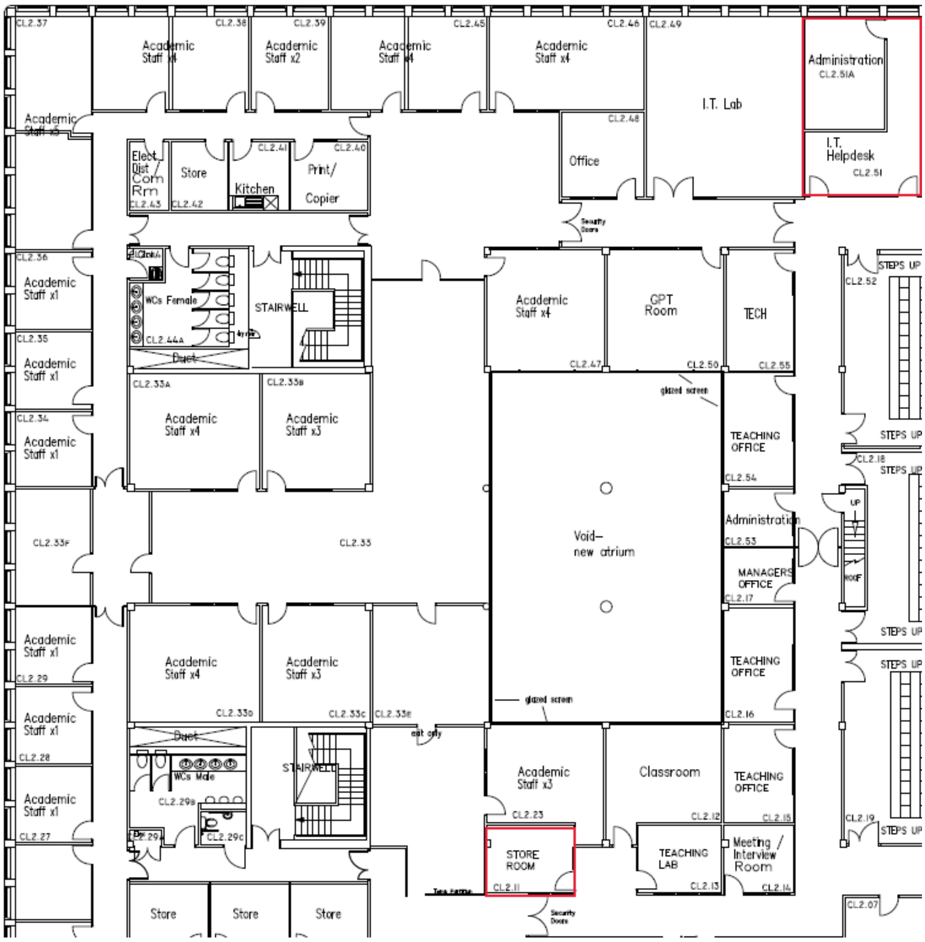


FIGURE 12. SECOND FLOOR PLANT AT CLARENDON BUILDING WITH HIGHLIGHTED EXCLUDED ROOMS FOR OVERRIDE

The second server room identified is in Cl2.11. It was identified during a meeting with the team leaders at Clarendon building (Keith Haley, Technician Manager and John Carter, senior lecturer). After checking which rooms were in control of the override, this one was identified as hosting the server, which has led to the deactivation from the program.

During the data gathering once the system was put into work, there have been some minor issues identified in terms of the completion of the monitoring points (Highest, average and minimum) at the different floor quadrants. This has led to the identification of a lacking missing data logging point (2nd Floor NW Minimum). This issue has been reported to Schneider electric to be solved.

Further description of testing of scenarios is described in section 3.9

3.2.7 DATA HANDLING

In order to analyse data and infer conclusions for the research team, for the DR-BoB consortium and for the Estates Department at the university, different logging data frequency intervals have been tested. The frequency available for data logging is 1 min interval. The interval required by LEM to operate in accordance to the project requirements as stated in D3.2 is 15 min, for the UK site (in the French site, in order to coordinate the 3 intervened buildings the frequency will be 60 min). This interval should be sufficient to analyse data in terms of energy consumption, DR evaluation and Environmental conditions analysis. This task is to be done within WP5 and details of the aspects to monitor and to establish baselines for evaluation and analytics (E&A) are shown in deliverable D5.1.

The process for establishing the logging data intervals and retrieving data from the system is shown in the StruxureWare user manual. Due to security issues, data can only be retrieved at the Campus Facilities offices in the Middlesbrough Tower. A screenshot of the dialog for establishing the reading log interval is shown below.

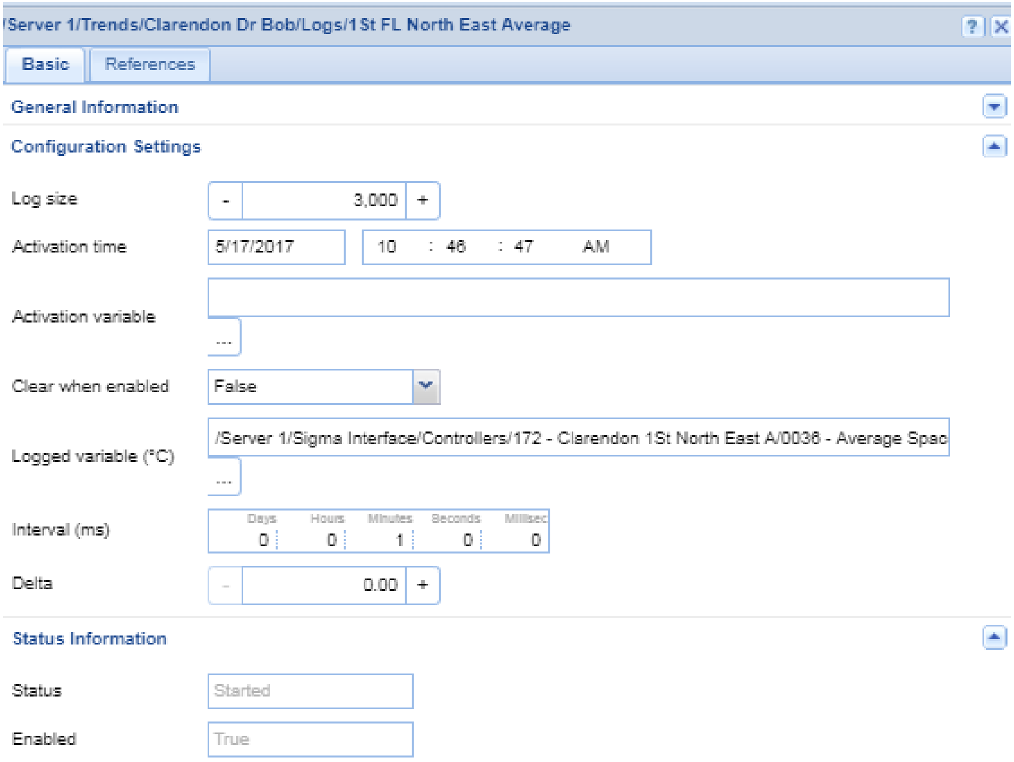


FIGURE 13. ONE MINUTE FREQUENCY MONITORING SET UP IN THE LOGGING SYSTEM IN STRUXUREWARE/SIGMA.

In the case of the optimisation definition for the UK site operation some adjustments needed to be done. A series of testing were carried out after detecting the pattern and setting the logging data frequency to 1 min interval, and hence be able to analyse the actual pattern in the correlation of the different integers, if existing.

We can see the two chillers working and the time in which they get switch on/off is clearer. There appears to be a correlation in the flow temperature and the chiller functioning, the temperature set point are higher for chiller 1 (blue) than chiller 2 (orange) though the flow temp threshold is narrower in the chiller 1 (1C against 4C) . As well the power of chiller 1 (around 7.72 kW) seems to be greater than for chiller 2 (around 4.4 kW).

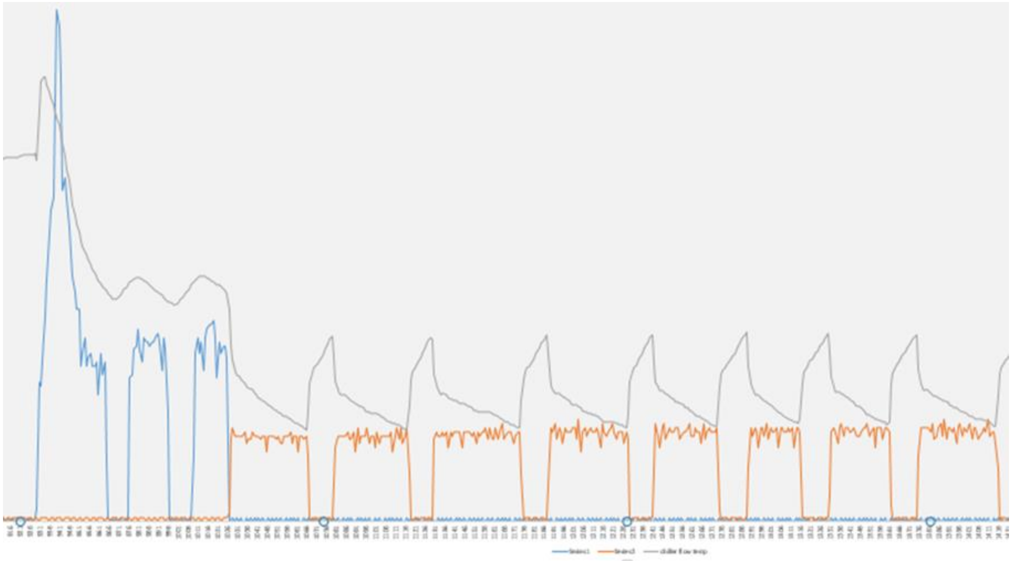


FIGURE 14. ONE MINUTE FREQUENCY MONITORING. IN ORANGE, CHILLER 1 ENERGY CONSUMPTION, IN BLUE CHILLER 2 AND IN GREY AIRFLOW TEMPERATURE. STUDY FOR OPTIMISATION.

The strategy to determine the optimisation has been carried out during several tests, in which the following aspects were highlighted:

- The switching frequency looks relatively fast (cycle every few minutes) therefore it is a reasonable judgement using linear approximation is appropriate.

To have enough data to determine the correlation trends, the team has run a test for the assets in Clarendon building in which for 2 hours the assets run with nominal set-point (24C), after that, they run for 3 hours with low set-point (20C) and after that, they run for 3 hours with high set-point (26C).

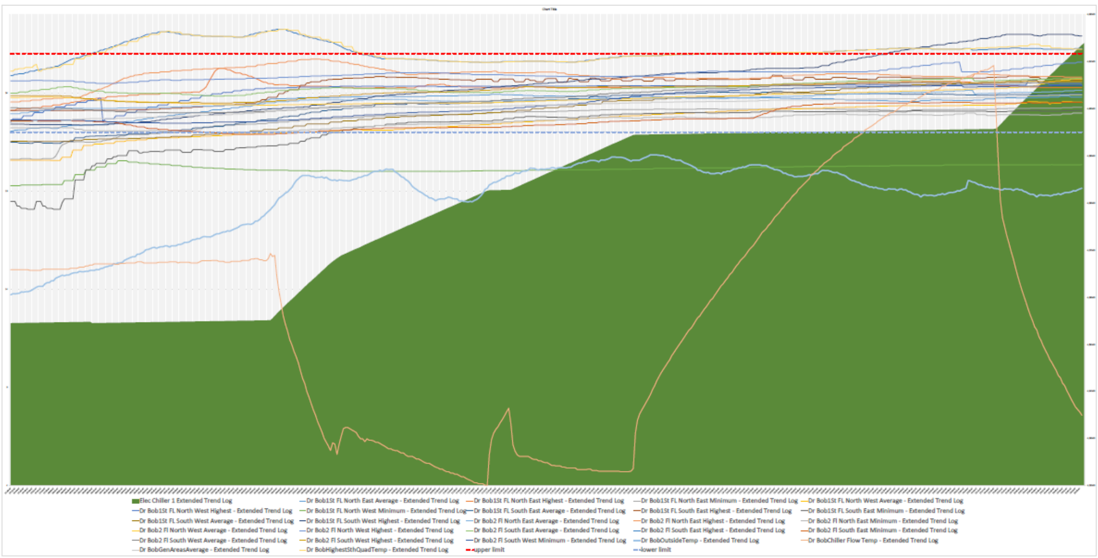


FIGURE 15. ONE MINUTE FREQUENCY MONITORING. STUDY FOR OPTIMISATION. ELECTRICITY CONSUMPTION FROM CHILLER 1 (MASS OF GREEN), CHILLER FLOW TEMP. (ORANGE) AND CALCULATION POINTS TEMPERATURES (OTHER COLOURS)

To retrieve data from the BMS interface, weekly visits at the Campus Services offices were arranged. From there, data can be retrieved in csv and xml file formats. This can be done using one by one logging reports or generating a multi-log point reports. The issue is to have the same timestamp to be able to coordinate data for analysis (which has some difficulties with the multi-log point report).

3.2.8 DATA VISUALISATION REQUIREMENTS

After having determined the different logging points and time interval for the data logs the decision is to determine the different trends and charts needed to examine and analyse the data. In the StruxureWare interface, different charts have been customised to do so. These are shown below.

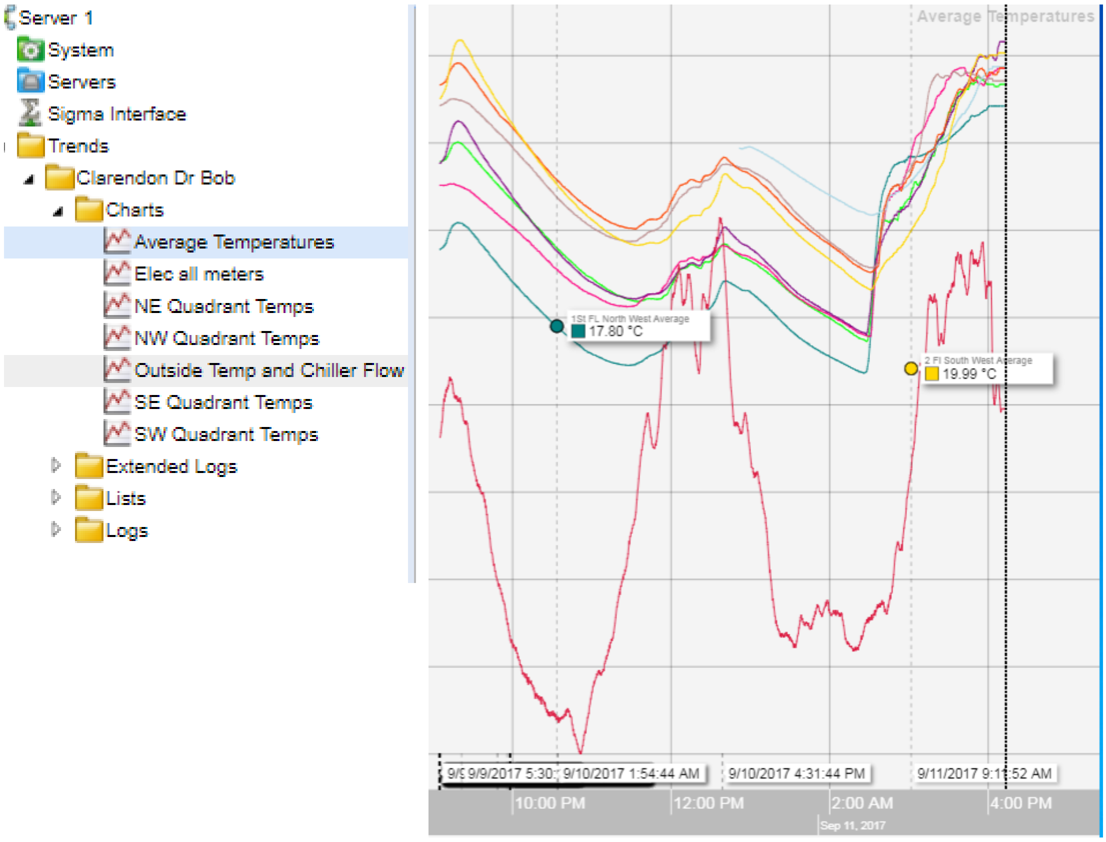


FIGURE 16. CUSTOM DISPLAY OF THE DIFFERENT SELECTED CHARTS IN BMS AT ESTATES DEPARTMENT WORKSTATION

The charts can be adapted to different timescales, include other logging trends, isolate or discard logging trends, and change the refresh window period.

3.3 TEAM LEADER ENGAGEMENT FOR SCENARIO 3A

One of the most important scenarios to be deployed in the UK demonstration site involves the 4 different buildings and multiple stakeholders need to be aware and provide support to the DR-BoB team. This happens within Scenario 3a, aimed at reducing demand during the Triad periods. As these periods are not known in advanced, they require a combination of predictive capabilities as well as flexibility as to be able to reschedule or shift activities across the day or even moving them to other weekday. To do so, collaboration and coordination with responsible staff of the equipment which generates the load remains vital

3.3.1 SCIENCE LABORATORY AREAS – MIDDLESBROUGH TOWER

As part of this scenario, two laboratories, located in the 9th and 8th floor within the Middlesbrough tower will be involved in scenario 3a. These laboratories experience an intense activity and hence, responding to the DR request is not an easy task. Coordination with the DR-BoB team will ease the process, and identification of the laboratory principal managers is crucial. In this case, Dr Paul Douglas and Dr Jibin He, responsible of the Chemistry and Biology laboratory, and Food and Nutrition laboratory respectively, have been nominated as team leaders for this scenario. Dr Laura Brown and other staff members will cooperate as well during the scenario, and providing feedback to the team.

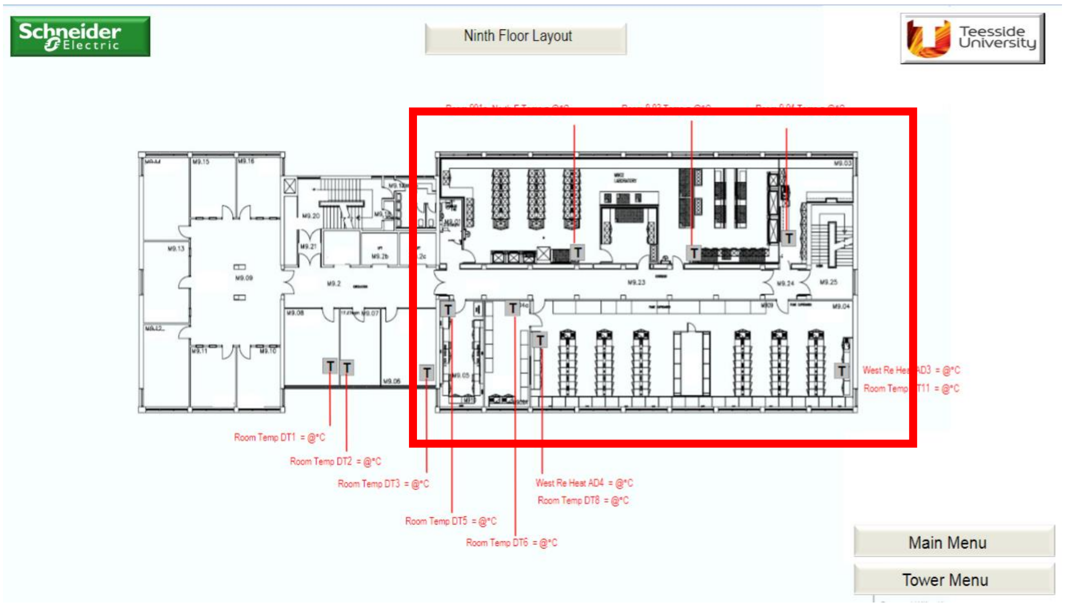


FIGURE 17. BMS DISPLAY OF THE NINTH FLOOR PLANT VIEW WITH THE FOOD LABS HIGHLIGHTED AT MIDDLESBROUGH TOWER

3.3.2 ELECTRICAL LABORATORY AREAS – STEPHENSON BUILDING

A similar approach has been defined within Stephenson building. Martin Quennell, Technician Team Leader at the electrical Laboratory areas, will be responsible for conducting, guiding and making sure that demand from the assets within this laboratory are switched off during the triad alarms, within the scenario 3a.

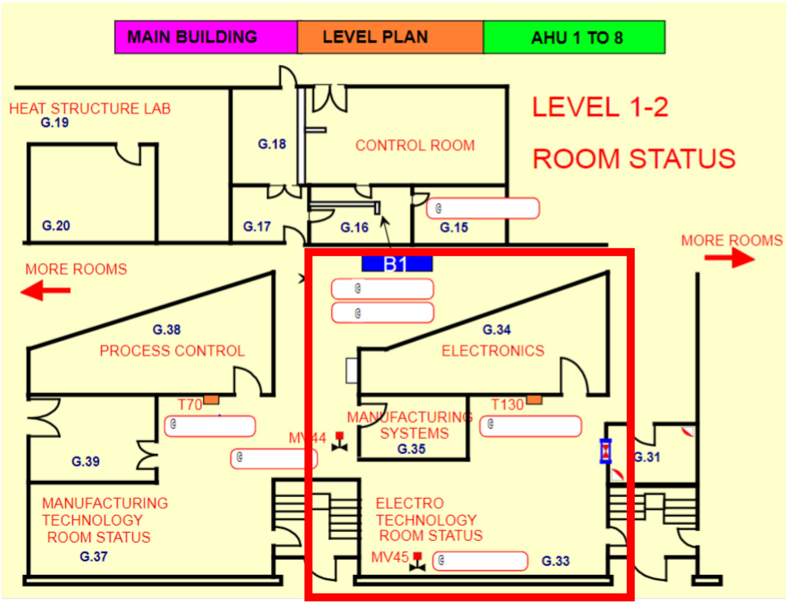


FIGURE 18. BMS DISPLAY OF THE GROUND FLOOR PLANT VIEW WITH THE ELECTRICAL LABS HIGHLIGHTED AT STEPHENSON BUILDING

3.3.3 GENERAL AREAS - CLARENDON BUILDING

The implication of the team leaders at the Clarendon building is paramount, as the number of students and staff involved in terms of likelihood of discomfort and request of assets disconnection is the greatest within this building in scenario 3a. This is due to the automated override of temperature set-points by the LEM and also the request for the staff to modify, if possible, their behaviour in order to reduce energy demand within the building. The team leaders (TLs) at the Clarendon building, were recruited to act as liaison with the staff in the building, and gather complaints (if any) doubts and requests from the users involved (aware or not of the DR event taking place). They will also propose the occupant panel composition for this building and have been involved in the risk assessment in order to define the rooms that should not be connected and elaborating and inventory of ancillary assets that could be disconnected during the triad periods.

An interview and briefing was conducted 09/09/2017. The meeting took place in the CL1.85 office in the Clarendon building. The meeting consisted of an explanation of the scenarios in which the Clarendon building assets and occupants will be involved. During the meeting some aspects were raised, i.e. some inherent difficulties, related to the faulty building fabric (insulation and air leakage) that will probably lead to comfort or temperature disruption during scenarios. Advice will be given to users to prevent use of alternative heating equipment (TL reported a number of existing fan heaters) which otherwise would be connected during the scenario running, if discomfort was perceived by the users.

As well, TLs reported the dependency of most of the staff at this building on desktop PCs, which probably will deter the disconnection of this equipment. Hence, the expected response from users in Clarendon Building mostly relates to the HVAC related equipment in the scenarios. Other ancillary equipment as lighting and dishwashers will be involved.

The TLs will participate in the cascading of emails to the personnel and students at the Clarendon building (1st and 2nd floor) within scenario 3a. A calendar event will be sent to the involved staff members, to give timely notice and explanation of the event.

A list of personnel at the different offices 'included' and selection of the representatives for the occupant panel is being done, to be finished by the end of October 2017 and included further deliverable D4.3.

3.3.4 PHOENIX BUILDING

Within the Phoenix building, two offices and their equipment will be involved. Ms Kirsty Metcalfe, Research Officer, will act as team leader within these spaces and keep communication with the team in order to act as liaison before, during and after the triad periods and scenario runs.

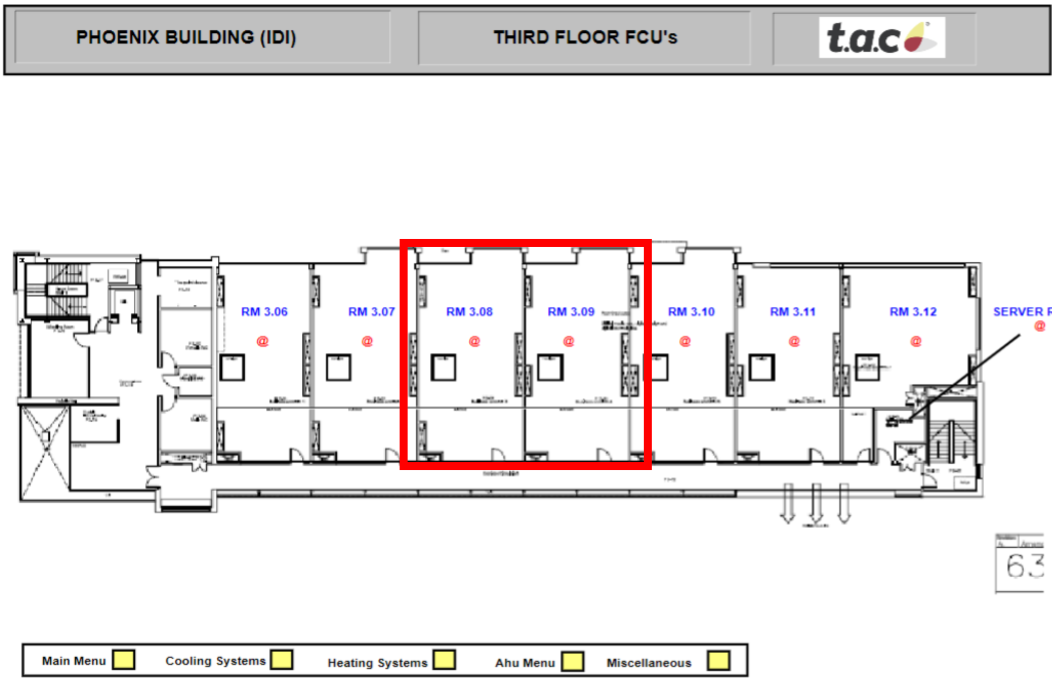


FIGURE 19. BMS DISPLAY OF THE THIRD FLOOR PLANT VIEW WITH THE RIS OFFICES HIGHLIGHTED AT PHOENIX BUILDING

3.4 LEM DEPLOYMENT

Teesside University LEM was configured and deployed as per D3.3. At Teesside University the LEM is:

- Deployed centrally to act as a controller across all assets.
- Deployed separately from the BMS and the BACnet LAN, with a Gateway PC to connect the LEM to the BMS and Metering System.
- Connected to the Gateway PC via a direct RS232 serial connection, allowing the LEM to read and write set points as needed in order to control the assets that are under the management of the BMS.
- The 3rd party Meter Service Provider will FTP the meter readings to the LEM directly. The LEM then filters the readings to those that are required by DR-BoB.
- Connected separately from the campus to the Internet to facilitate the receipt of signals from DEMS and to send collected data to DEMS.

Several tests, requests for improvement and modifications have been developed by the Teesside team who works in the LEM development, to achieve completion of the Requirements Traceability Matrix (RTM), in which the system requirements for the components have been gathered, approved and monitored. There are pending functionalities in LEM to be tailored to the demonstration sites and implemented within the system, but these are minor technical improvements to be developed once the sites are operating and running the tests and before starting the evaluation and analytics for the different scenarios. These shortcomings relate to the optimisation, which depends on the specific sites running and being monitored, so this will be achieved during October and November 2017.

3.4.1 COMMUNICATION

The details of the communications mechanism used at the UK site is provided in Deliverable 3.1 VEP and Interoperable IT Infrastructure. During the implementation of the different components of the system as described in D4.1, the communication between LEM and DEMS has been developed for the UK site, pioneering the process for the rest of the sites. Communication channels need to be established between the BMS and other meter readings sources, LEM and DEMS. From DEMS, communication towards CP will be granted.

For stability and security of Teesside University local campus IP network, it was decided to avoid direct IP connectivity between the DEMS external IP network and Teesside University local campus IP network.

A gateway PC is used to exchange information between systems located on Teesside University local campus IP network (BMS and metering associated with the BMS) and systems located on external IP network (ME, DEMS, remote metering server, and the LEM itself). The gateway PC is connected to Teesside University IP network and exchanges BMS data and commands using TIA-232 serial link. The LEM is hosted on a dedicated broadband connection (Figure 20. Left; Gateway PC installed at teesside University. Right; dedicated telephone/broadband line to isolate the network connection of the LEM.

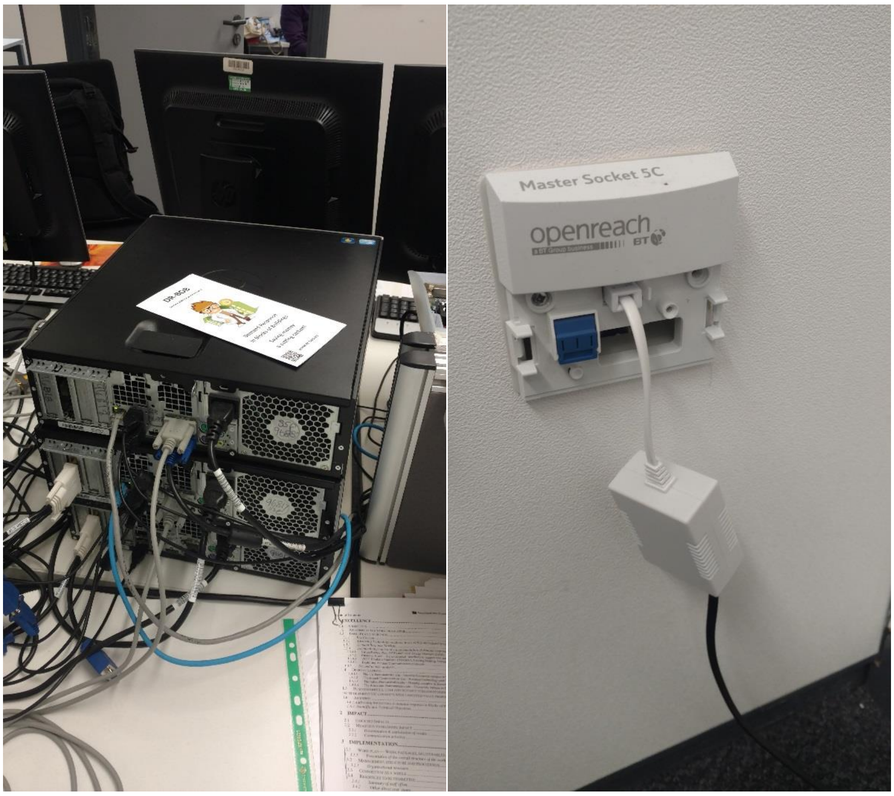


FIGURE 20. LEFT; GATEWAY PC INSTALLED AT TEESSIDE UNIVERSITY. RIGHT; DEDICATED TELEPHONE/BROADBAND LINE TO ISOLATE THE NETWORK CONNECTION OF THE LEM.

The meter values are accessed using BACnet/IP protocol via the Struxureware BMS. This implementation allows 1 min resolution monitoring to improve the robustness of conclusions drawn in WP5 Evaluation and Analytics.

The LEM has been configured to read and write set points, temperature sensor and meter data and pass control signals to the UK HVAC asset using the BACnet/IP protocol. As discovered during the early stages of WP3 and the Technology Readiness Level assessment, whilst the BMS hardware installed at the Teesside University site is able to implement this data exchange and control, an upgrade of software and communication adaptors was required to enable this connectivity.

After several tests, the need to assign unique IDs to the channels at both ends of the LEM and DEMS was highlighted. The added complexity to define for the different virtual assets, meter readings (individual or combined), forecasts, and for the other sites, recommendation channels required two levels of asset definition in DEMS, namely "DEMS MeterID" and "DEMS readingTypeId". These fields will be assigned to all the asset files which need to be digested by DEMS, in order to feed the process and generate the events. LEM reads the meter readings from its disparate sources from a single file in csv format. Each row is uniquely identified and LEM can then generate the output readings, forecasts, and recommendations, to be sent as independent files to the unique ID channel in DEMS.

3.5 COMMUNICATION

A communication baseline according to D4.1 has been developed, including the implementation plan for the UK site and communication strategies, which has been implemented satisfactory and is on schedule.

During the last months the definition of the occupant panels, the strategies to communicate and retrieve feedback, both from building managers, as for users and team leaders, has been developed, as is shown in D5.1.

Different plans for communication have been drafted, as part of the communication plan for Teesside University, for each scenario. As well, as per D4.1, TU has developed the different templates (Activities, training, communication, end to end testing) for the site.

3.6 RESOURCE SCHEDULE

As per the template Teesside has detailed, engaged and recruited, the personnel involved on each of the scenarios running within the demonstration. These are listed below discretised by the different activities within the preparation.

1: Preparation						
A: Planning						
Name	**Role**	**Responsibility**	**R**	**A**	**C**	**I**
Steve Middleton	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.			C	I
Andy MacLaren	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.			C	I
Terry Hudson	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organisation's executive management. Needs to be kept informed of anything that may impact occupant welfare.				I
Sergio Rodriguez	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.	R			
Andy MacLaren	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.		A		I
Legend: R. responsible A. Accountable C. Consult I. Inform						
B: Training						
Name	**Role**	**Responsibility**	**R**	**A**	**C**	**I**
DR-BoB RA	Trainer	Trains delegates in the use of a DR-BoB technology	R			
DR-BoB RA	Training Coordinator	Assists the trainer with the preparation for each training session. Communicates with delegates			C	

Name	Role	Responsibility	R	A	C	I
		(sends and receives training-related information).				
Scenario 3 (Triad) Team Leaders: Paul Douglas, Martin Quennel, Jibin He, Craig Notman (IT) (Middlesbrough tower), Kirsty Metcalfe (Phoenix building), John Carter and Keith Haley (Clarendon building)	Delegate	Agrees to attend training sessions. Attends training sessions. Provides relevant feedback following training sessions.			C	I
Sergio Rodriguez	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.		A		I
Legend: R. responsible A. Accountable C. Consult I. Inform						

C: Communication						
Name	**Role**	**Responsibility**	**R**	**A**	**C**	**I**
DR-BoB RA	Communication Coordinator	Provides direction on communication related to the demonstration of the DR-BoB solution. Owns the communication plan and leads communication activities.	R			
DuneWorks	Communication Consultant	Provides advice on the development of a communication plan. Acts as an expert in the field of communication with building occupants.			C	
Sergio Rodriguez	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.		A		I
TBC	Communication Recipient	Receives communications before and/or during the demonstration of the DR-BoB solution.				I
Legend: R. responsible A. Accountable C. Consult I. Inform						

D: End-to-End Testing						
Name	**Role**	**Responsibility**	**R**	**A**	**C**	**I**
Sergio Rodriguez	Test Coordinator	Organises testing by following a test plan. Coordinates the efforts of the various people involved in testing. Communicates with technology partners for the resolution of failures.	R			
DR-BoB RA	Tester	Carries out testing and records the results of testing in a test log. Identifies failed tests and provides information that can be used to resolve the failure.			C	I
Sergio Rodriguez	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.		A		I
Pavel Novak (DEMS), Papa Niamadiou (CP), Theo Mertz (ME), Muneeb Dawood (LEM), Richard Charlesworth	Technology partner	Receives information regarding failures. Resolves failures and communicates resolution to the pilot site Test Coordinator			C	I

(system architecture)						
Legend: R. responsible A. Accountable C. Consult I. Inform						

TABLE 9. PREPARATION OF ACTIVITIES. ROLES AND RESPONSIBILITIES.

In the case of the different scenarios, different relevant roles have been identified and assigned to specific members of the staff. During the scenarios' testing, the personnel involved have started being involved and participated within the drills.

TABLE 10. DEMONSTRATION ACTIVITIES. ROLES AND RESPONSIBILITIES WITHIN THE DIFFERENT SCENARIOS.

2: Demonstration						
A: Scenario 1						
Name	**Role**	**Responsibility**	**R**	**A**	**C**	**I**
Sergio Rodriguez	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.	R			
Steve Middleton	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.			C	I
Andy MacLaren	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.		A		I
Steve Middleton	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
Andy MacLaren	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
Nick Ingledew; Campus services John Carter and Keith Haley; Clarendon building	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organisation's executive management. Needs to be kept informed of anything that may impact occupant welfare. The personnel in clarendon building will likely report to Keith Haley			C	I
B: Scenario 2						
Name	**Role**	**Responsibility**	**R**	**A**	**C**	**I**
Sergio Rodriguez	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.	R			
Steve Middleton	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.			C	I
Andy MacLaren	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.		A		I
Steve Middleton	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I

			R	A	C	I
Andy MacLaren	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
Nick Ingledew	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organisation's executive management. Needs to be kept informed of anything that may impact occupant welfare.				I
C: Scenario 3						
Name	**Role**	**Responsibility**	**R**	**A**	**C**	**I**
Sergio Rodriguez	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.	R			
Scenario 3 (Triad) Team Leaders: Paul Douglas, Martin Quennel, Jibin He, Craig Notman (IT) (Middlesbrough tower), Kirsty Metcalfe (Phoenix building), John Carter and Keith Haley (Clarendon building)	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.			C	I
Andy MacLaren	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.		A		I
Steve Middleton	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
Andy MacLaren	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
Nick Ingledew	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organisation's executive management. Needs to be kept informed of anything that may impact occupant welfare.				I
D: Scenario 4						
Name	**Role**	**Responsibility**	**R**	**A**	**C**	**I**
Sergio Rodriguez	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.	R			
Steve Middleton	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.			C	I
Andy MacLaren	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.		A		I
Steve Middleton	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
Andy MacLaren	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I

Nick Ingledew	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organisation's executive management. Needs to be kept informed of anything that may impact occupant welfare.				I
C: Communication						
Name	**Role**	**Responsibility**	**R**	**A**	**C**	**I**
DR-BoB RA	Communication Coordinator	Provides direction on communication related to the demonstration of the DR-BoB solution. Owns the communication plan and leads communication activities.	R			
DuneWorks	Communication Consultant	Provides advice on the development of a communication plan. Acts as an expert in the field of communication with building occupants.			C	
Sergio Rodriguez	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.		A		I
As per Communication Plan (staff within the buildings affected by the scenarios, Students within the buildings affected by the scenarios, Team leaders, Facility and energy managers)	Communication Recipient	Receives communications before and/or during the demonstration of the DR-BoB solution.			C	I

TABLE 11. DEMONSTRATION ACTIVITIES. ROLES AND RESPONSIBILITIES WITHIN THE DIFFERENT SCENARIOS.

3.7 TRAINING OF BUILDING MANAGERS AND OCCUPANTS

The training activities have been initiated as per the defined framework in D4.1. GRIDP has defined a training session for the CP software which will be finalised after the system is completely implemented at the sites. Brief training for the Building Managers have been done during the scenario 3 and 1 testing on how to use the CP at the UK site. Nick Ingledew, occupant welfare representative in the tables 9 and 10, acted as the Building manager, opting out for different assets, within different buildings in scenario 3a and different assets in Clarendon building in scenario 1. This was made through accessing the CP with a unique user account and during the scenarios' end to end testing. DEMS and LEM could confirm the assets being opted out.

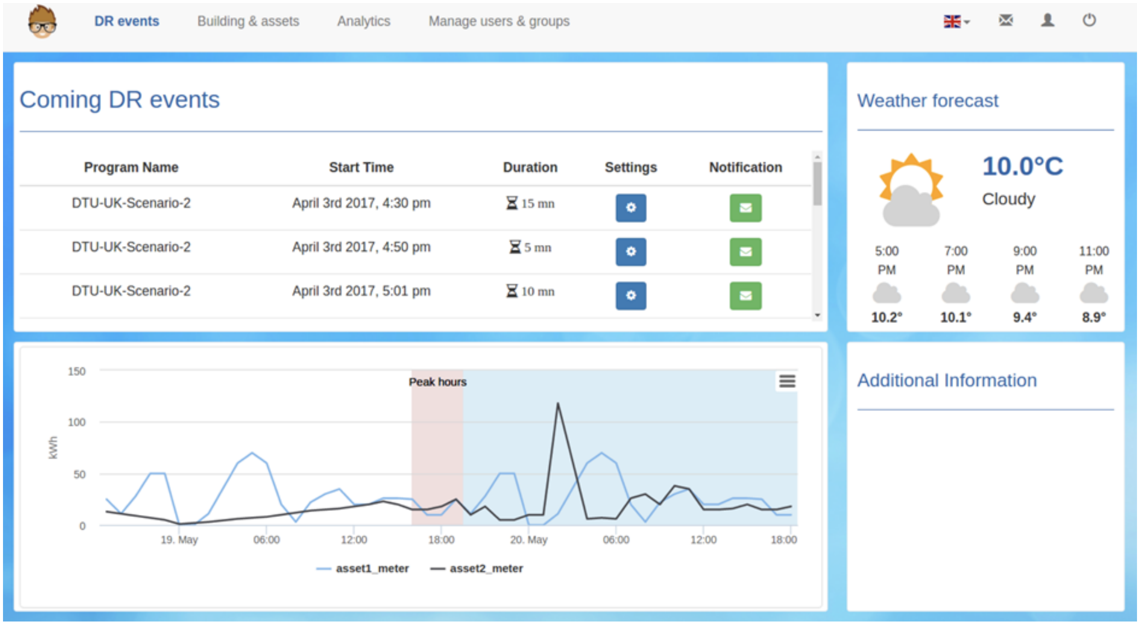


FIGURE 21. CP GRAPHIC INTERFACE RELATED TO THE UK SITE. MAIN PAGE.

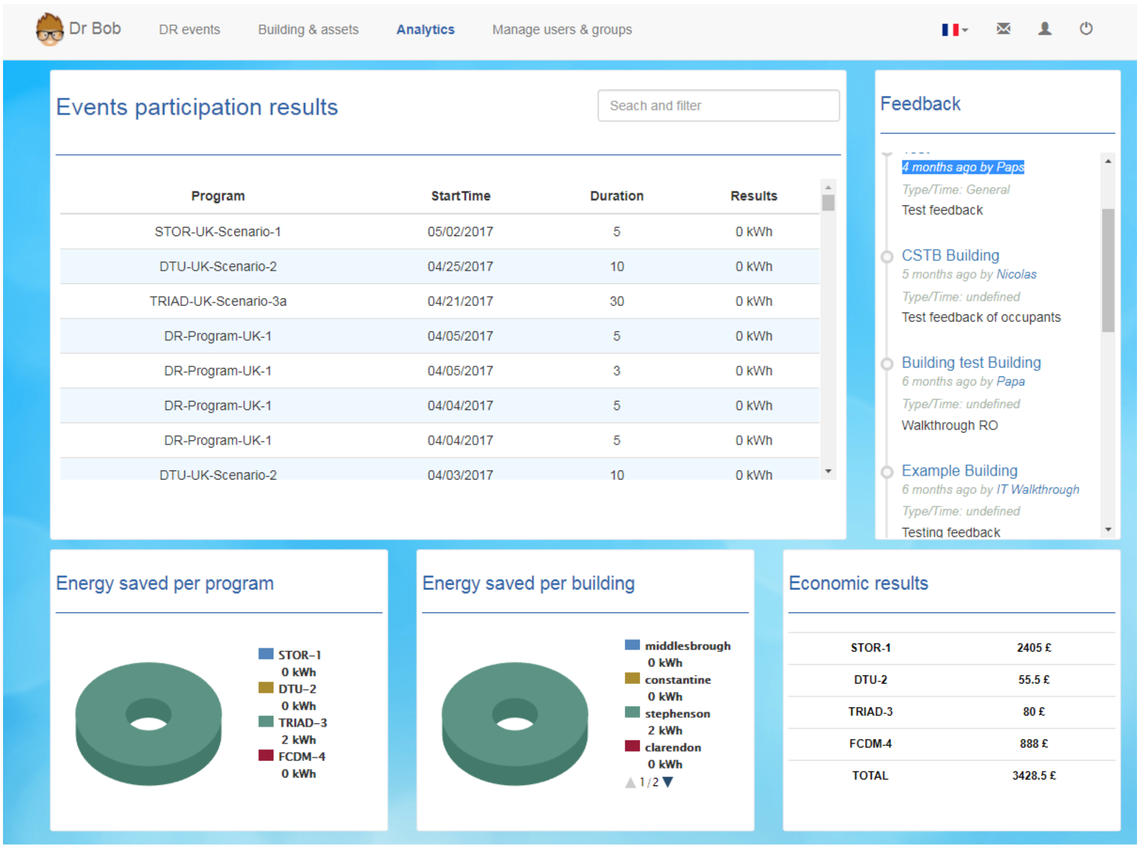


FIGURE 22. CP GRAPHIC INTERFACE RELATED TO THE UK SITE. TESTING RECORD AND ANALYTICS.

3.8 USER FEEDBACK FROM INTIAL TESTING

During the different scenarios' testing feedback from the users and the technical partners have been gathered as part of an improvement process which enriches the results and ensures that the users' priorities have been taken into account.

3.9 EVALUATION OF TECHNICAL PERFORMANCE FROM INITIAL TESTING

The different scenarios have been tested as reflected in Annex 1. There will be a second round of testing in the UK and the scenarios testing will start in the other different sites starting the last week of September 2017. This testing period will be finished by 30th October 2017 and the evaluation period will be granted to start.

The participation of the Building managers and team leaders within the testing is crucial and has been initiated, but a series of extra testing will guarantee their training and the expertise in using the system.

4 INSTALLATION AT FRENCH SITE

4.1 SITE SCENARIO UPDATE

As stated in D2.2, the DR BOB solution will be trialled in each demonstration sites within specific scenario conditions. In the French demonstration site, this will reflect the national FR market adapted to local meteorological conditions and existing DR programs and actions. During the project development, adjustments to the demonstration site and buildings selected to participate in the demonstration have been done. The initial and implemented list of buildings that are going to intervene in the different established DR scenarios within DR-BoB after these adjustments are described below.

Technology Park Montaury (France). This demonstration includes a single block of buildings closely located in Anglet. Each building in this block of buildings is governed by an independent owner. In comparison to what was stated in D2.2, the French demonstration no longer includes the buildings at the Technical College CANTAU. This results from the lack of internal resources available for the BMS upgrading and the demonstration activities within the site.

The buildings that are included in the different scenarios demonstrating DR actions within the DR-BoB project are:

- The Business Incubator (BI) building, which assets will take part into FR SC1, SC4 and SC5
- The FCMB building, which assets will take part into FR SC1, SC3, SC4 and SC5
- The Nobatek building, which will take part in FR SC1, SC4 and SC5

The demonstration scenarios planned to be tested at the French pilot site have been also updated. A new list of demonstration scenarios is described below.

Name and number of scenario	Purpose of scenario	Trigger of events	Number of events per year	Duration
Scenario 1. Electric demand reduction	Demonstrate a potential of controlling assets in block of buildings in response to a market signal related to a national French consumption	PP1 signal of the new French capacity market	10-15	Up to 8 hours
Scenario 3. Gas demand reduction	Local gas optimisation for heating/Gas demand reduction	Peaks of building heat demand	10-15	Up to 4 hours
Scenario 4. Peak power demand reduction	Peak power demand reduction during cold peaks of local weather	Cold peaks of local weather	10-15	Up to 3 hours
Scenario 5. Virtual microgrid or Sharing of electric energy inside the demonstration site area	Demonstration of new use of local excess of energy: instead to be sold to the grid the over energy is proposed to be absorbed into the building host and to be virtually absorbed into neighbor buildings	Excess of energy produced by PV panels of the BI building	10-15	Up to 4 hours

Table 8. Demonstration scenarios update at the French pilot site

These scenarios will be run during the demonstration period according to the planning on the Figure 23.

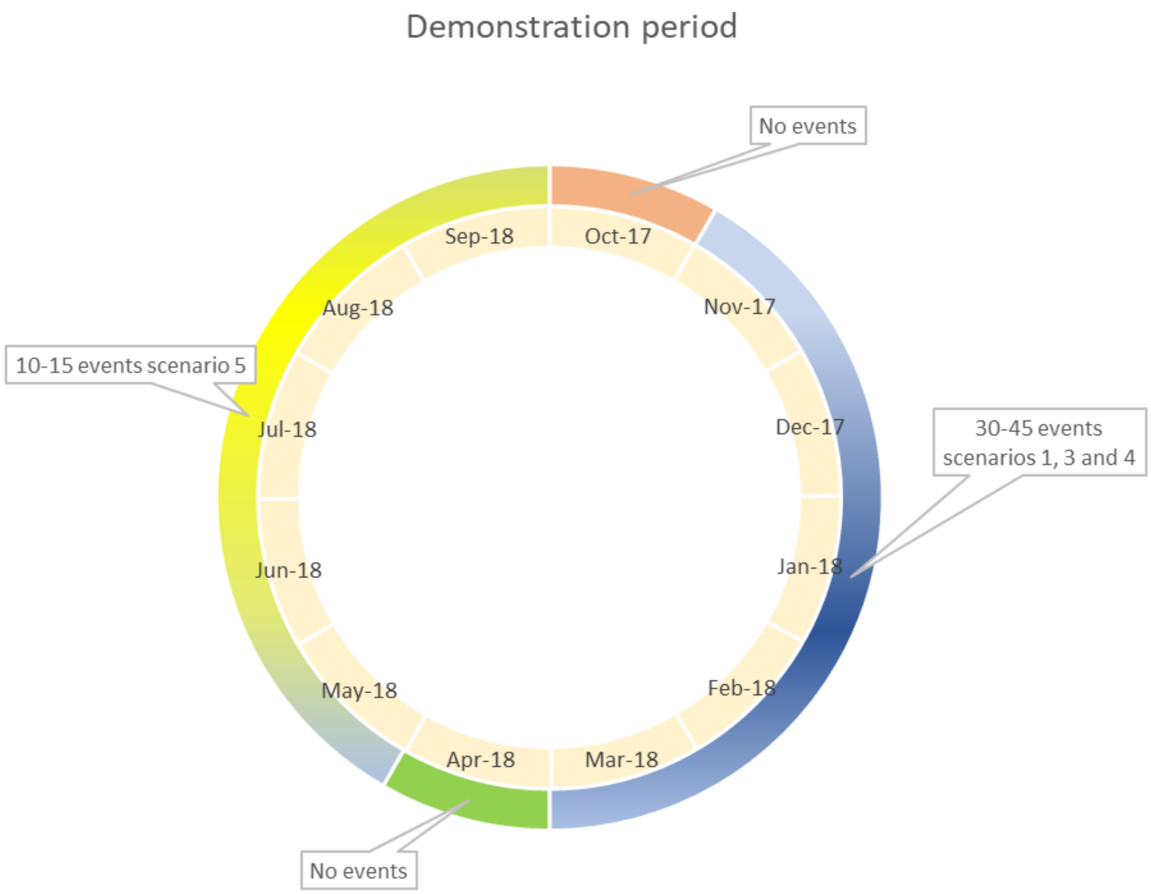


FIGURE 23. YEARLY PLANNING OF ACTIVATION OF DEMONSTRATION SCENARIOS AT THE FRENCH PILOT SITE

The demonstration *scenario 2. Electric demand reduction* has been removed from the list of scenarios to be tested at the French pilot site. Initially based on electricity prices on the wholesale market signal, this scenario has been specified with the NTC (Net Transfer Capacity) signal between France and Spain describing wholesale market on a transnational regional level and interconnection capacities between 2 grids (supposing that one part of electric energy imported in France from Spain impacts the grid located into the Basque country and consequently can impact electricity prices for building owners in this area). This wasan experimental not existing signal. Actually, there is no contractual or financial link between electricity prices for building owners and this signal in the French context. Moreover, high part of nuclear electricity generation does not have high potential variation and doesn't allow any DR. In addition, the Figure 24 outlines:

- Importation are done mainly in winter, which is in concurrence with scenarios 1 and 4 (capacity market signal);
- There are blocks of days (>5-10 following days with "peaks");
- Yearly huge change, especially the year 2016 is very different than the previous ones;
- At fixed year, there are some imports and exports each month.

That's why this scenario has been removed from scenarios to be tested during the demonstration period.

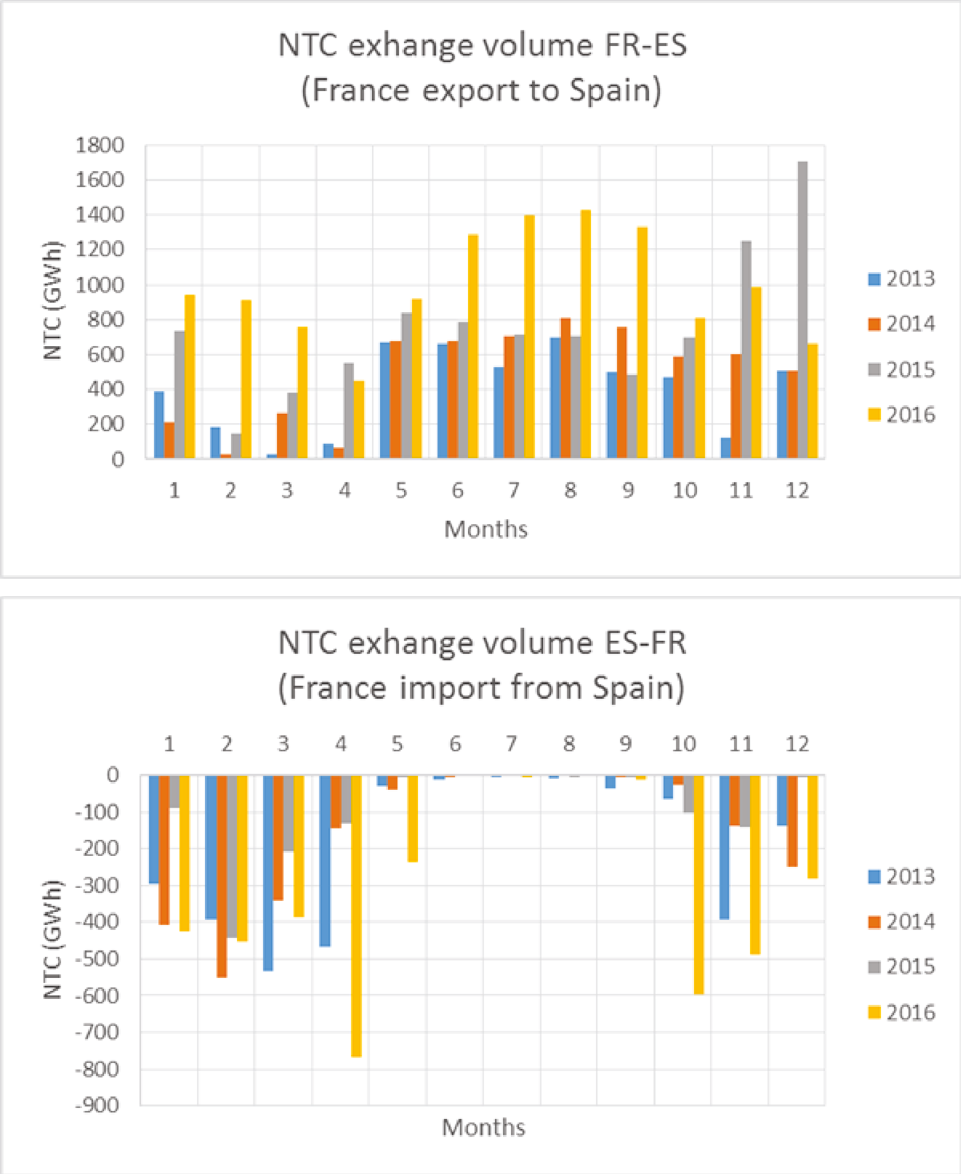


FIGURE 24. NTC EXCHANGES BETWEEN FRANCE AND SPAIN BETWEEN 2013 AND 2016

The scenario 1 has also been updated. Initially based on the red days signal from the Tempo contract (22 days per year with high national electrical consumption between 8:00 AM and 8:00 PM), the signal of this scenario has been changed to PP1 days signal from the new French capacity market managed by the French TSO RTE. This change has taken place to increase the interest of building managers to shifting electricity demand during the day which is limited for the Tempo offer because of Tempo time slot from 8:00 AM to 8:00 PM. The French capacity market proposes also 2 peak periods: PP1 (which are also PP2) and PP2 (which are not PP1) which are based on national electricity consumption (and voltage for PP2 days) and therefore similar to the white and red days. The peak times during these PP1/2 windows corresponds to these timeslots: [07h00;15h00[and [18h00;20h00[. Therefore, it gives more of flexibility for shifting electricity demand during the day which could be more advantageous for building managers. The number of PP1 and PP2 periods is also lower: of about 25/year with 10-15 PP1/PP2 events/year and of about 10 PP2 periods. In addition, using of this signal allows to set up financial rewards for the availability of generation or demand response capacities.

4.2 SYSTEM ARCHITECTURE UPDATE

The solution architecture planned to be deployed at the French pilot site has also been updated from initial description into the D2.3. It has been modified on the next points:

- The BMS systems of 3 buildings of the French pilot site have been interconnected by a VPN connection to allow collective management of 3 buildings and increase opportunity for DR participation;
- All building assets, excepting the heat pump into NBK building will be controlled manually by local building managers through BMSs;
- Demand reduction due to actions on non-connected non-metered assets will be evaluated through qualitative evaluation;
- All temperature controlled areas in the buildings are involved into demonstration scenarios for optimisation of temperature control.

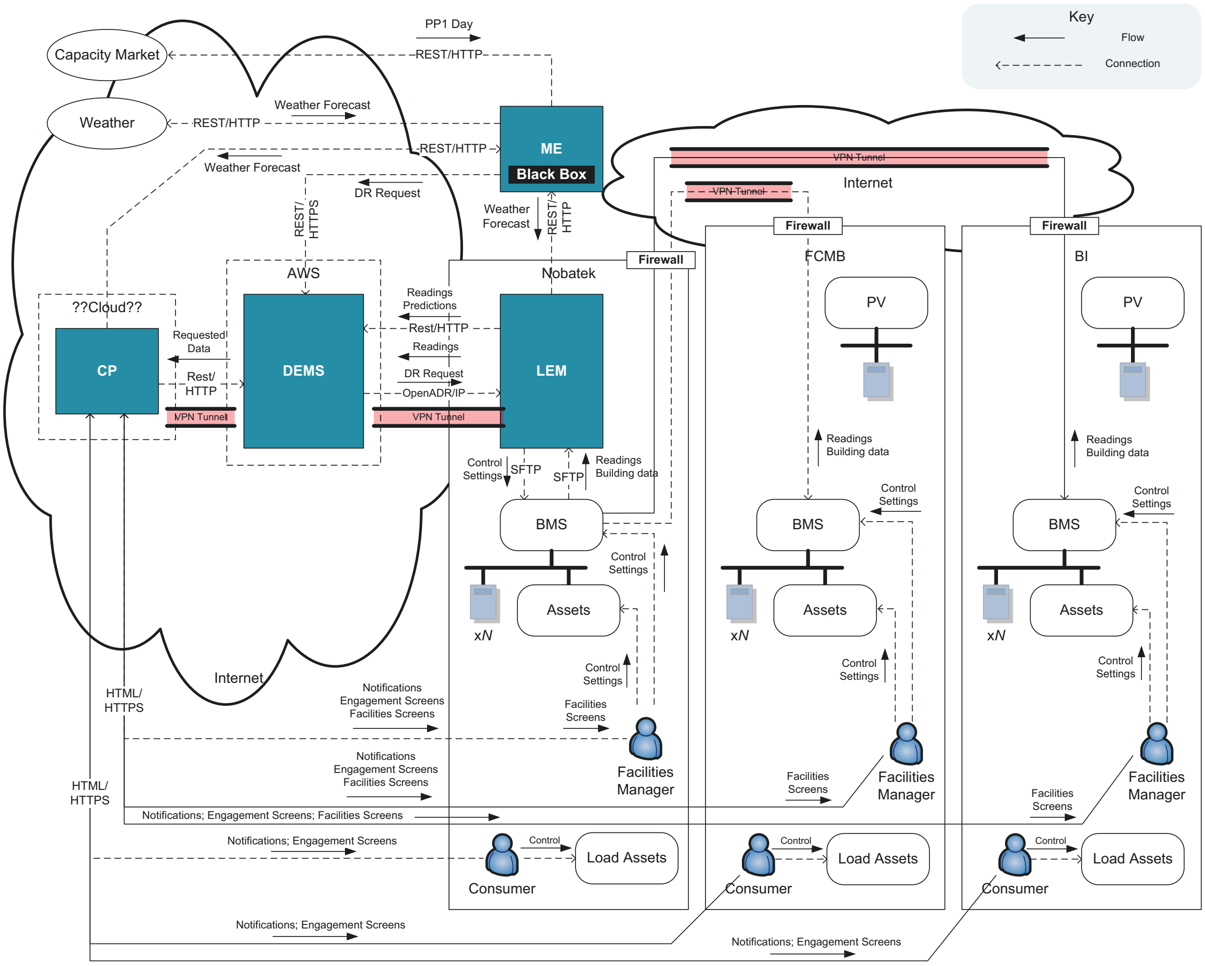


FIGURE 25. SYSTEM ARCHITECTURE UPDATE ON THE FRENCH PILOT SITE

Virtual Assets (VA) are simply the name for a single, or group of assets, that we measure, forecast and control as a single unit. Controlling individual assets is not always the best approach as, for example, is the case with a HVAC it is a system and any independent control signal could cause conflict with the BMS and other controllers, therefore treating them as a single unit eliminates these potential issues. For the same reason, it has been decided to proceed to manual control of assets by building managers and to test automated control on only one virtual asset which is the NBK heat pump.

The VA selected for participation at demonstration activities of the DR-BOB have been selected based on:

- Maximum energy demand criteria. Practically all-important loads of buildings (heat pumps, AHUs, servers and servers' infrastructure) are involved into demonstration scenarios;
- Maximum occupants' involvement criteria. The use and associated energy consumption of tertiary buildings strongly depend from occupants' activities and habitudes. To raise their awareness about energy management and engage them into DR-BOB project the French pilot site team has decided to shift energy associated to laptops consumptions which are mainly used into buildings.

4.3 ADAPTATION OF BMS SYSTEMS INTO BUILDINGS

To setup the DR-BOB solution on the French pilot site BMS systems into buildings have been adapted to solution requirements in terms of data collection and asset control. New meters have been installed and integrated into supervision software of BMS systems of FCMB and BI buildings.

4.3.1 CONFIGURATION OF NBK BMS

NBK has updated his BMS system during the first year of the DR-BOB project. The communication infrastructure as well as metering system and supervision and data acquisition software have been changed to allow open access to metering data and wider interoperability with tierces software. The energy management solution Effimanager has been also installed and connected to the BMS data.

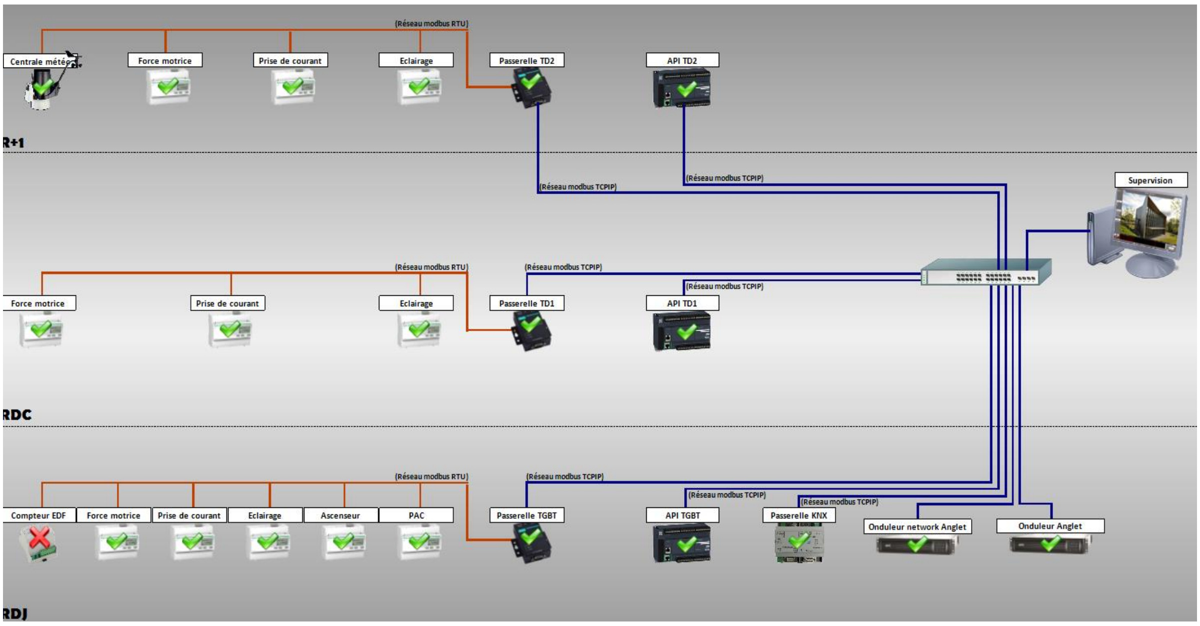
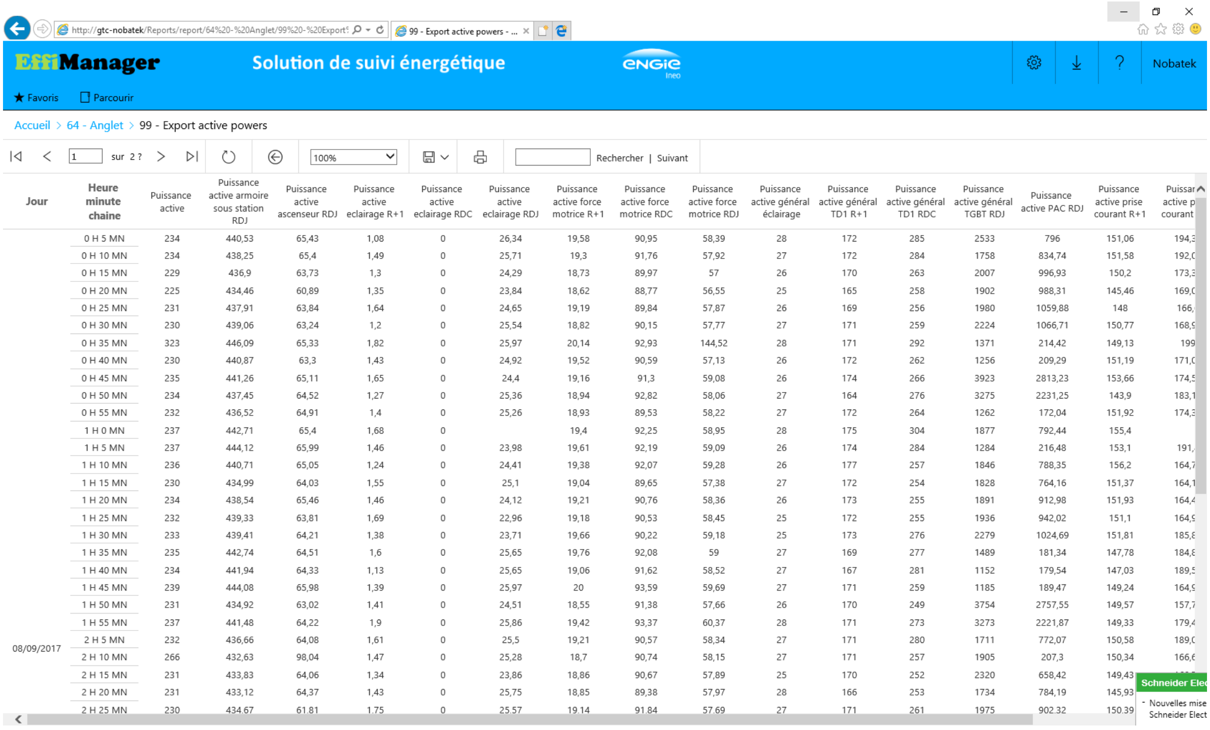


FIGURE 26. SYSTEM ARCHITECTURE OF NEW NBK BMS

To have more accurate prediction of energy demands the data collection frequency has been set up on the 5 min, what means that all the data (metering, set points, temperatures, functioning modes etc.) are collected and stored into supervision software database periodically every 5 minutes.

To be able to upload metering and temperature data to the FTP server on which the LEM and DEMS are connected the automated reports containing data required have been configured inside Energy management solution EffiManager used by Nobatek. These automated reports in csv format are generated each day at midnight and updated hourly with new data. Just after updates they are uploaded to the FTP server.

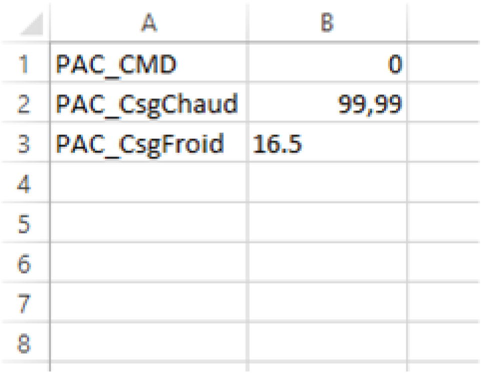


Jour	Heure minute chaine	Puissance active	Puissance active armoire sous station RDJ	Puissance active ascenseur RDJ	Puissance active eclairage R+1	Puissance active eclairage RDC	Puissance active eclairage RDJ	Puissance active force motrice R+1	Puissance active force motrice RDC	Puissance active force motrice RDJ	Puissance active général éclairage	Puissance active général TD1 R+1	Puissance active général TD1 RDC	Puissance active général TGBT RDJ	Puissance active PAC RDJ	Puissance active prise courant R+1	Puissar active p courant
	0 H 5 MN	234	440,53	65,43	1,08	0	26,34	19,58	90,95	58,39	28	172	285	2533	796	151,06	194,3
	0 H 10 MN	234	438,25	65,4	1,49	0	25,71	19,3	91,76	57,92	27	172	284	1758	834,74	151,58	192,0
	0 H 15 MN	229	436,9	63,73	1,3	0	24,29	18,73	89,97	57	26	170	263	2007	996,93	150,2	173,3
	0 H 20 MN	225	434,46	60,89	1,35	0	23,84	18,62	88,77	56,55	25	165	258	1902	988,31	145,46	169,0
	0 H 25 MN	231	437,91	63,84	1,64	0	24,65	19,19	89,84	57,87	26	169	256	1980	1059,88	148	166,
	0 H 30 MN	230	439,06	63,24	1,2	0	25,54	18,82	90,15	57,77	27	171	259	2224	1066,71	150,77	168,9
	0 H 35 MN	323	446,09	65,33	1,82	0	25,97	20,14	92,93	144,52	28	171	292	1371	214,42	149,13	199
	0 H 40 MN	230	440,87	63,3	1,43	0	24,92	19,52	90,59	57,13	26	172	262	1256	209,29	151,19	171,0
	0 H 45 MN	235	441,26	65,11	1,65	0	24,4	19,16	91,3	59,08	26	174	266	3923	2813,23	153,66	174,5
	0 H 50 MN	234	437,45	64,52	1,27	0	25,36	18,94	92,82	58,06	27	164	276	3275	2231,25	143,9	183,1
	0 H 55 MN	232	436,52	64,91	1,4	0	25,26	18,93	89,53	58,22	27	172	264	1262	172,04	151,92	174,3
	1 H 0 MN	237	442,71	65,4	1,68	0		19,4	92,25	58,95	28	175	304	1877	792,44	155,4	
	1 H 5 MN	237	444,12	65,99	1,46	0	23,98	19,61	92,19	59,09	26	174	284	1284	216,48	153,1	191,
	1 H 10 MN	236	440,71	65,05	1,24	0	24,41	19,38	92,07	59,28	26	177	257	1846	788,35	156,2	164,7
	1 H 15 MN	230	434,99	64,03	1,55	0	25,1	19,04	89,65	57,38	27	172	254	1828	764,16	151,37	164,1
	1 H 20 MN	234	438,54	65,46	1,46	0	24,12	19,21	90,76	58,36	26	173	255	1891	912,98	151,93	164,4
	1 H 25 MN	232	439,33	63,81	1,69	0	22,96	19,18	90,53	58,45	25	172	255	1936	942,02	151,1	164,9
	1 H 30 MN	233	439,41	64,21	1,38	0	23,71	19,66	90,22	59,18	25	173	276	2279	1024,69	151,81	185,8
	1 H 35 MN	235	442,74	64,51	1,6	0	25,65	19,76	92,08	59	27	169	277	1489	181,34	147,78	184,8
	1 H 40 MN	234	441,94	64,33	1,13	0	25,65	19,06	91,62	58,52	27	167	281	1152	179,54	147,03	189,5
	1 H 45 MN	239	444,08	65,98	1,39	0	25,97	20	93,59	59,69	27	171	259	1185	189,47	149,24	164,9
	1 H 50 MN	231	434,92	63,02	1,41	0	24,51	18,55	91,38	57,66	26	170	249	3754	2757,55	149,57	157,7
	1 H 55 MN	237	441,48	64,22	1,9	0	25,86	19,42	93,37	60,37	28	171	273	3273	2221,87	149,33	179,4
08/09/2017	2 H 5 MN	232	436,66	64,08	1,61	0	25,5	19,21	90,57	58,34	27	171	280	1711	772,07	150,58	189,0
	2 H 10 MN	266	432,63	98,04	1,47	0	25,28	18,7	90,74	58,15	27	171	257	1905	207,3	150,34	166,6
	2 H 15 MN	231	433,83	64,06	1,34	0	23,86	18,86	90,67	57,89	25	170	252	2320	658,42	149,43	
	2 H 20 MN	231	433,12	64,37	1,43	0	25,75	18,85	89,38	57,97	28	166	253	1734	784,19	145,93	
	2 H 25 MN	230	434,67	61,81	1,75	0	25,57	19,14	91,84	57,69	27	171	261	1975	902,32	150,39	

FIGURE 27. AUTOMATED REPORT CONTAINING POWER METERING DATA INSIDE THE EFFIMANAGER SOLUTION INTO THE FRENCH PILOT SITE

To allow automated control of NBK heat pumps by the LEM a dedicated functionality has been developed by BMS integrator. The automated control of NBK heat pumps (there are 2 heat pumps for heating/cooling) is made through 2 csv files (one file per heat pump) located in the local directory V6_5-GTCNobatek\InterfacePAC on Supervision PC. This local directory is shared as shared folder (could be also shared as shared drive) into NBK BMS VLAN.

These files contain 3 lines and 2 columns as mentioned into the Figure 28:



	A	B
1	PAC_CMD	0
2	PAC_CsgChaud	99,99
3	PAC_CsgFroid	16.5
4		
5		
6		
7		
8		

FIGURE 28. CONTENT OF CSV FILES FOR THE AUTOMATED CONTROL OF THE NBK HEAT PUMP

Where

- the column A is a legend.
- Column B, cell B1 defines management way of heat pumps and can contain 3 values: 0=BMS management, 1=Switch-Off Heat pump, 2=Switch-On Heat pump.
- Column B, cell B2 defines a heat set point: 99,99=Set point from BMS, any other value represents other set point (note, the separator should be a point and not a comma).

- Column B, cell B3 defines a cold set point: 1,1=Set point from BMS, any other value represents other set point (note, the separator should be a point and not a comma).

The LEM can control NBK heat pump in the next way:

- The LEM connects to this shared folder/drive;
- When event, LEM opens these 2 files and write values according predictions;
- Supervision software of NBK BMS read these 2 files and change quasi instantly (the delay is about 10 seconds) heat pump function accordingly.

4.3.2 ADAPTATION OF BI BMS

The BMS system of the BI building has been adapted to be convenient to the requirements of blocks of the DR-BOB solution. It passed through the next stages:

- Integration of general building electricity meter data into the BMS. From the delivery of the building the data from general building electricity meter were not integrated into supervision software of the BMS. The initial idea to calculated general building electricity consumption by making a sum of all sub metered data has been fallen as some electricity lines inside the building are not metered.
- Initial data logging process based on Change of value mechanism has been updated to Pooling mode with 5 min sample rate. It allows regular data acquisition on the fixed times of day.
- The web-server of the principal controller SAUTER has been updated to allow logged data to be synchronized on the same start time.
- Data collection process has been automated to generate data files with hourly frequency and send it to the French FTP server. As specified by the LEM requirements, all the data points collected have been aggregated into one single csv file.

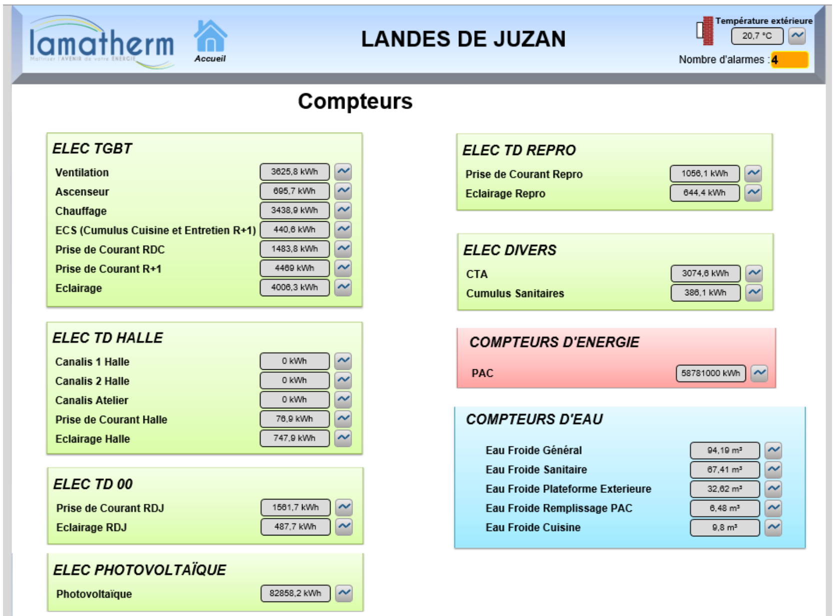


FIGURE 29. METERING DATA SCREEN INTO THE BI BMS

4.3.3 ADAPTATION OF FCMB BMS

The BMS system of FCMB building has been also adapted to allow testing of some demonstration scenarios. The next works have been made on it:

- Integration of woodchips level sensor into the BMS. The woodchips level sensor has been acquired and installed into woodchips tank. The data from this sensor have been integrated into BMS application. This sensor allows FCMB building manager to instantly know level of woodchips into the tank and this to be able to take a decision about what heating energy source he prefers to use during the peaks of building heating demand (scenario 3).

- Data collection process has been reconfigured to generate data files with hourly frequency and send it to the French FTP server. As specified by the LEM requirements, all the data points collected have been aggregated into one single csv file.

FIGURE 30. ENERGY METERS SCREEN INTO THE FCMB BMS

4.3.4 INITIAL TESTING AND FAULT FINDING

After adaptations of each BMS have been done an initial testing taken place at each building. It allowed to detect some faults related mainly to data logging process:

- Energy data logged within the NBK BMS did not correspond to real values on the meters;
- Energy data logged within the BI BMS were not synchronized on the same start time after update of data logging process to Pooling mode with 5 min sample rate. Some data points started to be logged at minute 00:00, others at 00:02 and last ones at 00:04. This desynchronization could impact evaluation and cost-savings/certification of energy demand reduction.
- Difficulties for data collection of woodchips level sensor data into supervision software of the FCMB BMS due to use of a firewall application inside FCMB. This firewall application blocked some screens into supervision interface and all the outgoing http connections.

All mentioned faults have been resolved by additional work with BMS integrators.

4.3.5 DATA HANDLING

One problem encountered during implementation phase was the impossibility to change data acquisition sample rate for data points into the FCMB BMS. Before exported, the data are aggregated on a minimum 1-hour interval frequency and this value is not available for change.

The solution to this issue was to set the frequency to 1 hr for the 3 buildings in the French site, although the data collected from 2 other buildings allowed a higher frequency of data digest by LEM. The reason for this is that LEM generates forecasts for all the pilot site data for the same sample rate in order to be able to compare, visualize and operate DR for the three buildings in the same timescale as a single block of buildings. In the case of the French pilot site data, collected from 3 different BMS (data from NBK and BI BMS are acquired with 5 min sample rate and data from FCMB BMS are acquired with 1-hour sample rate) the data need to be compiled on the highest frequency available which is 1 hr, before it is imported by the LEM to allow predictions of energy demand on the whole block of buildings. NBK has proceeded to aggregation of data exported to the FTP server from the NBK and BI BMS on 1-hour sample rate by coding additional software and scripts which has resulted in multiplication of data files on the FTP server. Each hour 2 data files per meter are generated: one with raw sample rate and another with 1-hour sample rate.

All the data exported to the FTP server are backup locally on the corresponding supervision PC (NBK BMS, FCMB BMS) or logging controllers (BI BMS). Initial findings suggest that a suitable way to export data will be eased by sending one individual file for each meter per specific time stamp.

4.4 CONNECTIVITY BETWEEN BUILDINGS

As mentioned in D4.1 the DR-BoB Technical Solution requires that the LEM establishes communication channels for data collection and assets control with each of the building's BMS's. This important requirement is satisfied by:

- Modifying local networks of each building at the way to physically separate BMS communication infrastructure from the rest of local network.
- Setting up Virtual Private Networks (VPN) between the buildings across public network to enable BMS to exchange the data with the LEM. These VPNs use standard Internet

connections of the buildings which should provide sufficient bandwidth.

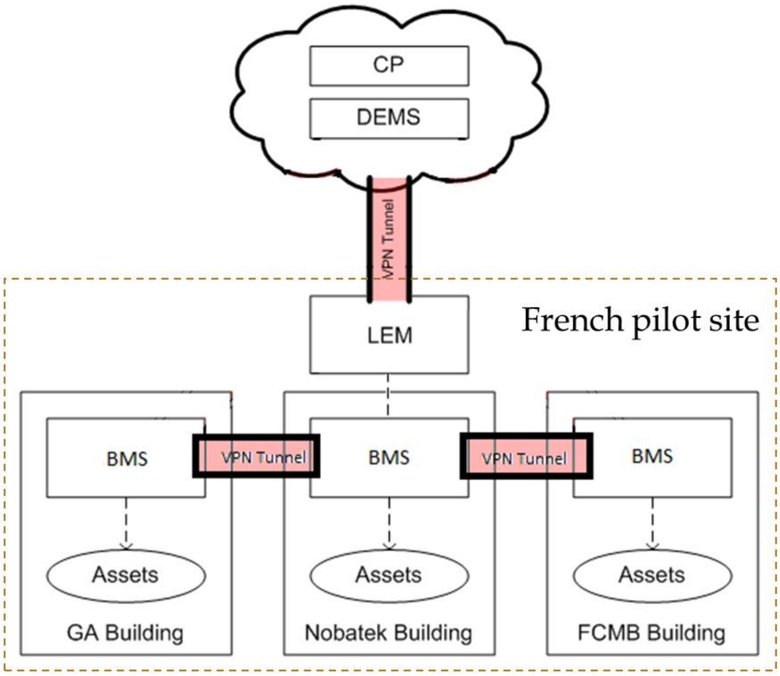


FIGURE 31. DR-BOB SOLUTION ARCHITECTURE AT THE FRENCH PILOT SITE

4.5 BUILDING MANAGERS ENGAGEMENT

4.5.1 BI BUILDING

The BI building makes part of the community of agglomeration Basque country heritage whose mission is the promotion of innovation and economic development of the French Basque country area. This building is managed by Marie-Agnès Barrière, salaried of community of agglomeration whose office is located inside this building and who provides technical, economical and organisational management of the building and the enterprises renting premises. She together with 2 other persons of the community of agglomeration Basque county participate into almost all weekly discussions about involvement of the BI building into the project.

4.5.2 FCMB BUILDING

The FCMB building is managed by Denis Rouault, deputy director of The Compagnons du Tour de France who provides technical and economic management of the Training centre. He manages building through building management system and coordinates some technicians.

4.5.3 NBK BUILDING

The NBK building is managed by Guillaume Laval, sustainable construction engineer in Nobatek. He provides technical management of the NBK building through building management system and coordinates maintenance activities.

4.6 LEM DEPLOYMENT

LEM was configured and deployed as per D3.3 inside Debian virtual machine on the Ruggedcom RX1400 device provided by Siemens. This Ruggedcom device is installed into NBK building and connected to the BMS systems by:

- Local LAN connection to the NBK BMS;
- VPN tunnel to the BI and FCMB BMS.

LEM IP address into the NBK LAN is 192.168.210.5.

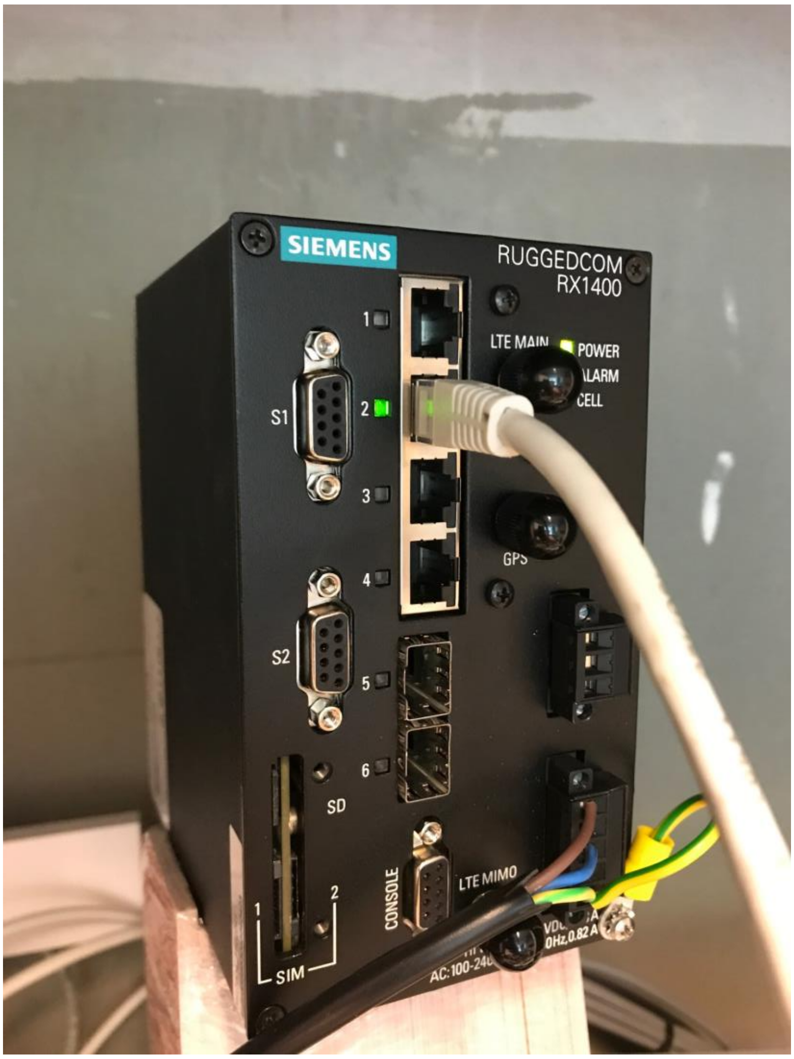


FIGURE 32. LEM INSTALLED ON THE RUGGEDCOM RX1400 AT THE FRENCH PILOT SITE

The LEM communicates with DEMS within OpenVPN tunnel. This communication has been set up and tested as part of implementation activities. The communication of data between the LEM and BMS is ensured by an intermediary FTP server installed on the virtual machine at the Ruggedcom device. During the testing period, the data have been temporarily collected at the FTP server hosted in the Teesside University.

4.7 COMMUNICATION

As mentioned in D4.1, communication and implementation plans have been delivered satisfactory and on schedule. The communication activities are divided into preparation and demonstration periods.

Communication activities during the demonstration period aim at:

- notifying users of solution (building managers) about upcoming DR events;
- providing recommendations about actions to be made to achieve goals;
- collecting feedback from users and occupants of buildings;

- notifying users and occupants about results of events;
- evaluating impact of events on occupants.

These communication activities will start at the beginning of the demonstration period and will be based on 2-way interactive communications between building occupants, building managers and pilot site manager. According to the building considered, the frequency and means of communication will be adjusted.

At the scale of a DR event a generic communication schema is proposed as follows:

- Users (building managers) will be notified about a new incoming DR event request 24 hours before by an e-mail notification and an Outlook meeting invitation: the both will include a link to the Consumer Portal with more detailed information about the request (origin of event (scenario), recommendations about assets to participate and actions to be made, expected savings, goals, recommendation about participation of users) and Opt Out option (all events will be generated with Opt In option selected by default).
- If user does not select Opt Out option to participate into this DR event, he will be notified by an incoming event through Outlook alerts (are a pop-up windows) sent 1 hour and some minutes before the event starts. He also needs to notify occupants about his decision. It will be made by an e-mail which will be manually or automatically set up by the building manager on the Consumer Portal.
- Beginning of DR event will be notified by a pop-up window on the Consumer Portal and by switching on/off the lighting into open spaces (only in Nobatek building). The last action is to be validated experimentally, it will be tested during the first months of the demonstration period.
- Once a DR event is finished, an e-mail will be sent to the occupants in the next 30 minutes asking them to provide a short feedback about their direct or indirect participation;
- Notification about availability of results will be sent by e-mail to the occupants at the end of each week. This notification will include a link to the corresponding page of the Consumer Portal;
- Notification about availability of a more detailed "long" questionnaire which will be sent to the occupants by the 20th every 2 months. This notification will include a link to the questionnaire which will be a Google Forms or Slack link asking the occupants to fill in it by the 25th of the month.

The whole process is graphically presented in the figure below.

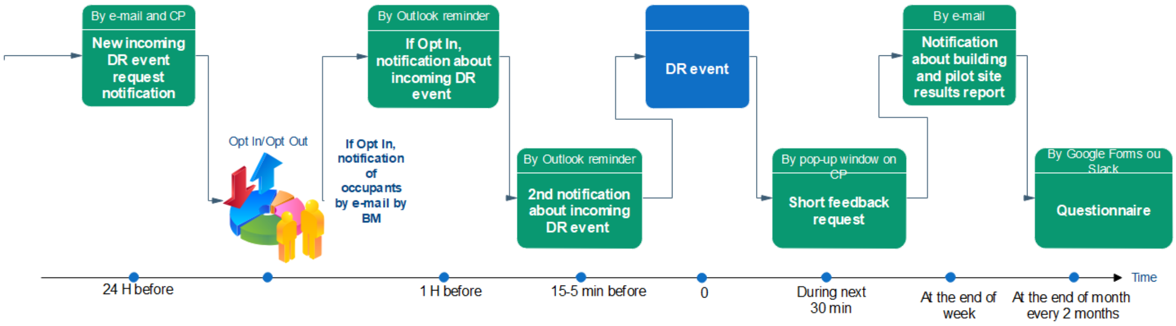


FIGURE 33. COMMUNICATION PROCESS AT THE SCALE OF AN EVENT

3 NBK staff as well as the 3 building managers are involved into communication activities (see Table 12).

Name	Role	Responsibility
Pascale Brassier	Communication Coordinator	Provides direction on communication related to the demonstration of the DR-BoB solution. Owns the communication plan and leads communication activities.
Magali Houllier	Communication Consultant	Provides advice on the development of a communication plan. Acts as an expert in the field of communication with building occupants.
Igor Perevozchikov	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.
Pascale Brassier	Communication Recipient	Receives communications before and/or during the demonstration of the DR-BoB solution.

TABLE 12. DR-BOB RESOURCES INVOLVED INTO COMMUNICATION ACTIVITIES AT THE FRENCH PILOT SITE

4.8 RESOURCE SCHEDULE

As mentioned into the deliverable 4.1 currently the French pilot site plans to assign roles to 10 persons in relation with demonstration activities. To successfully conduct the demonstration, separated roles for each person involved have been defined. These roles are described in table 12

Pilot Site Coordinator	Igor Perevozchikov
Active Participants	Pascale Brassier, Lionel
Pilot Site Owner	FCMB building: Denis Rouault NBK building: Christophe Cantau BI building: Marie-Agnès Barrière
Asset Controller	FCMB building: Denis Rouault NBK building: Igor Perevozchikov BI building: Marie-Agnès Barrière
Building Controller/Manager	FCMB building: Denis Rouault NBK building: Guillaume Laval BI building: Marie-Agnès Barrière
Occupant Welfare	FCMB building: Denis Rouault NBK building: Igor Perevozchikov BI building: Marie-Agnès Barrière

TABLE 13. PERSONS INVOLVED INTO DEMONSTRATION ACTIVITIES INTO THE FRENCH PILOT SITE

A complete resource schedule for preparation activities (before starting demonstration activities) is available in the Table 14.

Name	Role	Responsibility
FCMB building: Denis Rouault NBK building: Igor Perevozchikov BI building: Marie-Agnès Barrière	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
FCMB building: Denis Rouault NBK building: Guillaume Laval BI building: Marie-Agnès Barrière	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
FCMB building: Denis Rouault NBK building: Igor Perevozchikov BI building: Marie-Agnès Barrière	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organization's executive management. Needs to be kept informed of anything that may impact occupant welfare.
Igor Perevozchikov	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.

FCMB building: Denis Rouault NBK building: Christophe Cantau BI building: Marie-Agnès Barrière	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.

TABLE 14. FRENCH PILOT SITE RESOURCES ENGAGED INTO PREPARATION ACTIVITIES AT THE FRENCH PILOT SITE

During the demonstration activities, the resources available could not be the same as during preparation activities due to movement of staff. The Table 15 gives the resources of the French pilot site planned to be engaged into demonstration activities.

A: Scenario 1		
Name	**Role**	**Responsibility**
Igor Perevozchikov	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.
Pascale Brassier	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.
FCMB building: Denis Rouault NBK building: Christophe Cantau BI building: Marie-Agnès Barrière	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.
FCMB building: Denis Rouault NBK building: Igor Perevozchikov BI building: Marie-Agnès Barrière	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
FCMB building: Denis Rouault NBK building: Guillaume Laval BI building: Marie-Agnès Barrière	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
FCMB building: Denis Rouault NBK building: Igor Perevozchikov BI building: Marie-Agnès Barrière	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organization's executive management. Needs to be kept informed of anything that may impact occupant welfare.
C: Scenario 3		
Name	**Role**	**Responsibility**
Igor Perevozchikov	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.
Lionel	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.
Denis Rouault	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.
Denis Rouault	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
Denis Rouault	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
Denis Rouault	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organization's executive management. Needs to be kept informed of anything that may impact occupant welfare.
D: Scenario 4		
Name	**Role**	**Responsibility**

Igor Perevozchikov	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.
Pascale Brassier	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.
FCMB building: Denis Rouault NBK building: Christophe Cantau BI building: Marie-Agnès Barrière	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.
FCMB building: Denis Rouault NBK building: Igor Perevozchikov BI building: Marie-Agnès Barrière	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
FCMB building: Denis Rouault NBK building: Guillaume Laval BI building: Marie-Agnès Barrière	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
FCMB building: Denis Rouault NBK building: Igor Perevozchikov BI building: Marie-Agnès Barrière	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organization's executive management. Needs to be kept informed of anything that may impact occupant welfare.
D: Scenario 5		
Name	**Role**	**Responsibility**
Igor Perevozchikov	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.
Pascale Brassier	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.
FCMB building: Denis Rouault NBK building: Christophe Cantau BI building: Marie-Agnès Barrière	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.
FCMB building: Denis Rouault NBK building: Igor Perevozchikov BI building: Marie-Agnès Barrière	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
FCMB building: Denis Rouault NBK building: Guillaume Laval BI building: Marie-Agnès Barrière	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
FCMB building: Denis Rouault NBK building: Igor Perevozchikov BI building: Marie-Agnès Barrière	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organization's executive management. Needs to be kept informed of anything that may impact occupant welfare.

TABLE 15. STAFF PLANNED TO BE USED AT THE FRENCH PILOT SITE DURING THE DEMONSTRATION ACTIVITIES

4.9 TRAINING OF BUILDING MANAGERS AND OCCUPANTS

To help Building Managers better understand CP's functionalities and check they suit their requirements, CP walkthroughs online session (Skype & Circuit) will be organized for the French pilot site. During these walkthroughs, all parts and settings of CP will be presented, questions answered, feedbacks and comments gathered for further update. In difference from the UK pilot site, the BMs of the French pilot site will have additional information needed to run scenario 3 and 5. Scenario 5 being still under implementation don't allow to organize the training session. Final training session will be scheduled once all the scenarios are implemented.

The persons involved into the training activities of building managers and occupants at the French demonstration scenarios are listed in the Table 16.

Name	Role	Responsibility
Papa Niamadio	Trainer	Trains delegates in the use of a DR-BoB technology
Igor Perevozchikov	Training Coordinator	Assists the trainer with the preparation for each training session. Communicates with delegates (sends and receives training-related information).
FCMB building: Denis Rouault NBK building: Igor Perevozchikov BI building: Marie-Agnès Barrière	Delegate	Agrees to attend training sessions. Attends training sessions. Provides relevant feedback following training sessions.
Igor Perevozchikov	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.

TABLE 16. DR-BOB RESOURCES INVOLVED INTO TRAINING ACTIVITIES AT THE FRENCH PILOT SITE

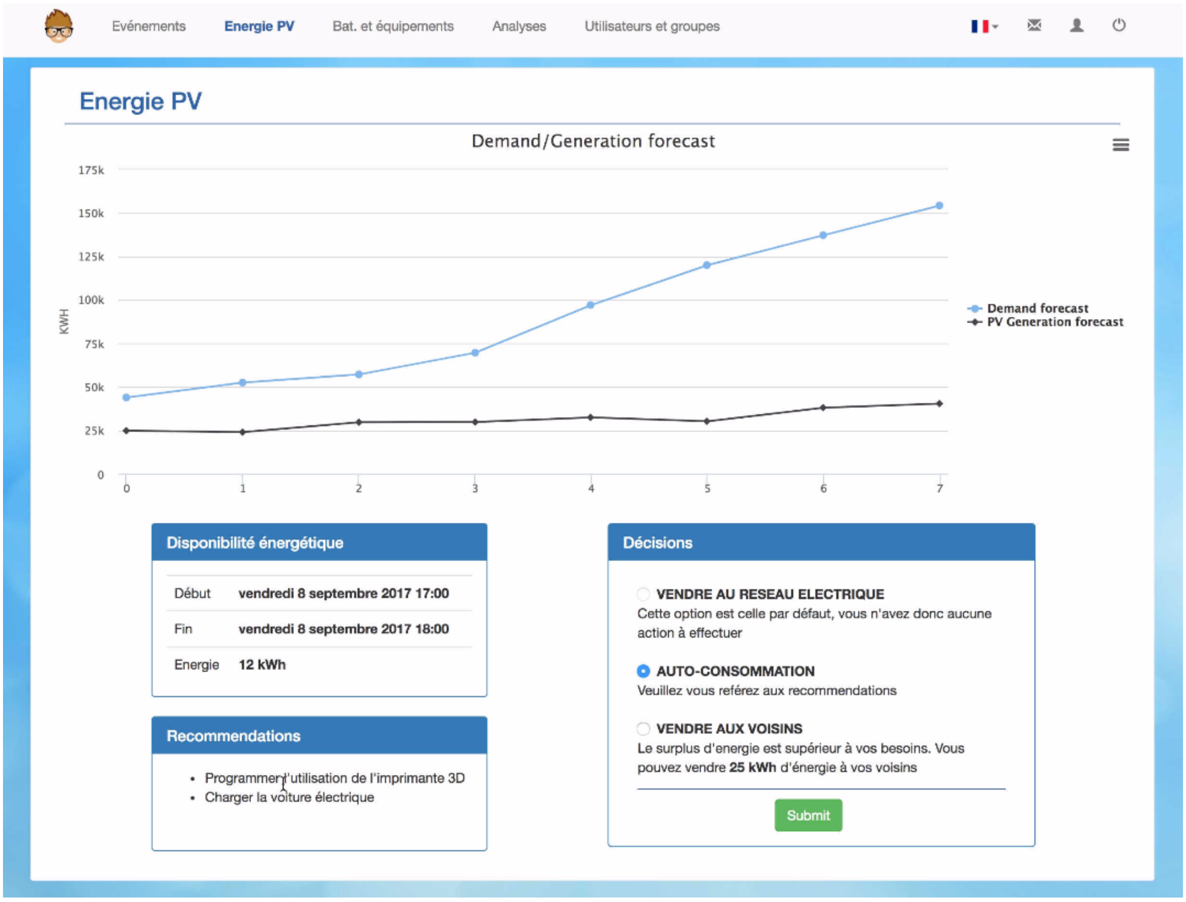


FIGURE 34. CONSUMER PORTAL SCENARIO 5 SPECIFIC APPROACH FOR THE FRENCH PILOT SITE

Consumer Portal will have a specific feature at the French site as Scenario 5 will be run for this block of buildings. For this scenario, surplus PV generated energy within BI building will be either consumed within the building, sold to the neighbouring buildings of the block (both with different owners and utilities companies) or sold to the grid. This specific situation is of great importance for the trial as this situation is commonly found in the paradigm of blocks of buildings. Screenshots for this scenario in the Consumer Portal are shown in Figure 2. DR-BoB architecture implemented at four pilot sitesand Figure 35.

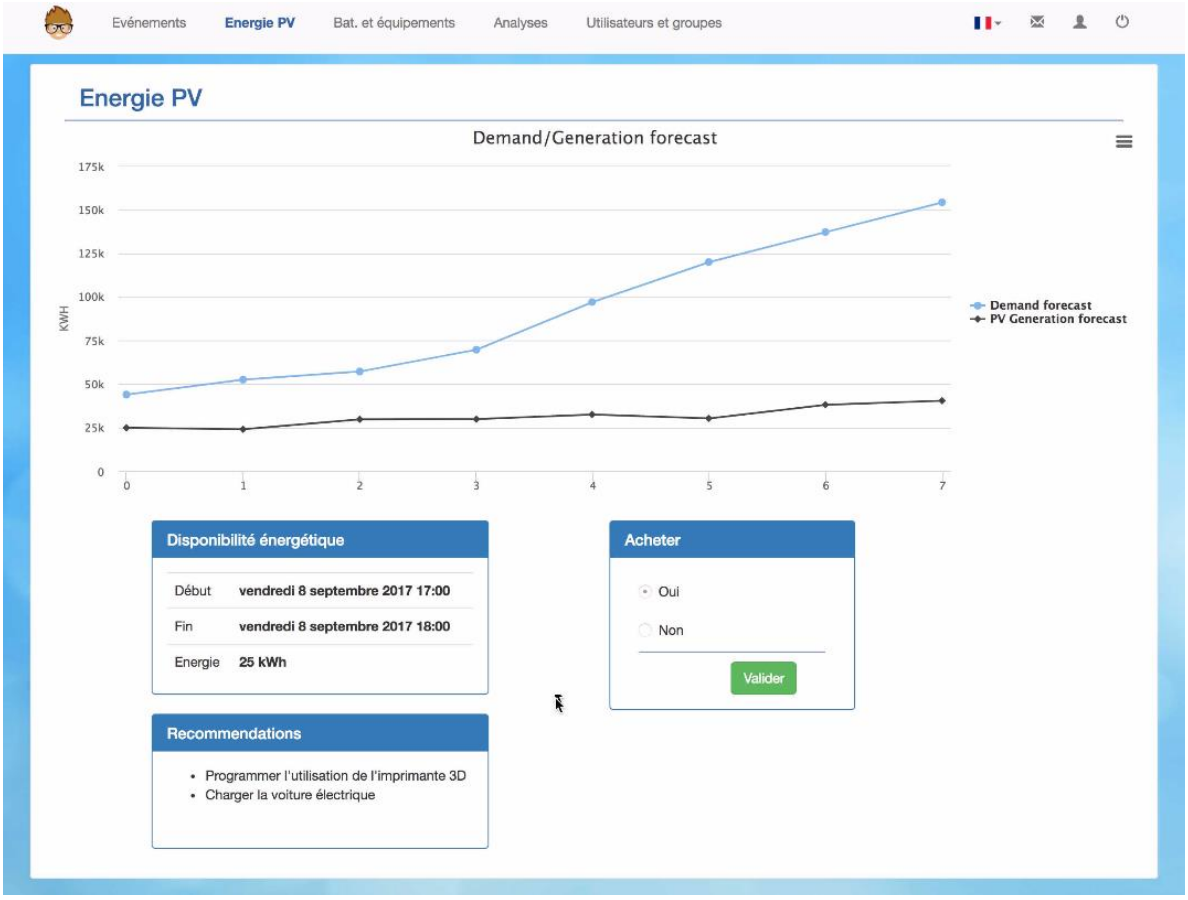


FIGURE 35. CONSUMER PORTAL OPT IN/OUT TO BUY EXCEEDED PV GENERATION FROM BI BUILDING

4.10 INITIAL END-TO-END TESTING PLANNING

The events of scenarios 1, 3 and 4 are planned to be generated between November 2017 and March 2018. The end-to-end testing for the abovementioned demonstration scenarios is planned to be made at the first half of October. As the events of the scenario 5 are not planned to be generated before the May 2018, the end-to-end testing of this scenario will be made later in November 2017.

The persons involved into this end-to-end testing of the French demonstration scenarios are listed in the Table 17.

End-to-End Testing		
Name	**Role**	**Responsibility**
Theophile Mertz	Test Coordinator	Organises testing by following a test plan. Coordinates the efforts of the various people involved in testing. Communicates with technology partners for the resolution of failures.
David Frederique	Tester	Carries out testing and records the results of testing in a test log. Identifies failed tests and provides information that can be used to resolve the failure.
Igor Perevozchikov	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.
David Frederique	Technology partner	

Pavel Novak (Omnetric)	Technology partner	Receives information regarding failures. Resolves failures and communicates resolution to the pilot site Test Coordinator
Muneeb Dawood (TU)	Technology partner	
Papa Niamadio (GP)	Technology partner	

TABLE 17. PERSONS INVOLVED INTO END-TO-END TESTING AT THE FRENCH PILOT SITE

5 INSTALLATION AT ITALIAN SITE

5.1 INSTALLATION OF ADDITIONAL METERING EQUIPMENT

At the very beginning of the implementation phase it was acknowledged that the Fondazione Poliambulanza did not have an adequate energy monitoring system to enable a fruitful exploitation of the DR-BOB solution. This led to the identification and installation of additional monitoring equipment in the various buildings of the hospital. The site was already in the process of buying and installing an Energy Monitoring System (EMS) with the aim of collecting and visualising all data under a single system, but only had a few meters with overall electricity, gas and district heating consumption and a few other metrics. This system is a Zucchetti Z-Energy EMS. A screenshot is shown in Figure 36.

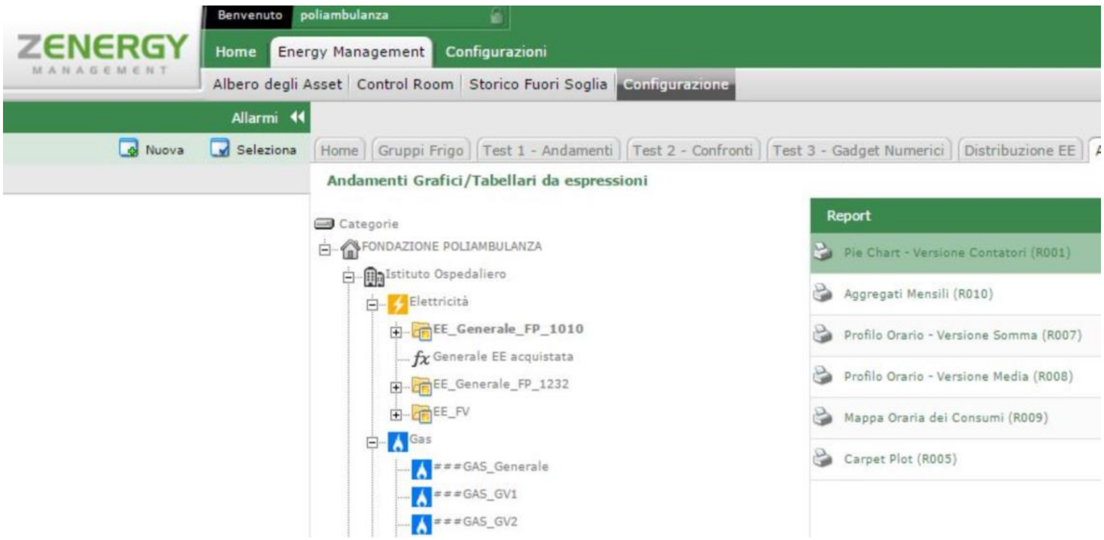


FIGURE 36. SCREENSHOT OF THE ZUCCHETTI ENERGY MANAGEMENT SYSTEM

FP, supported by R2M, identified several additional meters to be installed at the site in to order to both enable a correct use of the DR-BOB solution and get a better understanding of the hospital’s energy behaviour. This also included a number of meters and sensor for the tri-generation plant that entered into full operation in August 2017. All meters and sensors currently installed (or to be shortly installed) are reported in

Type of meter/sensor installed	Area/Asset	Installed as part of DR-BOB
Electricity meters	Whole site but CREM	✓
	CREM	✓

	All chillers (1 meter each)	✓
	All evaporative towers (1 meter each)	✓
	All chiller pumping systems (1 meter each) PV generation	✓
	CCHP Gross generation	✓
	CCHP Auxiliaries consumption	✓
Gas meters	Whole site	✓
	Steam Generators 1&2	✓
	CCHP	✓
Heat meters	District heating whole site but CREM	✓
	All chillers cooling energy (1 meter each)	✓
	CCHP total recovered heat	✓
	CCHP absorption chiller generation	✓
	CCHP recovered heat for heating	✓
	Heat consumed by polyfunctional building	
	Coolth consumed by polyfunctional building	
Temperature	Outdoor temperature	
COP	CCHP COP	✓

TABLE 18. ENERGY METERS CURRENTLY INSTALLED AT FONDAZIONE POLIAMBULANZA

Electricity meters generally measure power (kW) and power factor besides consumption (kWh). Heat meters generally provide also indication of supply and return temperatures (°C) and water flow (l/s). As reported in the table, most meters were installed as a direct consequence of the DR-BOB project.

The site is also equipped with a Siemens Desigo Building Management System (BMS). As part of the implementation phase, this has been connected to the Zucchetti Z-Energy in order to have a single system for visualising all data (both consumption and operative one) and also enable a single export channel.

5.2 COMMUNICATION BETWEEN BMS AND EMS

To better understand how the EMS receives data from the BMS it is useful to explain how the system architecture was designed and set up (Figure 37).

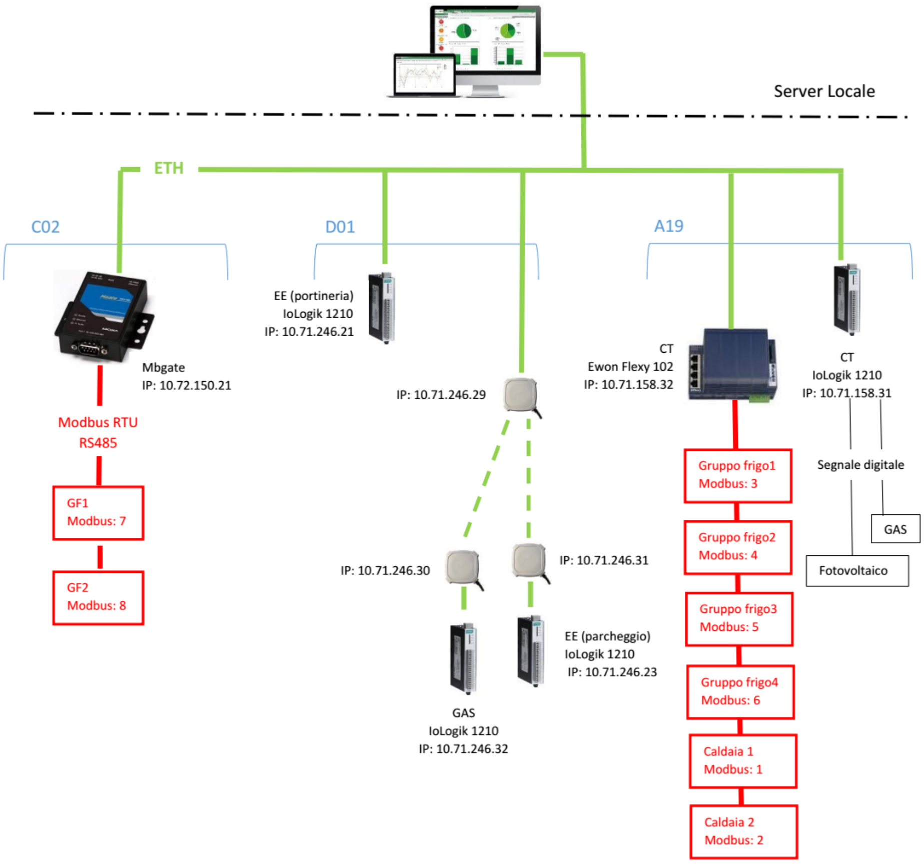


FIGURE 37. Z ENERGY SYSTEM ARCHITECTURE

The meters installed for the DR-BOB project, depending on the type and technology, can provide different type of outputs which are in this case Modbus-RTU or digital pulse. To be able to transmit the data from the meters to the Z-Energy virtual server it was required to installed a set of different converting devices connected on one side to the meters and on the other side to the Poliambulanza Intranet networks through standard Ethernet cables (Figure 38).

FIGURE 38. DEVICES USED TO CONNECT METERS TO THE NETWORK (MODBUS LEFT, PULSE RIGHT)

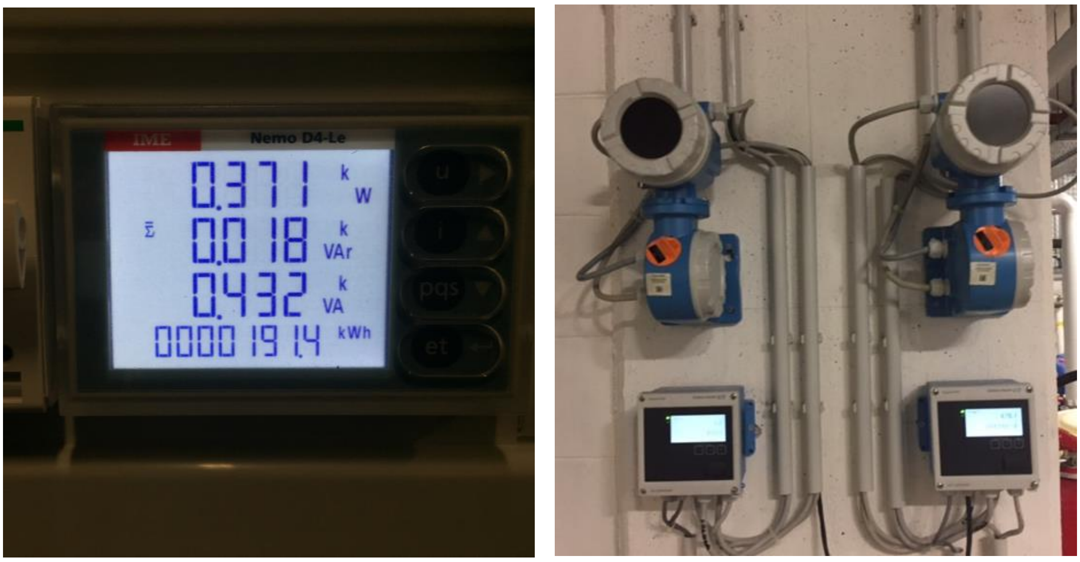


FIGURE 39. ELECTRIC ENERGY AND COOLING ENERGY METERS INSTALLED IN POLIAMBULANZA

The BMS Siemens Desigo installed in the hospital has a similar system architecture but much more complex due to the variety of different meters, sensors and actuators that need to interact between the each other and the software on the virtual server. BMS data travels in the same physical network of the EMS.

To connect the BMS to the EMS it was necessary to install a System Controller from Siemens (a PX001ED), usually used to connect in field devices to the BMS, and program it as an output from the BMS network.

The required data that reach the BMS software can be sent as an output, through a Modbus output, to the system controller. Then this is connected back to the EMS network like any other power meter with a Modbus output.

FIGURE 40. SYSTEM CONTROLLER SIEMENS PX001ED

5.3 COMMUNICATION BETWEEN EMS AND LEM

FP agreed with TU and the other partners to not install the LEM physically on site, but to keep it at TU and establish a direct communication between the Zucchetti EMS and the LEM. It is noted that the decision was taken for reasons of practicality (related to the configuration of the LEM) and that nothing would prevent the LEM to be installed directly at Poliambulanza. The choice was made also to take advantage of the communication between the building BMS and EMS and of the single data channel. During the testing period, data will be set up through the IT FTP server installed at TU premises. A ruggedcom device will be installed at Teesside University to host the LEM for the Italian pilot site.

The communication has been established through an ftp server. The Zucchetti EMS generates a csv (or txt) file including all parameters needed by the DR-BOB solution every 15 minutes and makes it available to the LEM through the ftp server.

5.4 COMMUNICATION

The planning phase also provided for the definition of a detailed communication plan, to be used to communicate all aspects of the DR-BOB solution to either key users, staff engaged in DR actions and all other occupants of the hospital. The complete communication strategy was included in deliverable D4.1, issued at M17. The plan has been then converted into actions, which are summarised in the below table for what concerns the communication of results of the demonstration activities.

Scenario	Targeted group of users	Communication	Communication media
All	Board of directors	Results of tests (technical, economic and environmental) Impact on users and occupants comfort	Intranet, email, Dedicated reports
	Hospital staff	Detailed results of tests (mainly environmental)	Intranet, dedicated events
	Patients	Global results of tests and impact on environment and patient's comfort condition	Web site, posters, advertising material
S1	Technical staff	Results of tests (mainly technical) and impact of their participation	Intranet, emails, meetings
S2	Administration staff	Results of tests (mainly environmental) and impact of their participation	Intranet, emails, meetings
S3	Canteen and delivery staff	Results of tests (mainly environmental) and impact of their participation	Emails, meetings
S4	Technical staff	Results of tests (mainly technical) and impact of their participation	Intranet, emails, meetings

TABLE 19. SUMMARY OF STRATEGY FOR COMMUNICATION OF RESULTS

As also mentioned in D4.1, communication in Italy is particularly sensitive since explicit demand response schemes are not yet available and the sole concept of demand response is not well known and tends to be confused with energy efficiency. This implies significant efforts to train users involved in demonstration activities, as also reported in section 5.6.

5.5 RESOURCE SCHEDULE

Resources were carefully selected to ensure both the implementation and running of the DR-BOB solution. An extract of the resource schedule is reported in the tables below for both the preparation and demonstration activities.

1: Preparation						
A: Planning						
Name	**Role**	**Responsibility**	**Resp.**	**Acc.**	**Consult**	**Inform**
Andrea Marelli	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.			C	I
Andrea Marelli	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.			C	I
BMS team	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organisation's executive management. Needs to be kept informed of anything that may impact occupant welfare.				I
Jorge Federico Galluzzi	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.	R			
Jorge Federico Galluzzi	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.		A		I
B: Training						
Name	**Role**	**Responsibility**	**Resp.**	**Acc.**	**Consult**	**Inform**
Jorge Federico Galluzzi	Trainer	Trains delegates in the use of a DR-BoB technology	R			
Andrea Marelli	Training Coordinator	Assists the trainer with the preparation for each training session. Communicates with delegates (sends and receives training-related information).			C	
BMS team	Delegate	Agrees to attend training sessions. Attends training sessions. Provides relevant feedback following training sessions.				I
Jorge Federico Galluzzi	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.		A		I

C: Communication						
Name	**Role**	**Responsibility**	**Resp.**	**Acc.**	**Consult**	**Inform**
Jorge Federico Galluzzi	Communication Coordinator	Provides direction on communication related to the demonstration of the DR-BoB solution. Owns the communication plan and leads communication activities.	R			
Jorge Federico Galluzzi	Communication Consultant	Provides advice on the development of a communication plan. Acts as an expert in the field of communication with building occupants.			C	
Jorge Federico Galluzzi	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.		A		I
BMS team	Communication Recipient	Receives communications before and/or during the demonstration of the DR-BoB solution.				I
D: End to End Testing						
Name	**Role**	**Responsibility**	**Resp.**	**Acc.**	**Consult**	**Inform**
Jorge Federico Galluzzi	Test Coordinator	Organises testing by following a test plan. Coordinates the efforts of the various people involved in testing. Communicates with technology partners for the resolution of failures.	R			
BMS team	Tester	Carries out testing and records the results of testing in a test log. Identifies failed tests and provides information that can be used to resolve the failure.			C	I
Jorge Federico Galluzzi	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.		A		I
BMS team	Technology partner	Receives information regarding failures. Resolves failures and communicates resolution to the pilot site Test Coordinator			C	I

TABLE 20. RESOURCE SCHEDULE FOR PREPARATION ACTIVITIES AT FONDAZIONE POLIAMBULANZA

2: Demonstration						
A: Scenario 1						
Name	**Role**	**Responsibility**	**Resp.**	**Acc.**	**Consult**	**Inform**
Jorge Federico Galluzzi	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.	R			
Control room Operators	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.			C	I

Name	Role	Responsibility	Resp.	Acc.	Consult	Inform
Jorge Federico Galluzzi	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.		A		I
Andrea Marelli	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
Andrea Marelli	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
BMS team	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organisation's executive management. Needs to be kept informed of anything that may impact occupant welfare.				I
B: Scenario 2						
Name	**Role**	**Responsibility**	**Resp.**	**Acc.**	**Consult**	**Inform**
Jorge Federico Galluzzi	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.	R			
Maintenance staff	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.			C	I
Jorge Federico Galluzzi	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.		A		I
Andrea Marelli	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
Andrea Marelli	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
C: Scenario 3						
Name	**Role**	**Responsibility**	**Resp.**	**Acc.**	**Consult**	**Inform**
Jorge Federico Galluzzi	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.	R			
Canteen Manager	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts			C	I

		as an ambassador for the demonstration.				
Canteen Manager	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.		A		I
Canteen staff	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
Canteen Manager	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
Food delivery staff	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organisation's executive management. Needs to be kept informed of anything that may impact occupant welfare.				I
D: Scenario 4						
Name	**Role**	**Responsibility**	**Resp.**	**Acc.**	**Consult**	**Inform**
Jorge Federico Galluzzi	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.	R			
Control room Operators	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.			C	I
Jorge Federico Galluzzi	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.		A		I
Jorge Federico Galluzzi	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
Jorge Federico Galluzzi	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.				I
BMS team	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organisation's executive management. Needs to be kept informed of anything that may impact occupant welfare.				I

Table 21. Resource Schedule for Demonstration Activities at Fondazione Poliambulanza

5.6 TRAINING OF BUILDING MANAGERS AND OCCUPANTS

The planning also provided for the conduction of training sessions with key members of the hospital's staff involved either in the implementation activities or in the operative phase. Technical staff was trained since the beginning on the concept of DR. This allowed a correct installation of sub-meters and sensors and a fruitful communication between the pilot site and the DR-BOB solution developers (mainly TU, SIEMENS and NBK). Training sessions to the BMS team, the members of the administration, canteen and delivery staff, all participating in one or more scenarios, are currently ongoing. All training sessions are summarised in the table below.

Trained group	Training	Status/Deadline
Technical staff	General briefing on DR	Completed
BMS team, Andrea Marelli	General briefing on all scenarios	Completed
Administration staff	Training on Scenario 2	Ongoing/End of October
Canteen manager and staff, delivery staff	Training on Scenario 3	Ongoing/End of November

TABLE 22. PLANNED TRAINING SESSION AT POLIAMBULANZA

5.7 USER FEEDBACK FROM INTIAL TESTING

A series of end-to-end testing has been planned and partially carried out to ensure adequate communication between the EMS and the LEM and between the LEM and the other components of the DR-BOB solution. This includes the correct delivery of communication and recommendations from the LEM-DEMS to the Consumer Portal, which will be used to start any DR event. The complete list of tests is reported in the following table.

Testing activity	Status/Deadline
Set-up of ftp server	Completed
Data communication between EMS and LEM	Completed
Correct use of data channels	Ongoing/End of September
Communication between LEM/DEMS and CP	Ongoing/End of September
Correct opt in/out procedure	Ongoing/End of September
Calibration of optimal CCHP scheduling for scenario 4	Ongoing/End of October
Pre-test on Scenario 1 to assess DR potential of chillers	Ongoing/End of September

TABLE 23. COMPLETED AND PLANNED TESTING ACTIVITIES

Final end to end testing will take place during October and November 2017, with a series of testing involving occupants and building managers, to get better knowledge on the tools and approach implemented, in preparation for the 12 months evaluation period.

6 INSTALLATION AT ROMANIAN SITE

6.1 SITE SCENARIO UPDATE

There are 35 buildings at the Technical University of Cluj-Napoca site. These buildings do not have a common energy monitoring system. This has made necessary to identify and install of BEMS and monitoring equipment to evaluate the energy consumption in 4 block of buildings of the Technical university buildings, selected for the demonstration.

This demonstration includes several blocks of buildings spread over the city Cluj-Napoca with twelve old educational and residential buildings, although DR events will be carried out within 4 buildings. This demonstration site is governed by a single owner.

- Faculty of Electrical Engineering, which assets will take part into RO SC1, SC4 and SC5
- Faculty of Building Services, which assets will take part into RO SC1, SC4 and SC5
- Swimming complex, which assets will take part into RO SC1, SC4 and SC5
- Mărăști dormitories, which assets will take part into RO SC1, SC4 and SC5
  -

Building	Net floor area (m2)	Occupants (people)
Faculty of Electrical Engineering	**1.175**	**765**
Faculty of Building Services	**4.973**	**765**
Swimming complex	**5.280**	**765**
Mărăști dormitories	**13286**	**765**
Total	**24714**	**3060**

TABLE 24. NET FLOOR AREA AND OCCUPANTS DIRECTLY INVOLVED IN THE DEMONSTRATION ACROSS THE ROMANIAN DEMONSTRATION SITE IN DR-BOB PROJECT

Scenario 1

Demonstration Scenario 1 aims to temporally reduce TUCN peak power demand for the upcoming day by shifting / rescheduling the working hours of chillers, ventilations units, etc. away from national peak power demand periods. This scenario assumes temporary interruptions to cooling for 1 hour during peak power demand period, if it is necessary a precooling of the building will be done to maintain occupants comfort level.

Scenario 4

Demonstration Scenario 4 aims to permanently reduce TUCN buildings' peak power demand by rescheduling the use of high power equipment. Before the start of the academic year high power equipment staff will be asked to plan their work for the entire semester outside national peak power demand periods, introducing a break in their schedule for this period. The potential shift will be quantified as if a Time of Use tariff was charged.

Scenario 5

Demonstration Scenario 5 aims to temporally reduce Students Dormitories electrical energy consumption. Through the online monitoring system that will be implemented at the Romanian pilot site, even the students will be able to see the real time electrical energy consumption of Student Dormitories. The Romanian DR-BOB team plan to implement a student rewarding system if they can keep their electrical energy consumption under a previously imposed level when they are asked.

6.1.1 BUILDING AND ENERGY MANAGEMENT SYSTEM CONFIGURATION

Current transformers will be mounted in each location, on the general distribution and on the chillers supply. The chillers controller will be integrated via Modbus with the S1200 PLC. Each location will have a computer connected in the network which will receive the data from the PLC located in that site. The computer is connected with a TV on which a general overview for the general public will be displayed.

The main server will be placed in Location 1 (See 6.2.1), in the energy manager's office and will be a Siemens Simatic Box PC. The BEMS will run on this and it will be able to give commands to any PLC in the network.

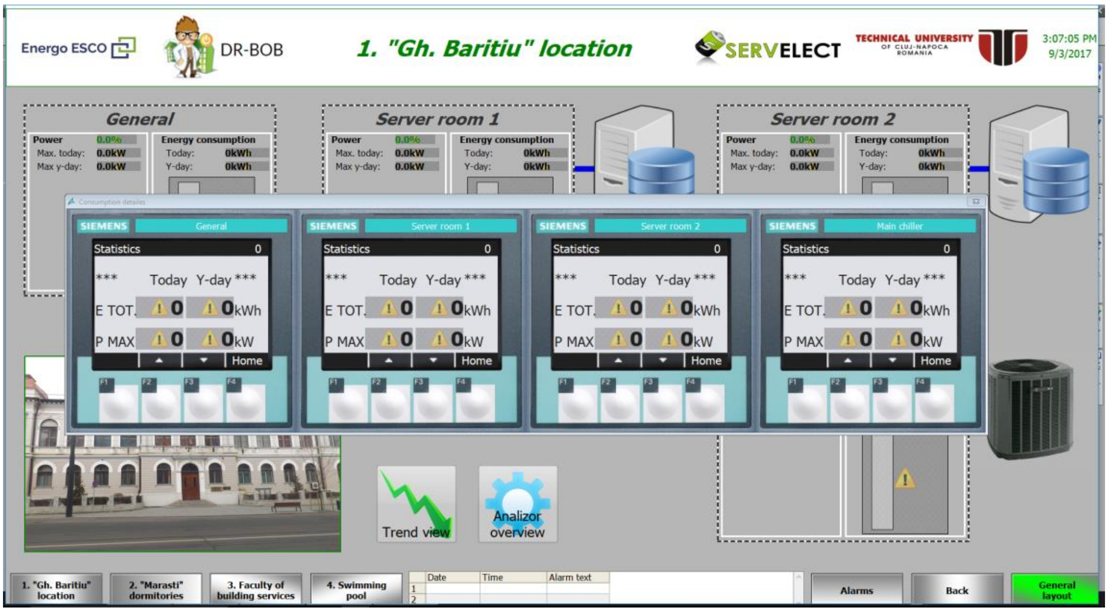


FIGURE 41. SCREENSHOT ILLUSTRATING BEMS INTERFACE OF ELECTRICAL ENGINEERING FACULTY

"PC TUCN" will have 2 network cards. A plaque for the current connection or the network second plaque to be assigned a static IP. Also the video plaque for the PC it will have 2 ports, the first port to be served by the existing monitor, respectively second port to connect TV. VGA extender kits will be used, that means we come from a video plaque into a VGA-Ethernet converter, and at TV will mount an Ethernet-VGA converter. Between the two equipment we place the Ethernet cable FTP. For "islands" it would require two static IP (PC TUCN + PLC). For all four locations, it is necessary to work in an intranet network. For "Dispatcher" (Electrical Engineering Faculty), additional two IPs (Server Power Manager and RUGGER Siemens). This will allocate 10 IPs to be able to be called from the dispatcher. The TUCN IT Department will set up VPNs between the four locations.

Siemens RUGGEDCOM RX1400 is a multiprotocol intelligent node which combines Ethernet switching, routing, and firewall functionality with various wide area connectivity options. The device has IP40 degree of protection, does not use internal fans for cooling and supports -40° C to +85° C extended temperature range. With the release of ROX 2.9 software, the RUGGEDCOM RX1400 supports a LINUX virtual machine environment, allowing customers and third party application developers to deploy customized intelligence at the network edge.

The RUGGEDCOM RX1400 provides a high level of immunity to electromagnetic interference, heavy electrical surges, extreme temperature and humidity for reliable operation in mission critical applications. It can be found in electric utility substations, traffic control cabinets, railways, oil and gas and other harsh environments.

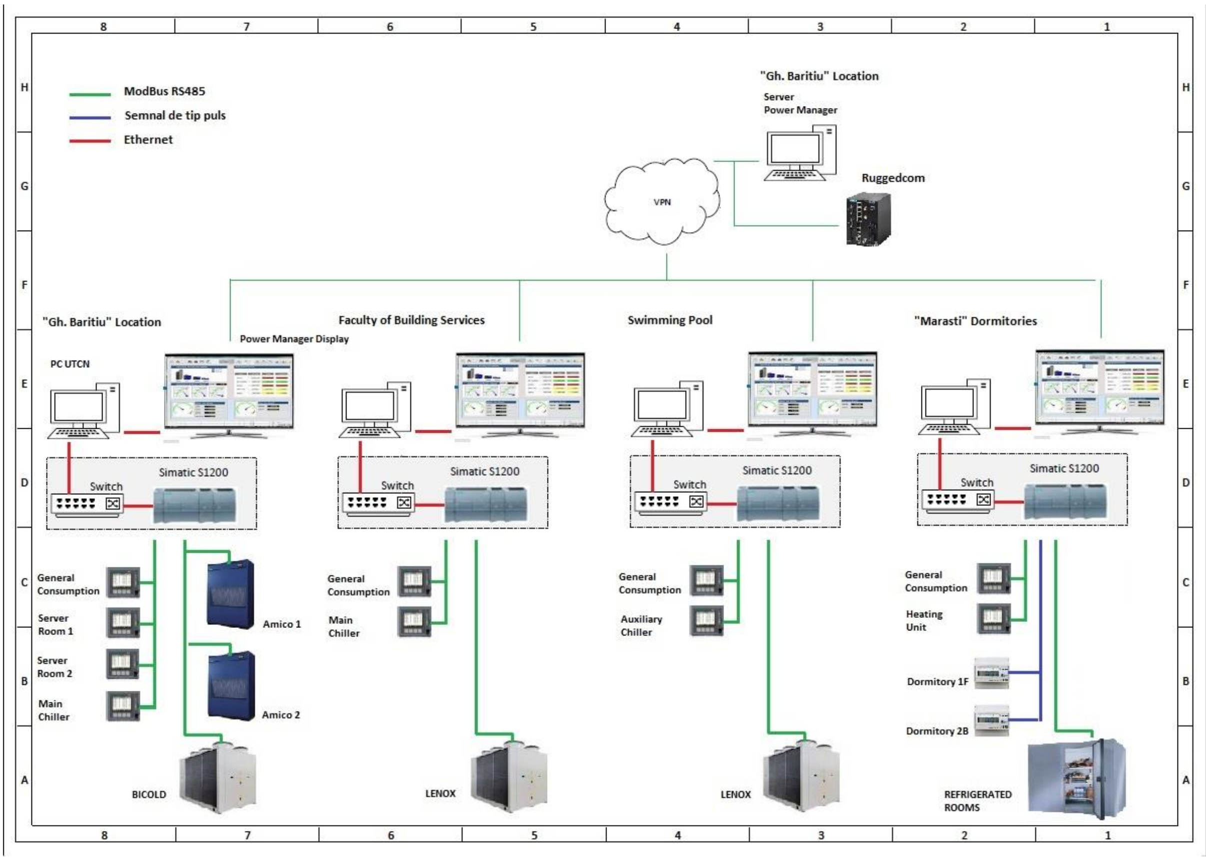


FIGURE 42. ILLUSTRATING BEMS ARCHITECTURE FOR TUCN BUILDINGS

6.2 CONFIGURATION OF BEMS

6.2.1 IDENTIFYING SPECIFIC AREAS FOR DR-BOB CONTROL TUCN

Location 1: Electrical Engineering Faculty – BoB 1

Location 2: Faculty of Building Services – BoB 2

Location 3: Marași Student Campus – BoB 3

Location 4: Swimming Pool – BoB 4

6.2.2 ASSETS UNDER CONTROL TUCN

In Location 1 there are 3 chillers: one Bicold and two Uniflair Amico used for the cooling of two server rooms.

In Location 2 the main chiller (Lennux) of the building will be monitored and controlled.

In Location 3 the application will focus on the energy consumption of the two student dormitories (1F and 2B) and of the 9 cold rooms from the student diner.

In Location 4 the asset under control will be the chiller used for the swimming pool sports room.

6.2.3 METER CONFIGURATION TUCN

For electrical energy consumption Siemens PAC3100 Power Monitors will be used with Current Transformers specific for each location. The control for the chillers will be done via Siemens S1200 PLC using the Modbus protocol.

6.2.4 DATA HANDLING TUCN

The server is located in Location 1 (Electrical Energy Faculty)

Monitors will be placed in every location for the occupants, visitors and technical team to see data in real-time from the energy meters.

6.2.5 DATA VISUALISATION REQUIREMENTS

Data will be displayed differently for the energy manager and the general public.

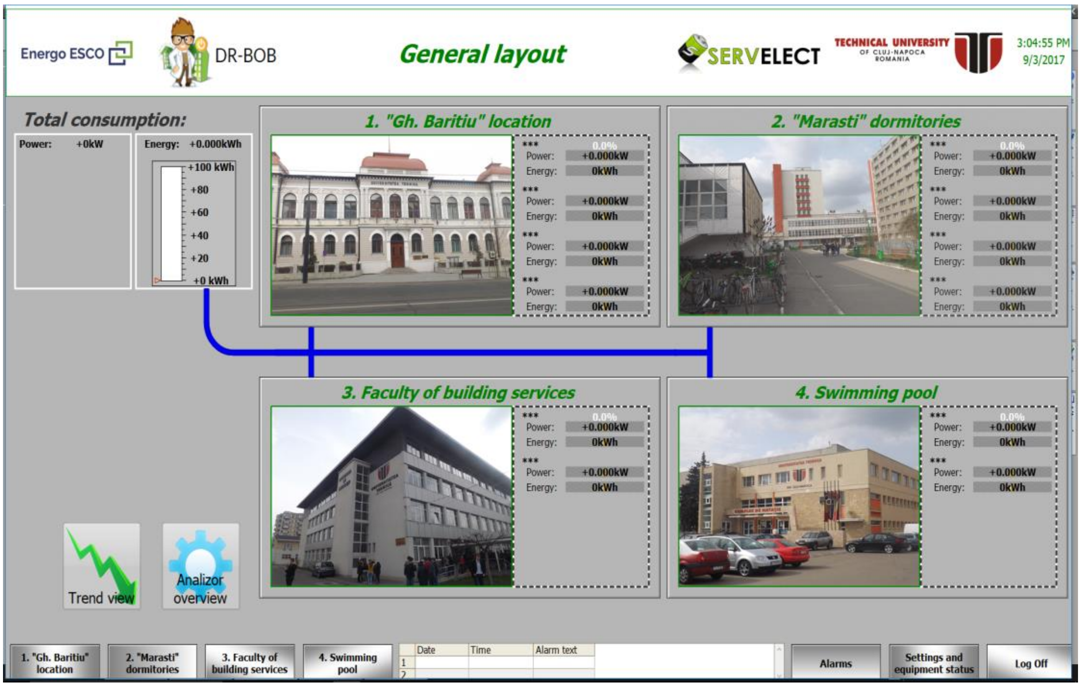


FIGURE 43. SCREENSHOT ILLUSTRATING BEMS INTERFACE FOR ALL LOCATION OF TUCN

6.3 TEAM LEADER ENGAGEMENT FOR SCENARIO 1, 4 AND 5

6.3.1 ELECTRICAL ENGINEERING FACULTY (EEF)

Bogdan BÂRGĂUAN – Energy Manager of TUCN

Tiberiu TARCO – Assistant Energy Manager of TUCN

Andrei CECLAN – team leader

Levente CZUMBIL – assistant team leader

6.3.2 FACULTY OF BUILDING SERVICES (BSF)

Bogdan BÂRGĂUAN

Tiberiu TARCO

Andrei CECLAN

Levente CZUMBIL

6.3.3 MARAȘTI STUDENTS CAMPUS (MSC)

Bogdan BÂRGĂUAN

Tiberiu TARCO

Andrei CECLAN

Levente CZUMBIL

6.3.4 SWIMMING POOL (SP)

Bogdan BÂRGĂUAN

Tiberiu TARCO

Andrei CECLAN

6.4 LEM DEPLOYMENT

The LEM deployment at the Romanian site is not as yet in place as the BMS upgrading and site works are expected to finish by September 2017. The approach to be taken though has been agreed with the Romanian site coordinators and will consist of a similar approach as per the UK site definition (see section 3.4 in this document). The IT security will make easier to install LEM in a local PC with elevated administrator rights. This will allow communication with DEM and ME, and allow the system to operate. At the same time the local PC will communicate with the local BMS recently installed to gather the required data for the LEM.

6.5 COMMUNICATION

The communication plan has been developed in accordance with D4.1. – Template Communication Strategy – TUCN.

During the last month the definition of the occupant panels, the strategies to communicate and retrieve feedback, both from building managers, as for users and team leaders, has been developed, as is shown in D5.1.

A generic communication schema is proposed for the DR event, using different channels adapted to the involved stakeholders, like:

- For the top decision makers of TUCN: presentations once on a three month to keep them inform about the ongoing events of the project, they are informed about the communication channels where they can find details about DR BoB actions (website);

- For the Technical Department Staff: permission and acceptance to control the assets are requested through an official document, the energy use will be periodical communicated via email, DR BoB project website and also by providing them access to the CP;

- For the building Administrators: before each DR event they will be announced via email, paper brochure;

- For the IT Department: notifications a day ahead when receiving the DR event request, so as to involve the cooling in the servers and perform if necessary any pre-cooling just before the event;

- For the academic staff as building occupants: they will be notified one day ahead and one hour before of each DR event via email, paper brochure on every office, message on central displays of the buildings with information on the event and the actions to be undertaken;

- For the students in the hostels: they will be notified one day ahead and one hour before of each DR event via, paper brochure on every hostels, banner in front of every hostels entrance with information on the event and the actions to be undertaken

- Others: all university academia staff (not only those involved in the DR events) will be informed about DR BOB project and energy saving opportunities via periodical emails.

6.6 RESOURCE SCHEDULE

Resources selected ensure both the implementation and running of the DR-BOB Scenarios. The resource schedule is reported in the Table 25.

Scenario 1		
Name	**Role**	**Responsibility**
Andrei Ceclan	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.
Building administrator	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.
Levente Czumbil	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.
Tiberiu Tarco	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
Bogdan Bargauan	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
Mihaela Cretu	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organization's executive management. Needs to be kept informed of anything that may impact occupant welfare.
Scenario 4		
Name	**Role**	**Responsibility**
Andrei Ceclan	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.
	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.
Levente Czumbil	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.
Tiberiu Tarco	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
Bogdan Bargauan	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
Mihaela Cretu	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organization's executive management. Needs to be kept informed of anything that may impact occupant welfare.
Scenario 5		
Name	**Role**	**Responsibility**
Andrei Ceclan	Pilot Site Coordinator	Coordinates site activity related to the demonstration. Reports progress to the relevant Work Package lead. Represents the pilot site at DR-BoB meetings.

Students leaders	Active Participant	Helps to execute the scenario and/or provides feedback on the demonstration and/or acts as an ambassador for the demonstration.
Levente Czumbil	Pilot Site Owner	Sets site policy relating to facilities and assets. Needs to be kept informed about the involvement of site assets (both rooms and equipment) in the demonstration.
Tiberiu Tarco	Asset Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
Bogdan Bargauan	Building Controller	Sets site policy for the use of facilities and building assets. Needs to be kept informed about the involvement of site assets in the demonstration.
Mihaela Cretu	Occupant Welfare	Concerned with occupant welfare. Reports on welfare issues to the organization's executive management. Needs to be kept informed of anything that may impact occupant welfare.

TABLE 25. RESOURCES FOR IMPLEMENTATION AND RUNNING OF DR-BOB SCENARIOS AT THE ROMANIAN PILOT SITE

6.7 TRAINING OF BUILDING MANAGERS AND OCCUPANTS

Each building Administrator has local access on the BEMS for their BoB and benefit of support from the DR BoB team.

6.8 USER FEEDBACK FROM INITIAL TESTING

There were several issues to be solved with the IT Department, especially regarding the control and monitoring of cooling units for servers.

6.9 INITIAL END-TO-END TESTING PLANNING

As the implementation of the DR-BoB solution has been delayed for this site, the initial testing of the scenarios will be as well delayed in its start. The first end to end testing will be delivered within the months of October and November 2017. This will affect in the initial start of the scenario running and the demonstration with the evaluation period starting the 1st of December 2017. This are the tentative dates to run the scenarios at the Romanian site are:

Scenario 1 – from December 2017 up to September 2018, with a concentration during hot season, when chillers are working more often.

Scenario 4 – from December 2017 up to July 2018, due to the fact that the educational programme will finish for summer vacation.

Scenario 5 – from December 2017 up to July 2018, due to the fact that the educational programme will finish for summer vacation.

7 CONCLUSIONS

This report exposes the upgrading works carried out to enable adaptation of the DR-BoB technology components. These works have been delivered in parallel for all of the sites. The UK site has served as the primary site for the testing of the whole integrated system, and made ready for the rest of the sites. The end to end testing of the different scenarios has been delivered just for the UK site and will be done within September and October for the rest of the sites, after the integration has been successfully achieved at the UK site.

The installation has been tailored to each site specific characteristics and requirements as stated in D2.3, and hence each site documentation reflects the detailed process using a slightly different structure, according to the installation state of completion. This won't hamper the development and implementation of the technical solution and the demonstration of the different buildings and scenarios defined within D2.2 and subsequent documentation updates.

The complete final implementation of the different components required to run the DR-BoB solution at the different demonstration sites will be achieved in an escalated way. This will allow the deployment of LEM, VEP, DEMS and CP at each site at different stages, and will allow lessons learned from one site to be applied in the others. These lessons learned as well as a final information on the implementation at the different demonstration sites will be given in D4.3 "Evaluation data" as well as the results from the evaluation period data analysed at the sites. This information will also feed D5.3 "guidelines for future pilots" for which readiness for implementation of DR strategies and DRTRLs will be developed.

The different meter sources and configurations in the different BMSs have represented an important barrier in the process to establish stable and the communication and LEM. As well, different security protocols applied at specific sites (UK, TUCN) made apparent the need for tailored system implementation and therefore each of the sites will have a slightly different system architecture. Application of DR-BoB technology solution relies as yet to the specific site DRTRL and BMS and meter readings configuration.

The system integration was tested at the UK demonstration site and it is expected that the UK site is fully implemented in September 2017. The different meter channels (meter readings, meter forecasts and recommendations) will be implemented during October for the French, Italian and Romanian sites in DEMS and LEM. By October 2017, the Italian site will have delivered its LEM deployment and testing. This site has already established a stable and coordinated in format communication with LEM in the IT FTP server, to be later migrated to the ruggedcom device along with the Italian LEM (November 2017). The French site has almost finished the commissioning and upgrading of its BMS systems, and integration of BMS data within the different buildings will be achieved during October 2017. It will start the testing during October 2017, according to the specific plan. The Romanian site has started the LEM implementation after the BEMS has been commissioned and the metering points have been enabled (September 2017). Further work is required to test the configuration of its respective LEM once implementation begins. Tasks 4.3, 4.4 and 4.5 have continued its advance and complete implementation (Milestone 6) will be achieved during November 2017.

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9 APPENDIX 1 – LEM INTEGRATION TESTING (UPDATE)

9.1 RECORD OF TESTING THE ELEMENTS AND INTERFACES

The initial integration testing schedule proposed by TU was as below. All testing was conducted on the UK site data and assets with simultaneous communication between technology partners over the Skype For Business platform provided by TU.

Scenario	Assets	DR-BOB Components	Proposed Date
Scenario 4 Frequency response	UPS + Backup Generator (simulated)	LEM, DEMS, CP	Thurs 16th Feb
Scenario 2 Demand Turn Up (DTU)	CHP (simulated)	ME, LEM, DEMS, CP	Thurs 23rd Feb
Scenario 3 Triad response	Team leaders in laboratories, workshops	ME, LEM, DEMS, CP	Thurs 9th March
Scenario 1 STOR	HVAC demand reduction through BMS	ME, LEM, DEMS, CP	Thurs 23rd March

TABLE 26. SCHEDULE OF TESTS OF UK SITE SCENARIOS

The LEM-DEMS interface was unsuccessful during the Scenario 4 test on 16/02/17, however, the LEM succeeded in reading events that had been generated by the Market Emulator (ME).

On 23/02/17 the LEM virtual machine suffered a temporary network failure which was later investigated and resolved with Siemens technical support. The LEM was reconfigured and was able to pass meter readings to DEMS and generate its own events using the proprietary OpenADR API. Errors were raised by DEMS and some events rejected, however, this was identified as a consequence of some test events having start and end times defined astride the present time; both must be defined in the future for correct functioning. Meter readings from Scenario 2 simulation were initially blank in DEMS due to an XML format error but this was resolved and retested on 09/03/17.

The Scenario 3 test involved staff (Martin Quennell's team in one of the Teesside University laboratories) receiving email messages from the Consumer Portal (CP) in response to the creation of events by Market Emulator. The chain was successful and comments on the format and content of the messages were well received.

An issue in the CP being unable to gather events from one scenario from DEMS, when there are a large number of upcoming events on another scenario, was spotted and marked for future resolution. It was also noted that there is no notification, to the LEM developers or site managers, if the flow of metering data from the site to DEMS stops for any reason. Interruptions may be due to a number of points of failure in the communication path from the meter itself to DEMS. It was therefore concluded that an alert would have to be configured within DEMS that notifies the LEM development team and the relevant site specific contact that there is a problem. This could be expressed as a new, non-essential requirement to DEMS.

A proprietary web API has been identified to enable the LEM to retrieve historic events from DEMS to enable recovery from a power, software, network or other failure.

Difficulties in the implementation of both the BMS upgrade, to enable BACnet communication, and the incorporation of BACNet libraries into the LEM code have delayed the testing of Scenario 1. As of 23/06/17 the Clarendon Building set-points have been successfully controlled across the network by an individual element of the LEM software.

Scenarios 3a and 1 were tested successfully on the 24/08/2017. With the participation of the technical parties at the different back ends the team was able to perform a testing of the system working in UK SC 1 and SC3a, involving the following components:

- LEM creating the event signal, for scenarios 1 and 3a
- DEMS receiving the signal and transmitting it to CP
- CP sending requests to FM team for both scenarios UK SC1 and SC3a.
- Involvement of the FM team (Nick Ingledew) in operation of the CP
- Explanation to the FM team about the functionality of the CP.
- FM team opting out from UK SC1 for the whole set of assets. this was checked in DEMS and LEM
- FM team opting out for some assets in UK SC1. This was as well visible for DEMS and LEM
- FM team opting out for all the assets in UK SC3a. As well visible for DEMS and LEM
- FM team (Nick Ingledew) sending request to Team Leaders in order to respond to the request this afternoon.

There were some hurdles encountered during the testing:

- BMS automated assets meter readings and forecasts were not sent by LEM, due to a software permission in the gateway PC. It was preferred to conduct the test either way, as the LEM override functionality was tested during previous tests.
- An authentication error was found in DEMS while creating the UK SC1 event by LEM. This was solved during the testing, and due to an out of date password for accessing DEMS.

After this testing the technical lead assumed that all the scenarios and components have been tested and the integration milestone had been achieved. There are still connectivity issues to be solved but the whole system integration has been successfully tested.
Next step will be to solve the connectivity problems, and run another round of scenario tests which have started with the testing of scenario 4, this time with a real time frequency signal meter reading that triggers the event at an established variation threshold.