

# Northern Isles Energy Solutions (NINES) Active Network Management (ANM) System: Enterprise Architect Use Case Models



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## 1 Preface

This document is produced for the purpose of knowledge sharing and should be considered as a guide to the processes and mechanisms which support Scottish and Southern Energy Power Distribution (SSEPD) project delivery.

It presents use case models describing the scope of the Active Network Management (ANM) system developed for SSEPD's Northern Isles New Energy Solutions<sup>1</sup> (NINES) project. These models were created using business and systems analysis modeling techniques used by SSEPD's Future Networks and Policy Team to capture an understanding of project scope and to clearly communicate business requirements and technical solutions. The document uses Unified Modeling Language<sup>2</sup>, a standard modeling notation system.

Further information on the software tool used to create the material presented in this document (Enterprise Architect, from Sparx Systems) and tutorials on use case models can be found on the Sparx website (<http://www.sparxsystems.com.au/uml-tutorial.html>).

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<sup>1</sup> For more information about the NINES project and the ANM system see <http://www.ninessmartgrid.co.uk>

<sup>2</sup> Ref [http://www.omg.org/gettingstarted/what\\_is\\_uml.htm](http://www.omg.org/gettingstarted/what_is_uml.htm) for more information

## 2 Shetland ANM Actors

The Shetland ANM actor model defines all the parties that interact with the ANM system. Actors represent roles performed by internal SSEPD departments and roles performed by external 3rd party and partner companies. There is also a timer actor to indicate system features that are triggered automatically at a point in time.

Actor	Definition
Academic Institution	Academic institution which needs to access data from SSE's systems for its research
ANM Support	The ANM Support roles is provided by a third party supplier who will maintain and support the Active Network Management (ANM) systems.
Data Historian	A repository for capturing data relating to the Shetland ANM System.
Distribution Control System	The Distribution Control System that allows operational control of the HV and EHV network. It is maintained by RTS and operated by the Network Management Centre (NMC).
Domestic Heating Group	Domestic Heating Group represents a controllable demand and an energy storage capability provided by a group of storage heaters in homes located in a specific zone on the network.
Domestic Hot Water Group	Domestic Hot Water Group represents a controllable demand and an energy storage capability provided by a group of hot water tanks in homes located in a specific zone on the network.
Generation Control System	The Generation Control System that allows operational control of the generation network. It is maintained by RTS and operated by Generation Controllers.
Large Generation	Generation represents an energy generation capability provided by a large (>50kW) renewable generators (e.g. a wind farm).
LPS Management Team	Lerwick Power Station (LPS) Management Team is responsible for planning the maintenance and operation of LPS engine sets and ANM controlled devices. They provide advice and operational support to the LPS Shift Supervisors.
LPS Shift Supervisor	Lerwick Power Station (LPS) Shift Supervisors operate the power station on Shetland. They maintain and monitor generation and storage systems (including LPS engine sets and ANM controlled devices).
Measurement Point	A Measurement Point represents a physical location on the network where voltage or current is measured for use in network constraint management.
Battery	The Battery provides an energy storage capability on Shetland that can act as either a consumer or producer on the network.
Network Management Centre	Network Management Centre (NMC) personnel are SSEPD employees who monitor and control the HV and EHV network throughout the North of Scotland. The NMC is often referred to as 'The Control Room'
Network Planner	Network Planners are SSEPD employees who analyse the current electricity network operation and plan the development and change of the EHV, HV and LV electrical network.
New Consumer	An abstract actor representing any of the new demand devices on the network.
New Producer	An abstract actor representing any of the new generation devices on the network.

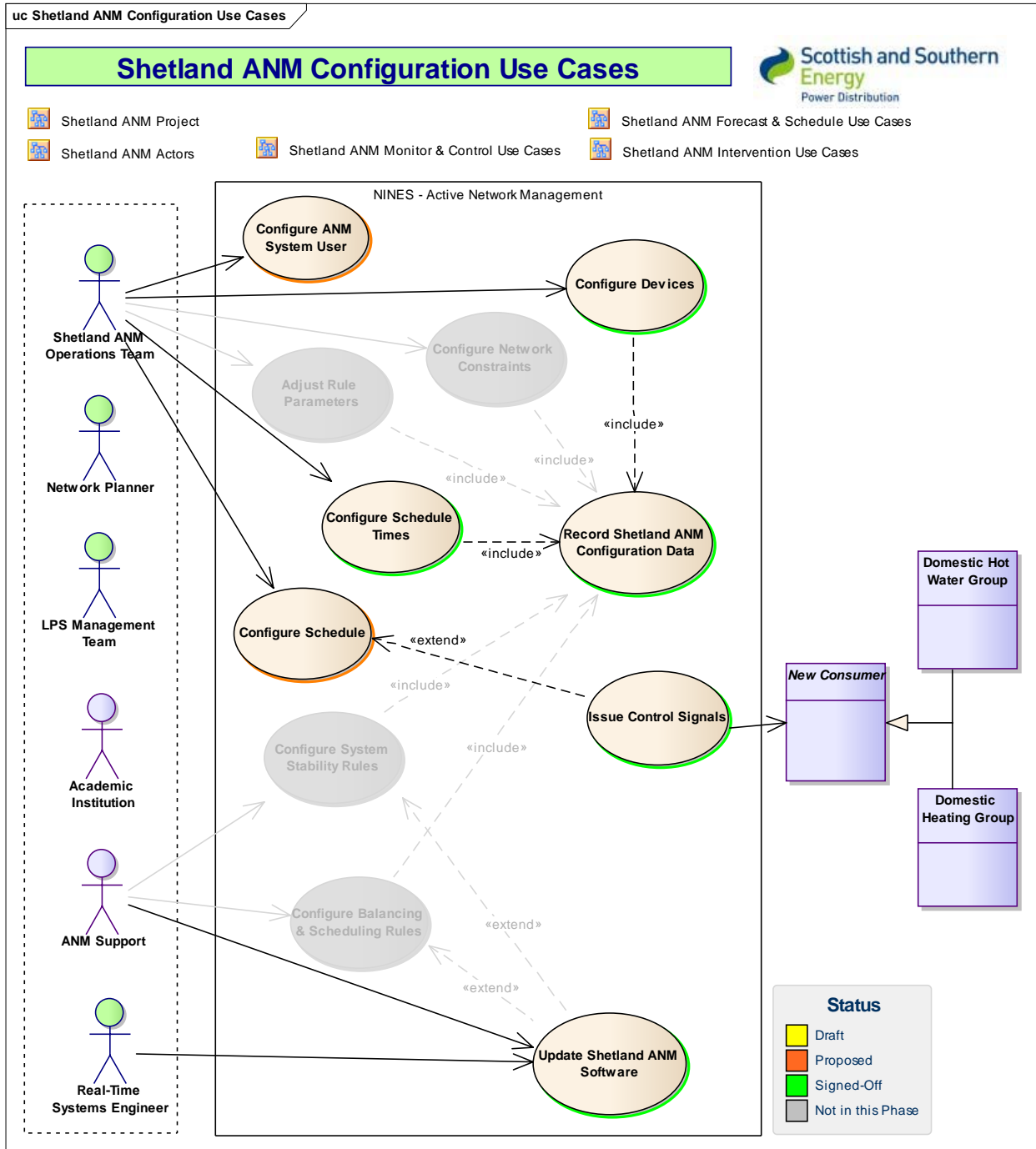
Actor	Definition
New Prosumer	An abstract actor representing any device on the network that provides both controllable demand and generation, this may be through storage.
Shetland ANM Operations Team	The Shetland ANM Operations Team is responsible for the configuration and control of the Shetland AMN scheme. They are responsible for the configuration of the device parameters and network constraint rules that determine the forecasting, scheduling and active control of the new generation, demand and storage devices on the network. This role may be initially performed by the NINES Design Authority in liaison with Academic Research Analysts who are constructing models and advising on rules.
Small Generation Group	Small Generation Group represents an energy generation capability provided by a group of small (>3.5kW and <50kW) renewable generators located in a zone on the network (e.g. community wind turbines).
Timer - Daily	A timer that is triggered on a daily basis (once per day).
Timer - Daily Schedule	A timer that is triggered daily at pre-defined scheduled times. It will trigger at least once per day but may be set to trigger multiple times. The timing can be user configured.
Timer - Real-Time	A timer that is triggered in a constant loop.
Weather Forecasting	Weather forecast data will be provided by an existing SSE Weather Forecasting System. This will include information on temperature and wind speed.
Wind Forecasting	An existing SSE Wind Forecasting System will provide an estimate of MW power output for wind turbines (both for groups of micro generation and larger wind farms). This estimate will take wind speed and turbine availability into account.

### 3 Use Case Model

[Use Case Diagrams](#) are used to model user/system interactions. They define behaviour, requirements and constraints in the form of scripts or scenarios.

#### 4 Shetland ANM Configuration Use Cases

This use case diagram describes a set of features that need to be provided by the Shetland ANM system in order to support the configuration of devices and rules.



### **Configure ANM System User**

The ANM Operations Team will be able to create new Usernames and Passwords and assign appropriate security level of access to the ANM System for users.

### **Configure Devices**

Allows the Shetland ANM Operations Team to use the ANM HMI to add or delete; or make updates to the parameters for an individual device (e.g. Battery) or group of devices (e.g. DDSM heaters in a zone on the network). In certain longer term network fault situations the Network Management Centre may request the Shetland ANM Operations Team to alter the device parameters for a period of time.

**Phase 1** will only provide:

- Configuration of reference schedules, frequency response characteristics and ramp rates
- update of existing device parameters (note that user will not be able to add or delete devices)

### **Record Shetland ANM Configuration Data**

The Configuration data entered to the Shetland ANM System will be captured in a way which supports a recovery process. A recovery may be required when an event occurs which results in the latest configuration data to be lost. This data is to be captured each time configuration data changes and be fully recoverable with support from ANM Support, RTS and Shetland ANM Operations Team.

### **Configure Schedule Times**

The Shetland ANM Operations Team will use ANM HMI to view and adjust the frequency of when Schedules are compiled.

The Shetland ANM Operations Team will use ANM HMI to view and adjust the delay time before the schedule is applied. This time delay is a configurable delay between the production of forecast and schedules and the application of the calculated schedule. This delay allows the LPS Shift Supervisor an opportunity to view the forecast and schedules and if required, escalate any issues to the Shetland ANM Operations Team.

**Phase 1** will only provide:

- delay value
- frequency value

### **Configure Schedule**

**Phase 1** of the project will allow the Shetland ANM Operations Team to view and edit the schedule values for a group of device types. The live schedule and two reference schedules known as the default and disable schedules can be viewed and updated.

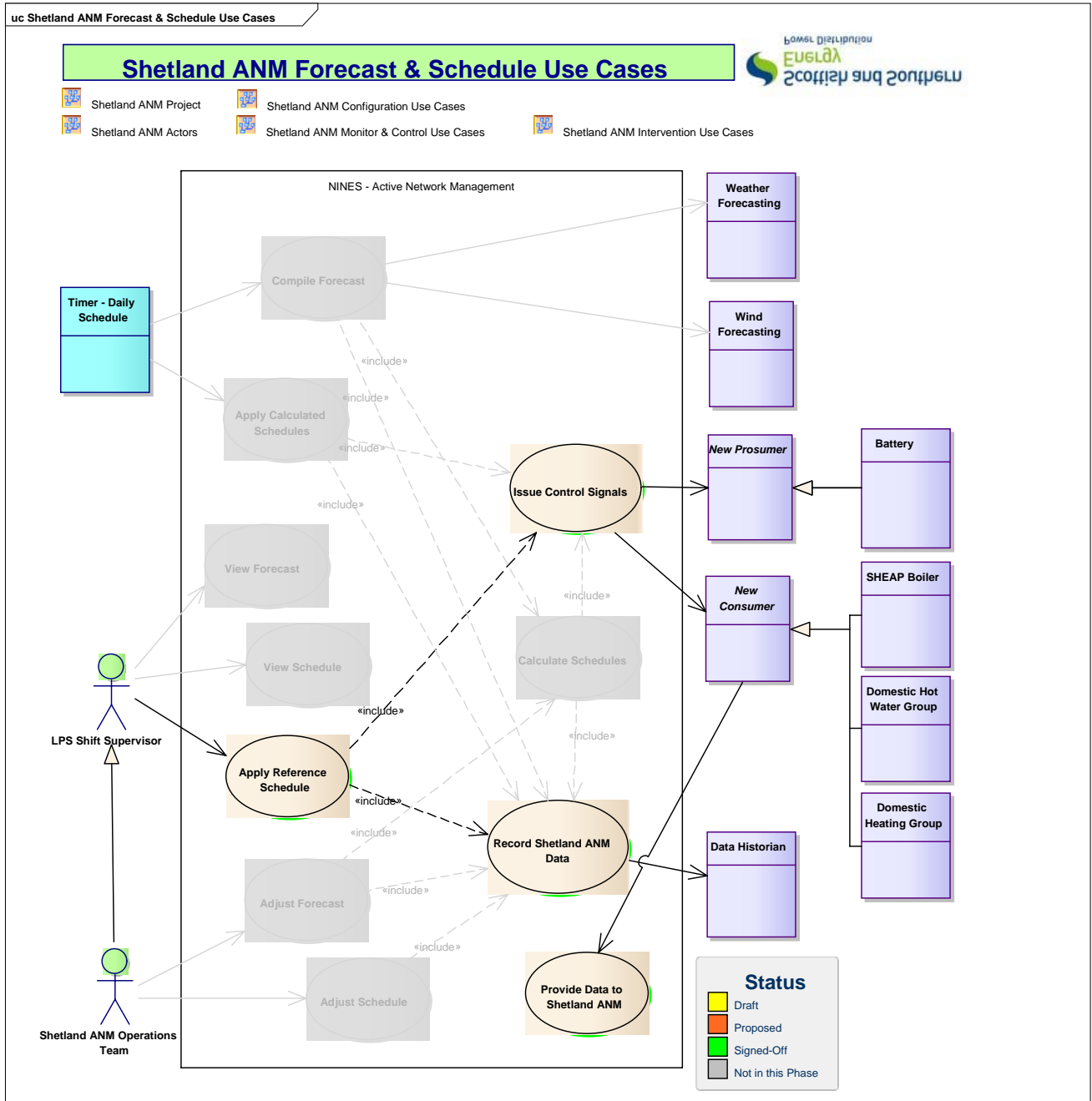
If any schedule values are updated, the schedule will be saved for use by the device group at a time in the future and the Shetland ANM Operations Team can also choose to issue the schedule immediately.

### **Update Shetland ANM Software**

Allows ANM Support to provide RTS with Shetland ANM System software upgrades and bug fixes. For example ANM Support may wish to release an updated software calculation module in response to new Academic models. The ability to enable SSEPD to roll back to an earlier version of software is also required.

## 5 Shetland ANM Forecast & Schedule Use Cases

This use case diagram describes a set of features that need to be provided by the Shetland ANM system in order to support the forecasting and scheduling of ANM controlled devices.



**Apply Reference Schedule**

Allows LPS Shift Supervisors to use Generation Control System and the ANM Operations Team to use ANM HMI to select and apply a predefined reference schedule to an ANM controlled device. This will be an action in response to an ANM Alarm or anticipated event such as the bi-annual clock change or holidays.

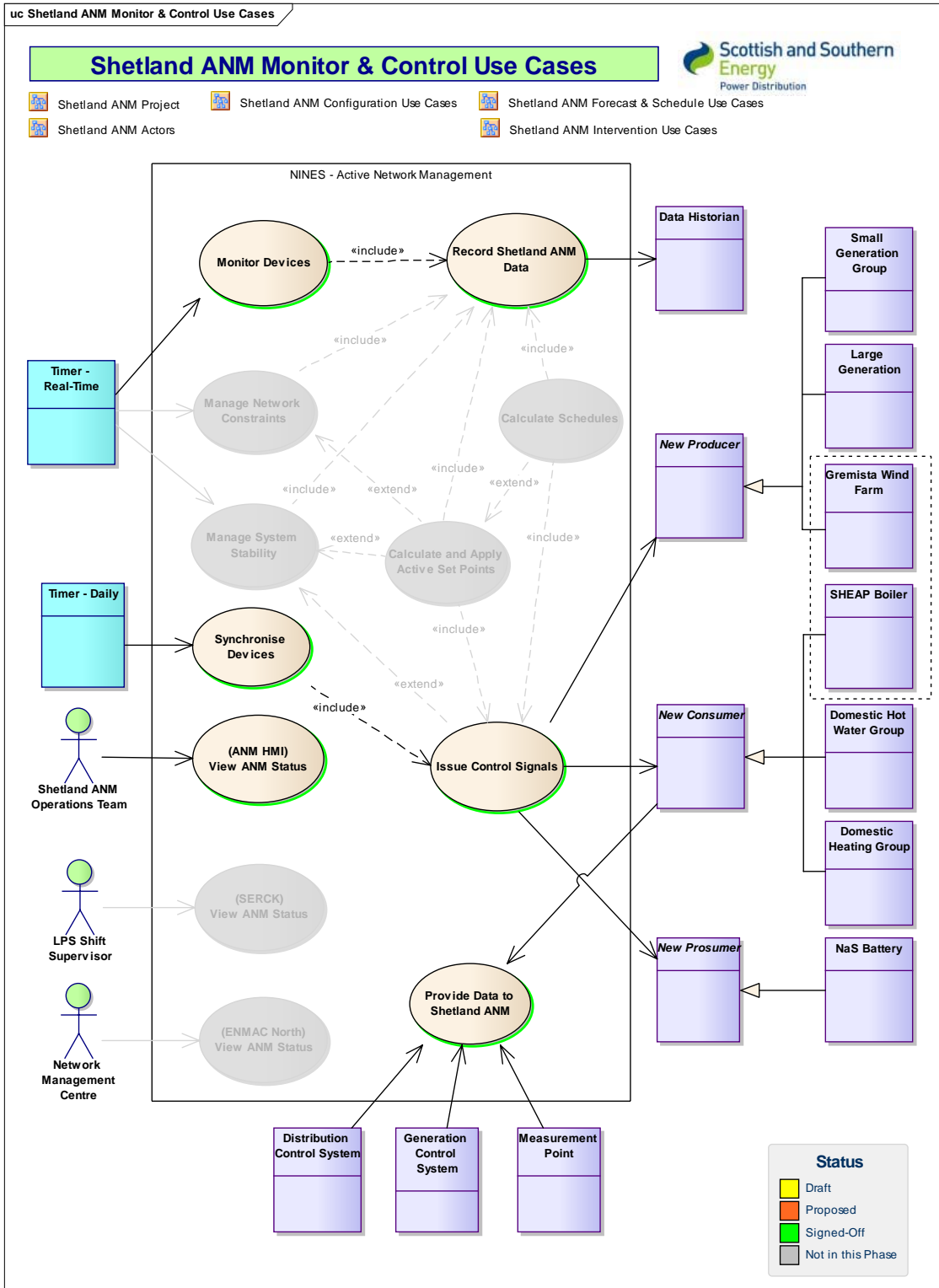
**Phase 1** will only provide:

- ANM Operations Team to use ANM HMI to select and apply a predefined reference schedule to an ANM controlled device



## 6 Shetland ANM Monitor & Control Use Cases

This use case diagram describes a set of features that need to be provided by the Shetland ANM system in order to support the automatic monitoring and control of the ANM scheme whilst providing visibility to LPS and Network Management Centre.



**Monitor Devices**

The Shetland ANM System monitors the condition of devices in terms of device parameters. The Shetland ANM System uses data provided by devices and aggregates, calculates or scales the data to determine the available resources for each of the ANM controlled devices.

Note: The information about the devices will have been fed from the devices to the Shetland ANM system as part of the Provide Data to Shetland ANM Use Case.

**Synchronise Devices**

On a daily basis control signals will be sent to all ANM controlled devices to ensure that they have the correct date and time, default schedules and default frequency response characteristics. This ensures that devices are synchronised with the Shetland ANM system.

**Phase 1** will only include:

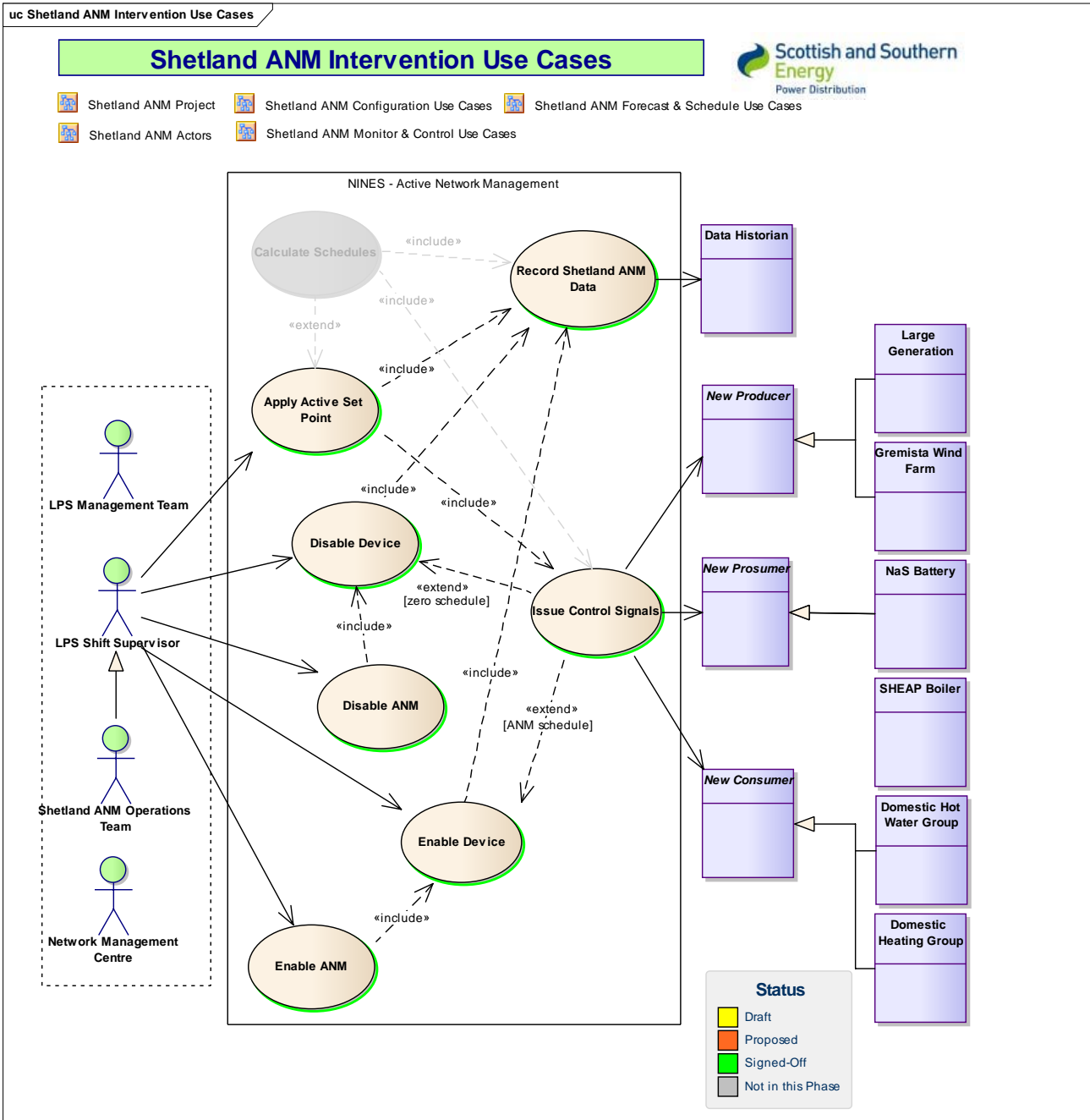
- Default schedules
- Live schedules

**View ANM Status ANM HMI**

Allows the Shetland ANM Operations Team to utilise the ANM HMI to view the communications health and detailed status information for each of the ANM controlled devices (including disabled/enabled status and available resources). Also displays all alarms and indicators raised by the Shetland ANM System. The ANM Operations Team will be able to acknowledge each alarm.

## 7 Shetland ANM Intervention Use Cases

This use case diagram describes a set of features that need to be provided by the Shetland ANM System in order to allow the LPS Shift Supervisors to intervene and override all or parts of the ANM scheme.



### **Apply Active Set Point**

Active set points are applied as a result of instructions from the Network Management Centre, Shetland ANM Operations Team or LPS Management Team (eg to curtail due to a network fault).

The LPS Shift Supervisor can use the Generation Control System to override the Shetland ANM System and apply an active set point to a specified ANM controlled device for a period of time. The Shetland ANM System will verify that the intervention is within the scheduling constraints and available resources and will warn of any conflicts.

Once the time period associated with the set point has elapsed, the Shetland ANM System will issue a control signal to release the set point allowing the device to revert back to its active schedule.

### **Disable Device**

The LPS Shift Supervisor using the Generation Control System and ANM Operations Team using ANM HMI can disable an individual device or group of devices,

A device can be disabled from the Shetland ANM Scheme as a result of instructions from the Network Management Centre (eg during maintenance) or the LPS Management Team.

### **Enable Device**

The LPS Shift Supervisor can use the Generation Control System to enable an individual device or group of devices.

A device will be enabled as a result of instructions from the Network Management Centre or the LPS Management Team.

### **Disable ANM**

The Shetland ANM System will be disabled in a black start situation (when the Shetland network has no power whatsoever). Disable ANM happens automatically when the network frequency falls below frequency parameters that are user configurable on the ANM HMI.

A Shetland ANM system collapse should not be reliant on frequency values recorded at a single measurement point on the network. The measurement points used to support an automatic 'Disable ANM' will be configurable by the Shetland ANM Operations Team using the ANM HMI.

Disable ANM can also be performed manually by the LPS Shift Supervisor using the Generation Control System, which may be in response to a request from the Shetland ANM Operations Team.

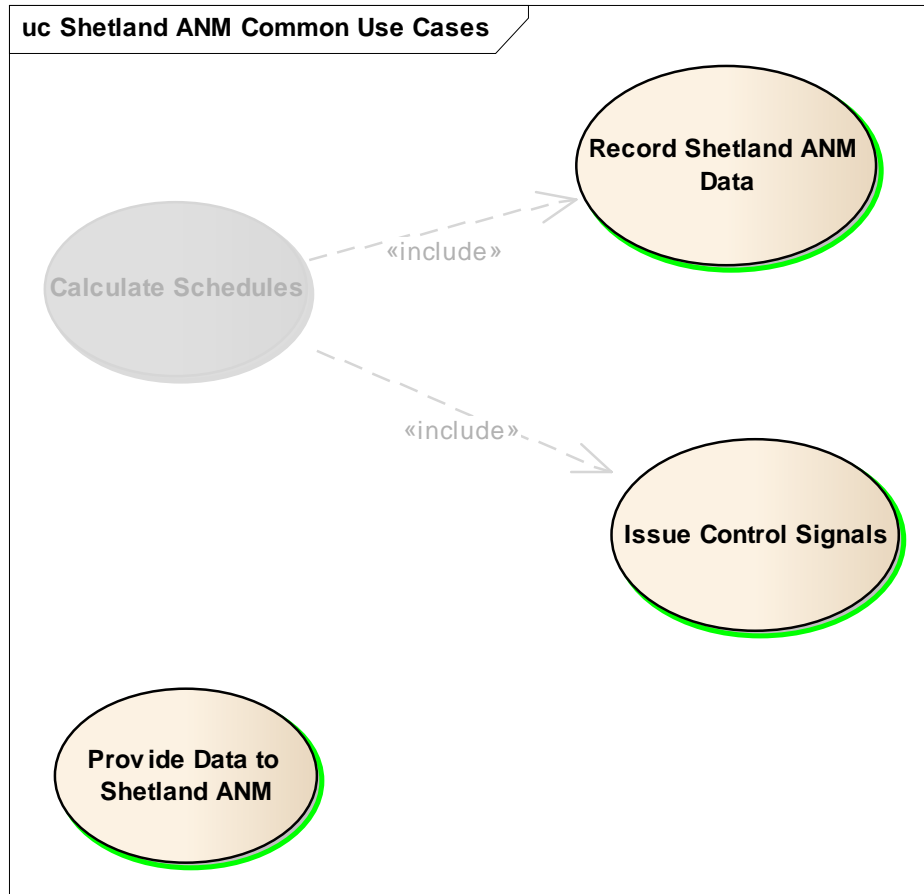
### **Enable ANM**

The Shetland ANM System will be enabled i.e. when the network has recovered from a black start situation or Shetland ANM System software upgrade is completed.

The LPS Shift Supervisor will wait until the network is operational and stable and then use the Generation Control System to enable the Shetland ANM System.

## 8 Shetland ANM Common Use Cases

The following use cases are reused across the set of ANM use case diagrams.



### Issue Control Signals

The Shetland ANM system issues control signals to groups of ANM controlled devices.

### Record Shetland ANM Data

Records in one place the following information to the data historian:

- Forecasts
- Schedules
- Active set points
- ANM system status

This Shetland ANM data is also required to be analysed and support reporting requirements and governance to ensure the ANM controlled devices are operating within the terms of their contractual agreements and to ensure the system is operating appropriately

**Provide Data to Shetland ANM**

ANM receives data from various systems and devices as follows:

- Network status data from the Distribution Control System
- Forecast data from Data Historian
- Devices status, communications health and available resources from ANM devices
- Constraint measurements from measurement points on the network

**Phase 1** will only provide:

- Devices communications health and available resources from ANM devices.