Scottish Hydro Electric Power Distribution

Proposals for the development of the Integrated Plan for Shetland

1. DEVELOPMENT OF THE INTEGRATED PLAN

1.1. During the latest Distribution Price Control settlement, a licence obligation was put in place which requires Scottish Hydro Electric Power Distribution (SHEPD) to present an Integrated Plan to manage supply and demand on Shetland. The Shetland Islands are not connected to the main interconnected GB electricity network and, as such, faces unique electrical challenges – but also a unique opportunity to decarbonise supply. Under the current licence condition, this Integrated Plan is to be presented to the Authority by 31st January 2013 and SHEPD will be required to demonstrate that it has identified a solution based on the lowest lifecycle costs and taking into account its environmental obligations.

1.2. As part of the Integrated Plan, SHEPD is considering, amongst other things, the upgrading or replacement of Lerwick Power Station, the impact of third party generation requirements, the abundance of renewable energy resources and the future demand on Shetland.

1.3. This consideration of the factors influencing the supply and demand issues on Shetland necessitates an innovative approach to their management. However, with innovation comes the need to trial solutions before reaching an answer. As a result, SHEPD propose to split the implementation of the Integrated Plan into two phases:

- Phase 1 (Northern Isles New Energy Solutions "NINES") – implementation of the infrastructure necessary to actively manage demand, generation, reactive compensation and energy storage assets. These elements will be coordinated to maximise the amount of energy harvested from renewable generation while maintaining supply quality and security. In doing so, two principal effects are achieved:
    - § a reduction in maximum demand; and
    - § a reduction in the electricity units generated by fossil fuels
- Phase 2 (Shetland Repowering) – upgrading or replacement of Lerwick Power Station, taking into account the learning acquired during Phase 1 and, where appropriate, extending the Phase 1 technology.

As a result, SHEPD require a change to their licence to facilitate the implementation of Phase 1 prior to 31st January 2013.

1.4. This paper constitutes SHEPD's proposal for Phase 1 of the Integrated Plan and seeks to -

- Outline the current arrangements and challenges on Shetland;
- Set out the Shetland Repowering considerations;
- Explain Phase 1;
- Set out the economic case for Phase 1; and
- Outline a mechanism to amend the current licence obligation to allow for Phase 1.

Phase 2 of the Integrated Plan will continue to be developed during the implementation of, and learning from, Phase 1. Phase 2 will be presented to the Authority in 2013 according to any revised licence condition or direction from the Authority.

2. CURRENT ARRANGEMENTS AND CHALLENGES ON SHETLAND

2.1. Supply and Demand

2.1.a. The Shetland Isles are located some 130 miles to the north of the UK mainland.

2.1.b. The islands are not physically connected to the GB electricity system and, as such, rely entirely on local sources of generation. The main generation sources are: Lerwick Power Station (LPS), a 67MW diesel-fired station; the Sullom Voe Terminal (SVT) Power Station, which has an installed capacity of 100MW, but currently exports, at most, 22MW to the Shetland system; and Burradale Wind Farm, a 3MW privately-owned wind farm. In addition, there are a number of small-scale community-based wind generators.

2.1.c. LPS is owned by SSE Generation and operated by SHEPD. The plant consists of two stations, 'A station' and 'B station', with six and three units respectively. 'A station' was first commissioned in 1953; 'B station' was commissioned in 1983. SHEPD calls on LPS to balance supply and demand on Shetland on an instantaneous basis and, in doing so, LPS is required to provide many of the ancillary services that would normally be offered to the system operator through a diverse plant portfolio; all of this places considerable demands on LPS. Given the age of the plant, LPS has become increasingly expensive to maintain and operate. Furthermore, it is becoming increasingly difficult to ensure environmental compliance in and around the station. The Scottish Environmental Protection Agency (SEPA) has granted LPS a number of derogations in terms of environmental compliance, most notably a relaxation of its emissions limits under the Large Combustion Plant Directive. However, these derogations are contingent upon clear steps being taken to either introduce adequate emissions controls or to replace the existing station.

2.1.d. SEPA is aware of the provisions within the current price control for SHEPD to come forward with an Integrated Plan, including Shetland Repowering by January 2013, and the nature and timescales of the derogations reflect this. It is not possible to retrofit the existing LPS in order to meet environmental standards due to constraints on the location and size of the site and the age of the existing engines. As such, this has not been considered an option to be put forward in the Integrated Plan. However, in order to set a benchmark for Phase 1 and Phase 2 of the Integrated Plan, we have estimated a cost for retrofit as if it would have been possible. This assumed cost is then used in the base case NPV calculation.

2.1.e. The SVT power plant is an independently owned gas turbine plant located in the north of the island. Its primary role is to supply the requirements of the Sullom Voe gas terminal, but through a commercial power purchase agreement with SHEPD, it also provides power to help meet the islands' wider energy requirements. The Sullom Voe plant is of a similar vintage to LPS and is anticipated to require refurbishment or replacement within similar timescales to LPS.

2.1.f. Burradale Wind Farm is located close to Lerwick. Burradale operates at an average output (capacity factor) of around 50% taken over a full year. Average European wind power capacity factors are closer to 20%. Burradale Wind Farm therefore ranks among the most effective wind farms in the world. In more recent years, the introduction of feed in tariffs, in particular, has increased the interest in these types of installations on Shetland.

2.1.g. Demand on the islands varies between 11MW and 48MW and much of this is concentrated in the main town of Lerwick. It is important to note that these demand figures exclude SVT's industrial demand, which at present is supplied directly by the terminal's on-site generation. If SVT is taken into account, the total island demand is within the range 31MW and 68MW.

2.1.h. Despite the Sullom Voe gas processing terminal, there is no gas supply on the island. The heat demand on the islands is therefore provided largely through oil boilers and electric storage heaters. For around 1,000 customers in Lerwick, their heating needs are met through the District Heating Scheme, which uses a waste to heat energy plant sited just outside Lerwick. This scheme is operated by Shetland Heat Energy and Power (SHEAP) Ltd.

2.1.i. Although the electricity supply in Shetland comes from only three sources, all customers on the island can still choose who they wish to be supplied by in exactly the same way as mainland customers. In this respect, Shetland customers are able to fully participate in the liberalised GB energy market and continue to benefit from retail competition.

2.2. **The Network**

2.2.a. On the mainland, transmission networks (those above 33kV in Scotland) collect power from generators and transport it to distribution networks, which then deliver the electricity to end customers. It is the responsibility of the GB System Operator, National Grid, to ensure that the power generated equals the power demanded.

2.2.b. However, as there are only lines of 33kV or below on Shetland, the existing network on Shetland is entirely at distribution voltages, i.e. the distribution network collects power from generators and delivers it to the

end customers. SHEPD owns and operates this network and, in the absence of a mainland link, provides a system operator role to maintain a balanced system. This role has always existed, but was more formally recognised at the introduction of the British Electricity Trading and Transmission Arrangements (BETTA) in 2005, when provisions were made within SHEPD's distribution licence to allow it to recover its resulting costs.

2.2.c. As with any network, maintaining the balance between generation and demand is critical. As Shetland is not connected to the mainland, the network must be balanced using only the assets available on the islands. In other words, at any given time, there cannot be more generation than demand, or vice versa, and to be able to achieve this a significant percentage of this generation must have a reliable and controllable output. At present, the balance is such that it is not possible to offer any new generation connections on the islands as there is insufficient demand to use the generation. The current mix of generating plant is not sufficiently flexible enough to cope with any additional intermittent renewable generation whilst maintaining network stability. This is particvulary true during the summer where the low demand on the islands makes it impossible to accommodate any further renewable generation. If new generation was to be introduced without equivalent new demand to warrant it, the system would become unstable and this would result in a loss of supply.

3. WIDER CONSIDERATIONS FOR SHETLAND'S ENERGY SYSTEM

3.1. We have already described the pressures facing the main sources of generation on Shetland. The islands' repowering is a unique opportunity to review the islands' arrangements as a whole and to develop an integrated solution designed to make the most of Shetland's renewable resources and reduce its dependency on thermal generation.

3.2. There are, however, a number of wider issues that need to be considered.

3.3. **Securing supplies to Shetland**

3.3.a. SHEPD have a licence obligation to ensure that supplies to Shetland are maintained to Engineering Recommendation P2/6. This recommendation states that, for a location the size of Shetland, there must be an alternative means of maintaining supply to the area in the event of a fault.

3.3.b. It is this obligation which fundamentally drives the requirement for a reliable and efficient local power station on Shetland, as opposed to relying on intermittent renewable generation, third party contracts or a single mainland HVDC cable link. These sources might form a part of the solution. However, to comply with P2/6, SHEPD must be sure that if any one energy source was not available, an alternative supply was there to be deployed.

3.4. **New demand**

3.4.a. The scale of any replacement thermal generation plant will be directly related to the islands' peak demand. Ignoring the industrial load at SVT, which is met by on-site generation, the islands' peak demand, at present, stands at 48MW.

3.4.b. Given our duty to offer terms for connection on request, and the lack of generation capacity to meet this demand, SHEPD will make any current demand connection offers contingent on the proposed mainland link. Going forward, there might be additional demand requirements and these should be capable of being accommodated by the Integrated Plan.

3.5. **Mainland link**

3.5.a. A plan to build a single circuit HVDC link to the mainland has been developed to facilitate the connection of proposed large-scale renewable generation on Shetland into the main GB system.

3.5.b. This link to the mainland is expected to operate with around a 98.5% reliability factor. Therefore, Shetland can expect a link to the mainland much of the time but must still have an alternative means of supply for the times when the cable is unavailable. This is particularly important as, due

to the challenges of access to subsea cables, repair of faults or routine maintenance in these kind of cable links are likely to be of a significantly longer duration than those on overhead lines.

3.5.c. The Integrated Plan is therefore necessary regardless of whether the mainland link exists or not to meet the requirement for a reliable local power supply. In particular, the learning from Phase 1 can be applied to any enduring solution, be it a full duty station or a standby station.

3.6. **Viking wind farm**

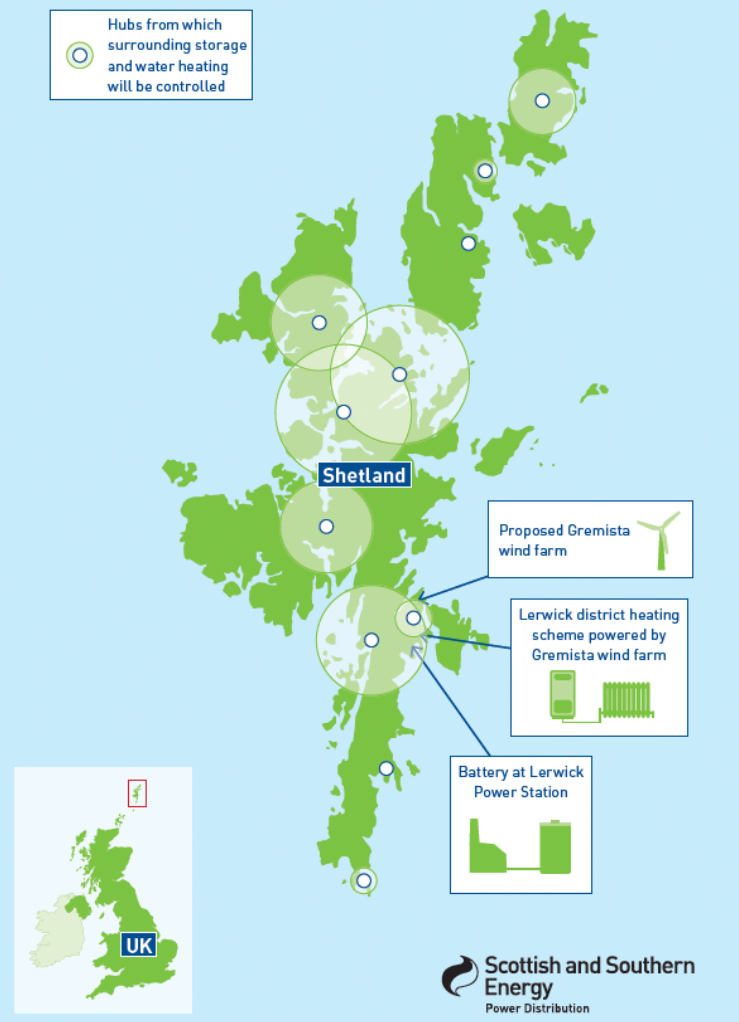
3.6.a. As mentioned in 3.5.a, there are proposals for a large-scale (around 450MW) onshore wind farm on Shetland. In light of these proposals, consideration has been given to the contribution that this wind farm could make to the continuation of supplies on the island during a fault on the mainland HVDC link.

3.6.b. Based on evidence from existing Shetland wind farms, it is anticipated that the output of this wind farm will be less than the demand on Shetland for up to 30% of the year. As such, this wind farm, on its own, is insufficient to secure supplies on the islands. In addition, it cannot be guaranteed to have sufficient output in the event of loss of the HVDC link.

3.7. New small and medium scale wind generation

Given the abundance of renewable resource on Shetland, there is significant potential for small and medium scale wind generation on the islands. The connection of this renewable generation is an important driver for the Integrated Plan.

4. PHASE 1 (NINES) OF THE INTEGRATED PLAN



4.1. Phase 1 of the Integrated Plan has been developed with the main aim of informing the optimum repowering solution. Whilst its primary objective will be to trial 'smarter' initiatives, importantly it will fund elements and infrastructure that we fully expect to endure as part of Phase 2 of the Integrated Plan.

4.2. The Phase 1 approach was previously explored in a bid, titled "NINES", under the Low Carbon Networks Fund (LCNF).

4.3. When reviewing the original "NINES" LCNF submission, Ofgem recognised the value of the project in addressing the current challenges on Shetland and noted that -"aspects of the NINES project solution could potentially provide a lower carbon and lower cost approach to meeting the energy needs of Shetland compared to replacing the ageing Lerwick diesel power station with a similarly sized diesel plant."

4.4. However, as compared with the previous incarnation of "NINES", the current Phase 1 approach, whilst technically identical to "NINES", has been

somewhat refocused on providing infrastructure and learning for Phase 2, rather than having a broader UK focus.

4.5. There has been significant support, both on Shetland and further afield, for what the original “NINES” project was intended to achieve. Given that the output, for the islanders, of Phase 1 will be very similar to the proposals in “NINES”, we intend to “brand” the Phase 1 approach as “NINES” in order to provide continuity.

4.6. Central to the project will be the creation of an integrated set of models designed to anticipate the impact of NINES. This set of models is expected to cover the following themes:

- Dynamic Stability modelling
- Steady State modelling
- Unit Scheduling modelling
- Customer demand forecast model
- System Development optimisation model
- Strategic Risk and Operational risk model
- Shetland Economic model
- Commercial model

4.7. During phase 1 these models will be validated to allow them to be used to inform phase to with the level of certainty that would be required for such a significant investment.

4.8. Facilitated by modelling and practical learning the aims of Phase 1 are to:-

4.8.a. Undertake specific projects that increase understanding of how best to accommodate Shetland’s significant wind potential on a small distribution network; and

4.8.b. Undertake specific projects that increase understanding of how the existing and known future demand on the island can be best managed on a constrained, isolated system.

4.9. The broader aim of Phase 1 being to inform the design of Phase 2 of the Integrated Plan and, specifically, through trial and learning optimise the supply and demand infrastructure on the islands.

4.10. There are six core elements in delivering the Phase 1 project and these elements are set out below. However, one of the key early outputs from Phase 1 will be a series of models. As stated earlier these models will serve to predict the behaviour of the energy systems on Shetland and will validate each of the key elements of Phase 1 as they are added. Following this validation process, these models will be used to reliably inform the design of any replacement of Lerwick Power Station. Overall, with the successful

operation of Phase 1, we expect to create the infrastructure and know-how to reduce the peak capacity requirement for any replacement power station by up to 20MW.

4.11. **1MW battery at Lerwick Power Station**

4.11.a. This 1MW battery will act as an energy storage system and will be energised in September 2011. In addition to facilitating the connection of new renewables, the battery will also seek to help to optimise and stabilise the operation of the existing island network by helping to reduce demand peaks. Initial models suggest, conservatively, that the battery can accommodate the connection of up to 400kW of new small scale renewable generation. As SHEPD gains a greater understanding of the battery's operational performance, it is envisaged that further renewables can be connected as confidence in the system and the associated models increases. Once commissioned, it will be the largest battery in use anywhere on the GB network.

4.11.b. The capital cost of the battery is being part funded by DECC via a Smart Grid Demonstration Capital Grant for £1.1m and £1m from SHEPD's First Tier Low Carbon Network Fund. The remainder will be funded through Phase 1 and the learning will inform the battery's role in the repowering solution (Phase 2 of the Integrated Plan).

4.12. **Domestic demand side response with frequency response**

4.12.a. SHEPD is working with Shetland Islands Council and Hjaltland Housing Association to install advanced storage heating and water heating in around 750 existing homes These new storage and water heaters (which will replace existing traditional storage heaters) are being provided through SIC, Hjaltland and ERDF funding and have been specifically designed to use a much more flexible electrical charging arrangement. This new charging arrangement will be determined based upon the predicted demand, weather forecasts, availability of renewables and any other network constraints.

4.12.b. These heaters will incorporate additional insulation to minimise heat loss and will be fitted with programmable timers to allow users much better control of temperature and operating times as compared with conventional storage and water heating systems.

4.12.c. The new heating system is anticipated to be more efficient, allows the customer full control of both temperature and operating time and equally allows for charging at times that best suit the network.

4.12.d. This initial roll out will help to gauge how effective storage and demand side response is at the domestic level. If successful, it is anticipated that this could be voluntarily extended up to a further 250 homes across Shetland and, ultimately, through customer choice, to all

electrically heated houses in Shetland. This can be achieved at relatively low incremental cost as the communications infrastructure and core Active Network Management scheme will already be in place to service the original 750 homes. It is anticipated that this will also give the opportunity to provide further learning on implementing these new storage heaters within the private sector.

4.12.e. The programme for the initial installation within the 750 properties is phased over the next three years. Therefore, extending this solution will form part of Phase 2 of the integrated solution and will be informed by the learning in Phase 1.

4.13. **Additional 'flexible' demand through 130MWh thermal store rated at 4MW**

4.13.a. Shetland Heat Energy and Power (SHEAP) is proposing to extend the existing Lerwick district heating scheme by installing a 4MW electrical boiler, which will be linked to a new thermal store capable of storing around 130MWh of hot water. The existing district heating scheme is currently supplied by waste heat from the islands waste to energy plant and also relies on significant quantities of oil to meet the requirements of the scheme.

4.13.b. The new boiler and thermal store will provide the capacity to extend the over subscribed district heating scheme and will also substantially reduce the current scheme's reliance on oil.

4.13.c. Aside from addressing the islands' oversubscribed district heating scheme, the real benefit offered by this arrangement is expected to come from the thermal store's ability to respond instantaneously to situations arising on the network. For example, if there is insufficient demand on the island system relative to generation, the intention is that SHEPD will be able to call on SHEAP's thermal store to increase island demand and 'soak up' the surplus generation, thereby helping to maintain a balanced system. Similarly, if the reverse situation arises, the intent is that SHEPD can ask SHEAP to withhold its demand until a time when the system is more able to accommodate it.

4.13.d. Clearly, for this to work, the commercial framework between SHEPD and SHEAP will have to reflect both the needs of SHEAP's customers, who are reliant on the thermal store for their heating and hot water, and the needs of SHEPD in terms of ensuring that SHEPD has this flexibility at times when it is of value. These arrangements will be informed by early modelling that is part of the Phase 1 project. The actual elements of this proposal are forecast to connect mid to late 2012 and, once connected, will be able to further validate the overall model that will inform Phase 2 of the Integrated Plan that is to be submitted to the Authority in January 2013. However, clearly, once installed this learning does not stop

and we envisage that we will be able to reflect further on this learning ahead of actual repowering during Phase 2.

4.13.e. To supply power for the boiler and thermal store, SHEAP is in discussions with SSE Renewables to bring forward a 6.9MW wind farm on adjacent land. The capital costs of the store and its onsite generation will be funded by the respective partners. This new wind farm will be connected to the boiler via a private electrical network, with any surplus electricity being exported to the grid. This will be a "managed connection" whereby the wind farm will only be able to export if network conditions are suitable. Additionally, taken together, the boiler and thermal store will be able to provide a range of ancillary services for both the new wind farm and also for other renewables.

4.13.f. Whilst the capital costs of the store and its onsite generation will be funded by the respective partners, the focus of the Phase 1 funding will be on understanding and testing the commercial agreements needed to make this arrangement work. Specifically, these arrangements will look to develop agreements for managed generation connections, flexible demand connections including ancillary services agreements and payments. If successful, these agreements will encourage other potential customers to come forward to provide connections on a similar basis which will help inform Phase 2 of the Integrated Plan.

4.14. **Renewable generation**

4.14.a. Shetland has some of the richest renewable resources in Europe and there is significant interest on the islands to connect a range of new renewable generators. These are primarily wind generators and range in scale from 10kW up to 7MW. However, this generation cannot connect to the current system due to the underlying voltage and stability constraints. Connecting more renewable generation, which is unavoidably intermittent, would exacerbate these problems.

4.14.b. To address this, Phase 1 will trial an active network management regime which will seek to offer renewable developers an earlier connection date. In return, they will be required to give their agreement to being constrained when the system cannot accommodate their generation. It is hoped that the measures that are being developed and trialled under Phase 1 will reduce this constraint by being able to actively provide demand when there is renewable resource available.

4.14.c. Indeed, these arrangements will be necessary even if Shetland is to become electrically connected to the mainland at some point in the future. Our understanding is that the economic case for a mainland link only allows for a single HVDC cable. If damaged, this could result in a prolonged outage, which would mean that Shetland would once again be electrically

islanded. Therefore, even then, the prospect of and ability to constrain will remain for generators on Shetland, albeit on a less frequent basis.

4.15. **Active Network Management (ANM) system**

4.15.a. This is the Phase 1 project's nerve centre: it will monitor the different parameters affecting the network, including embedded constraints, frequency stability and weather and will manage an appropriate response. It will also respond to, and tune, the models, which are being developed to monitor and understand how new storage assets will behave. This is being funded entirely through Phase 1, but will provide the core functionality for the enduring solution through Phase 2.

4.15.b. By creating flexible demand on the island we expect to be able to maximise Shetland's wind generation potential and minimise the need to install replacement thermal generation. Whilst the Phase 1 project will see an increase in the overall electrical demand on Shetland through the use of electricity rather than oil in SHEAP's existing district heating system, it will allow for a higher proportion to be delivered from renewable sources.

4.15.c. Initial studies suggest that it should ultimately be possible to reduce the peak demand by up to 20MW, facilitated through the elements set out above. This is primarily based upon the storage solutions and flexible demand offered through:-

- The new NAS battery at Lerwick Power Station (1MW of storage);
- The installation and active network management of storage and water heaters in 750 homes (which offers the potential to flex up to 15MW of existing demand); and
- SHEAP's thermal store and associated extension (funded by SHEAP and ERDF) to the current district heating scheme (which offers up to 4MW of flexible demand).

4.16. A key driver for the trial will be to look to understand how these elements work and interact in a real-life environment. Whilst in theory the above trial elements offer SHEPD up to 20MW of storage/flexible demand at any one time, the learning from Phase 1 will demonstrate to what extent this is actually available in practice. This will give SHEPD the confidence it needs in order to be able to incorporate these elements on a larger-scale as a part of the overall Shetland repowering proposal in Phase 2.

4.17. **Phase 1 learning relating to customer behaviour**

4.17.a. Phase 1 is focussed on providing demand side management and domestic storage through "passive" solution. Therefore, the requirement for customers to change their behaviour on a day to day basis is limited. However, customer behaviour is still a significant aspect of the learning in

Phase 1 and we hope to be able to answer the following questions as part of that learning:

- When provided with a more efficient heating system with more control, how will customers exercise this control?
- We would like to better understand the distribution of storage and consumption across the population of homes fitted with heating, as this will directly affect the range of flexibility we will have to balance the network.
- Given that the initial roll out of domestic heating and hot water systems is being subsidised through ERDF funding, what will the uptake of these systems be in a non-subsidised environment? Will customers choose this option as a natural upgrade to their home? What incentives might be required to facilitate this?

4.17.b. These answers will be used to validate the models created during the early stage of Phase1. The answers to these questions will directly influence the level of balancing that we can achieve from domestic energy storage and demand side management.

4.18. Importantly, the above initiatives as part of this first phase of Phase 1 target just 20% of customers on the islands. There is therefore scope to use the learning from this phase to provide wider benefits on the island. The wider potential for the storage and water heaters is, for example, already being explored. The key is that by using this first phase of Phase 1 to provide and verify the infrastructure and the impact of the Active Network Management solution, the incremental cost of widening the scope of the trial is minimal. It is therefore our view that a 20MW reduction in the peak demand is a realistic objective in terms of the full repowering solution.

4.19. As well as reducing the peak demand on the islands and therefore the size of any replacement thermal generation, the Phase 1 project also has wider benefits:-

- § Phase 1 will seek to significantly increase the volume of renewable energy that can be connected to the islands' network.
- § In the near-term, by "smoothing" the peak demand and increasing the amount of renewable generation on the islands, the requirement for LPS will be reduced. This will result in lower fuel costs and reduced operation and maintenance costs at Lerwick Power Station. It is estimated that the initial elements of the project committed during the Phase 1 deployment will result in an annual reduction in operating costs of approximately £1.1m per annum. This is reduction in costs expected to increase as Phase 1 progresses and more storage and renewables are connected.

- Phase 1 has already attracted a significant level of external funding (up to £21m), some elements of which are already approved and committed such as the c.£1m Smart Grid Demonstration Capital Grant Programme from DECC and the c.£2.4m from ERDF/Shetland Island Council and Hjaltland Housing Association for the energy efficient storage heating systems. Other partners, including Shetland Heat Energy and Power, SSE Renewables and Smarter Grid Solutions, continue to develop their elements of the project and are still fully committed to delivery of Phase 1. The involvement of these partners will ensure the earliest possible delivery of the elements of Phase 1.
- In addition, we believe that a good opportunity exists to access further external funding for Phase 2, should elements of Phase 1 form part of an innovative solution for this later stage. Compared with this more innovative approach, a more conventional solution is much less likely to attract external funding which would result in SHEPD customers having to pick up the excess costs of providing a supply on Shetland in full. This future external funding is not reflected in the cost analysis set out in Chapter 5.

4.20. The principle aim of Phase 1 (NINES) is to inform Phase 2. The effect of this knowledge will be to de-risk the decisions in relation to Phase 2

5. THE ECONOMIC CASE FOR PHASE 1

5.1. There are three clear parts to the needs case for Phase 1:

- Phase 1 impact on Shetland Repowering (LPS replacement);
- The de-risking of Phase 2; and
- The benefit of Phase 1 in reducing the cost of Phase 2

It is the benefit of Phase 1 in reducing the cost of Phase 2 which is considered in this paper. Assumptions have been made on how the cost of Phase 2 could be reduced and these will be verified by the Phase 1 implementation. At this point, prior to implementation of Phase 1, these assumptions are not definitive.

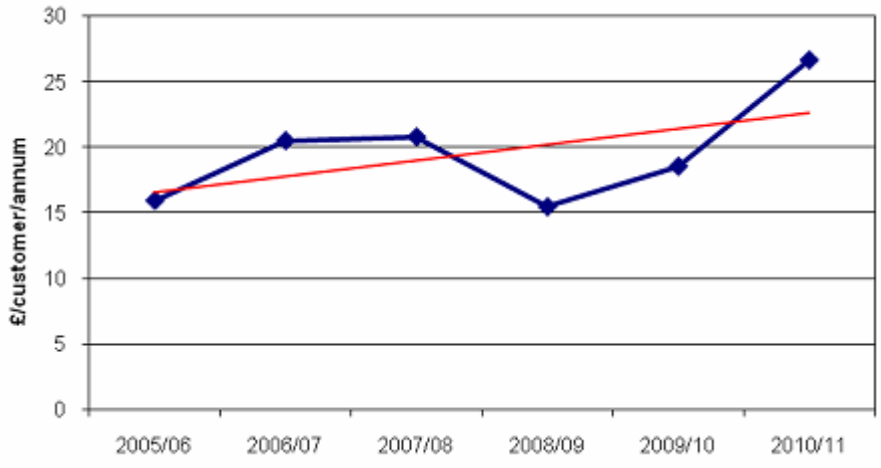
5.2. There are costs in funding the current arrangements on Shetland. In 2010/11, it cost £29m to provide supply on Shetland through Lerwick Power Station and the existing third party supply contracts.

5.3. In 2010/11, a third of this was recovered directly from Shetland customers through their electricity supply bills, although this does vary year on year depending upon mainland prices vis à vis the costs of providing a supply on Shetland. The remainder was recovered from customers connected across SHEPD's distribution network through a mechanism accommodated for under SHEPD's price control settlement. This mechanism helps to socialise the costs of providing an electrical supply to customers in a remote part of SHEPD's network and ensures compliance with the Common Tariff Obligation, which prevents electricity suppliers in the north of Scotland from charging comparable domestic customers different prices because of their geographical location.

5.4. In any one year, this Charge Restriction Condition takes account of Lerwick Power Station's capital and operating costs through a fixed allowance, the actual costs relating to LPS's fuel and environmental permits, and the actual costs of securing export from SVT's generation sets. The income associated with this generation, which is recovered through suppliers, is then netted off and the difference determines the excess costs of providing a balanced supply on Shetland. It is these costs that are recovered across all of SHEPD's customers.

5.5. On average, in 2010/11 the additional cost of providing a supply on Shetland resulted in an average cost across all customers connected to SHEPD's network of £27. This is a simple average based upon total cost divided by total SHEPD customers; this broadly ignores commercial customer and hence the cost to domestic customers will therefore be somewhat less. Nevertheless, while crude, this average cost illustrates the significant increase on previous years, as shown in Chart 1 below.

Chart 1: Average cost per SHEPD customer of funding the excess costs of balancing supply on Shetland



5.6. The slight dip in this socialised cost in 2008/09 and 2009/10 can be attributed to an increase in mainland supply prices relative to the costs of providing a supply on Shetland and a reduced call on the power purchase arrangement with SVT respectively. However, the general trend (red line) is an upward one, which reflects the increasing costs of operating and maintaining aging plant which, in turn, increases our reliance on third party contracts. It is this that has triggered the need to look at the options for Shetland repowering.

5.7. To this end, we have considered a number of different scenarios:-

(1) Replacing the existing LPS with a like for like replacement;

(2) As per (1) above, but with Phase 1;

However, neither of these scenarios address the concerns over the longevity of the existing third party contract arrangements. They both assume that the current contracts will remain available and at currently agreed prices.

Scenarios 3 and 4 remove this option of third party contract arrangements. They assume that no generation support will be provided by third parties and that such third parties achieve self-sufficiency in terms of their electricity needs. We believe these scenarios present not only the lowest cost solution, but also the most robust scenario taking into account the age of the current island generation.

(3) Meeting the islands' need for thermal generation (i.e. rather than intermittent renewable generation) through the replacement of LPS, i.e. removing the option of third party contracts;

(4) As per (3) above, but with Phase 1.

As previously stated in 2.1.d, refitting LPS is not an option.

5.8. We have based the modelling of each of these scenarios on the current mechanism that exists in SHEPD's licence, which accounts for the excess costs of balancing the Shetland system vis à vis the costs of providing a supply on the mainland (Charge Restriction Condition 4, Appendix 3, 'Calculation of Shetland balancing costs').

5.9. **Scenario 1: Replacing the existing LPS with a like for like replacement**

5.9.a. To model this scenario, we have applied a capital cost of £1,000/kW for a replacement station, giving an overall capital cost of £67m.

5.9.b. This scenario assumes that third party contracts continue to be available at their current capacity and price.

5.9.c. For modelling purposes, this capital cost has been accommodated through a RAV-based mechanism, whereby the upfront costs are recovered over a twenty year period. We have also included assumptions for this new plant in terms of its efficiency and operational and maintenance costs, which have resulted in running costs that are some 20% less than the existing LPS.

5.9.d. The net present cost of providing generation on Shetland under this scenario is £408m (over a 20 year period).

5.10. **Scenario 2: As per (1) above, but with Phase 1**

5.10.a. If we replace the existing LPS, but use Phase 1 to inform and provide the basis for a more innovative solution, the capacity can be reduced from 67MW to 48MW. In this scenario, the net present cost of providing generation on Shetland, despite the upfront cost of Phase 1 and assumed ongoing costs of maintaining this solution (we have, for example, factored in assumed costs relating to the need to pay flexible demand for any ancillary services and the need to retain and maintain the key systems), is some £8m less at £400m than scenario 1, over a 20 year period.

5.11. **Scenario 3: Meeting the islands' total demand for thermal generation through the replacement of LPS and removing the option of third party contracts**

5.11.a. This scenario presents the single thermal power station solution on Shetland, which we understand is the preferred solution of environmental regulators. Unlike the scenarios presented above, it removes the uncertainty around the enduring nature of existing third party contracts.

5.11.b. Importantly, this does not increase the requirement for installed capacity at LPS. LPS is already sized to accommodate the islands' peak demand (excluding SVT), but has become more reliant on third party contracts as LPS has aged and the requirement for greater headroom has

increased. A new 67MW station would be able to meet the islands' current peak demand of 48MW.

5.11.c. The net present cost of providing generation on Shetland under this scenario is £332m (over a 20 year period).

5.11.d. This marks a significant saving from scenarios 1 and 2, and indeed the current arrangements. As such, it clearly demonstrates the case for a single power station solution rather than the ongoing reliance on more costly and uncertain commercial third party contracts.

5.12. **Scenario 4: As per (3) above, but with Phase 1**

5.12.a. If we assume the same approach as scenario 3, but use Phase 1 to inform and provide the basis for a more innovative solution, the capacity of the replacement LPS can be reduced from 67MW to 48MW. In this scenario, the net present cost of providing generation on Shetland falls further to £323m (over a 20 year period).

5.12.b. This saving reflects the reduced capital cost of a smaller (in this case, 47 MW) station, which is solely facilitated by the Phase 1 project.

5.12.c. The following table aims to summarise each of the above scenarios and set them against the costs of providing the existing, albeit non-compliant and non-sustainable, arrangements. This shows the replacement of LPS to be more economic than the current arrangements and Phase 1 improves this further.

Table 1: Summary of Base Case and 4 scenarios

	Total NPC (at 4% post tax real) of providing supply on Shetland (£m)
Base case: Based upon 2010/11 actuals. Note this is non-compliant and is not enduring.	£440m
Scenario 1: Replacing LPS with a like for like replacement.	£408m
Scenario 2: Replacing LPS with a like for like replacement, but using Phase 1 to inform and provide the basis for this solution.	£400m
Scenario 3: Removing the reliance on third party contracts through LPS' replacement.	£332m
Scenario 4: Removing the reliance on third party contracts through LPS' replacement, but using Phase 1 to inform and provide the basis for this solution.	£323m

5.12.d. Importantly, this analysis ignores any potential for further external funding as part of the enduring solution. However, by pursuing a Phase 1 approach as part of the Integrated Plan, we believe there is a real opportunity to access further external funding in much the same way as we have been able to do to date. This would directly reduce the costs to SHEPD customers and we are committed to exploring this further in the run

up to the submission of our Integrated Plan. Crucially, this opportunity does not exist if we do not pursue the Phase 1 solution.

5.12.e. The above analysis clearly sets out that through a reduction in peak demand and active network management, Phase 1 will result in a lower cost, viable solution to Phase 2 of the Integrated Plan.

5.12.f. The benefit is primarily related to a reduction in capacity of the new LPS. This is assumed to be 20MW. However, as the Phase 1 proposals are innovative and have not yet been fully implemented, it is possible that a full 20MW benefit may not be realised. In order for NINES to break even against only an LPS replacement (in terms of its net present cost), a capacity reduction of around 15MW is required.

6. PHASE 1 FUNDING MECHANISM

6.1. The 2010-15 Distribution Price Control Review (DPCR5) acknowledged the issues with maintaining a secure electricity supply on Shetland and the restrictions on future demand and generation connections. To address these issues, the DPCR5 settlement put in place a framework for SHEPD to present to the Authority an integrated island solution in January 2013 :-

"We will require SHEPD to present an Integrated Plan to manage supply and demand on Shetland to the Authority by 31 January 2013. Such a plan must demonstrate that SHEPD has examined all available options to find the most efficient solution, and that this has involved competitive processes including tenders and development of partnerships and work with local communities. The plan should identify a solution based on the lowest lifecycle costs, taking into account environmental obligations.

The re-opener will be based around the development of an incentive mechanism to ensure maximum efficiency. Some form of pass-through may still be necessary for costs completely out of SHEPD's control. However, SHEPD will have to demonstrate that it has used best endeavours to minimise all uncontrollable cost components, including by negotiating solutions that pass through or share cost risks with counterparties. Both the structure of the incentive mechanism and the need for any pass-through mechanism will be decided at the time of the re-opener depending on the type of the solution proposed by SHEPD in its Integrated Plan."

(Page 89-90, Final Proposals - Allowed Revenue - Cost Assessment)

6.2. This policy is set out in Charge Restriction Condition 18A of SHEPD's distribution licence ("Arrangements for the recovery of costs for an Integrated Plan to manage supply and demand on Shetland").

6.3. At the time of the DPCR5 Final Proposals, it was envisaged that the Integrated Plan would be presented as a fully formed solution in 2013. The development of this Plan would take place in 2010-12 and the DPCR5 settlement put in place a mechanism for the "logging up" of efficient development costs incurred in that period. Consistent with the regulatory principle that "logged up" costs are of a minor nature, this development work was expected to be low cost, largely desktop based assessment.

6.4. However, since then, SHEPD has developed the Phase 1 approach. Phase 1 is more than a desktop development exercise. Rather, Phase 1 represents, in effect, the first stage of the Integrated Plan. Through implementing the Phase 1 approach, the network on Shetland is being developed to accommodate an enduring 'smart grid' solution and, in the short term, relieve

the pressure on LPS. Most importantly, Phase 1 will provide real learning to inform the second stage of the Integrated Plan.

6.5. Phase 1 advances SHEPD's work to propose an Integrated Plan for Shetland Repowering. The DPCR5 settlement required SHEPD to bring forward a plan in 2013 following a period of low cost assessment work. The Phase 1 project allows SHEPD to instead bring forward the first stage of development in 2011 to inform, and thus increase confidence in, a second stage of development in 2013. As described above, this is of real benefit to consumers. In light of this, SHEPD requests that CRC 18A is amended to reflect two-stage implementation of the Integrated Plan.

6.6. The proposal to amend CRC 18A to introduce a first stage to the Integrated Plan will provide certainty in funding and process. At present, SHEPD and its partners are incurring costs on a 'good faith' basis in order to keep Phase 1 on track. This is not sustainable. The project needs certainty over its method and level of funding, and the timetable for development, in order to progress and to maintain the commitment of its partners.

6.7. The cost profile of delivering Phase 1 is set out in Table 2 below. Importantly, whilst this phase will cost £35m in total to deliver; SHEPD customers will fund less than half of this.

Table 2: Phase 1 cost profile

£m (10/11 prices)	10/11	11/12	12/13	Total
Total	3.85	19.20	11.90	34.95
External funding	2.20	11.76	5.24	19.20
SHEPD customer funding	1.65	7.38	6.30	15.33

6.8. The regulatory funding allowance for Phase 1 of the Integrated Plan will equal the 'SHEPD customer funding' set out in Table 2.

6.9. SHEPD proposes that CRC 18A is modified to allow cash allowances of £15.33m in 2012/13 (in 2010 prices) for Phase 1 of the Integrated Plan. This constitutes a single cost to SHEPD customers of approximately £20 per customer in 2012/13, which represents approximately 1.7% of the average customer bill.

6.10. To protect customers from potentially inefficiently incurred costs, it is proposed that Ofgem review actual expenditure relative to allowance as part of the Phase 2 assessment process. This would allow for a 'true up' of costs with a 50% sharing factor applied to any efficient overspend or underspend relative to allowance.

6.11. Importantly, whilst the risk inherent in Phase 1 is mitigated by the use of technologies that have been proven elsewhere in the world, there is a risk in

bringing these technologies together and gaining first hand experience of how they interact at the proposed scale. This uncertainty is inherent in any innovation and it is important that this is recognised.

6.12. At the end of the Phase 1 project, 31 March 2013, SHEPD's delivery of the first stage of the Integrated Plan will be assessed against a number of output measures. These measures will reflect the key project milestones.

6.13. Proposed output measures are:-

- Installed storage: 1MW of storage to the Shetland system through the NAS battery and new domestic storage heaters for 400 homes.
- Managing demand: first stages of an active network management system, i.e. one that actively manages the NAS battery and domestic storage heaters and enables monitoring of the Shetland system to facilitate a coordinated, active response.
- Commercial innovation: a framework that facilitates and promotes the effective provision of managed demand connection.
- Phase 2 learning: develop and begin to validate a model of the Shetland system to accurately determine the application of Phase 1 learning of the Integrated Plan.
- Disseminate that learning to interested parties.

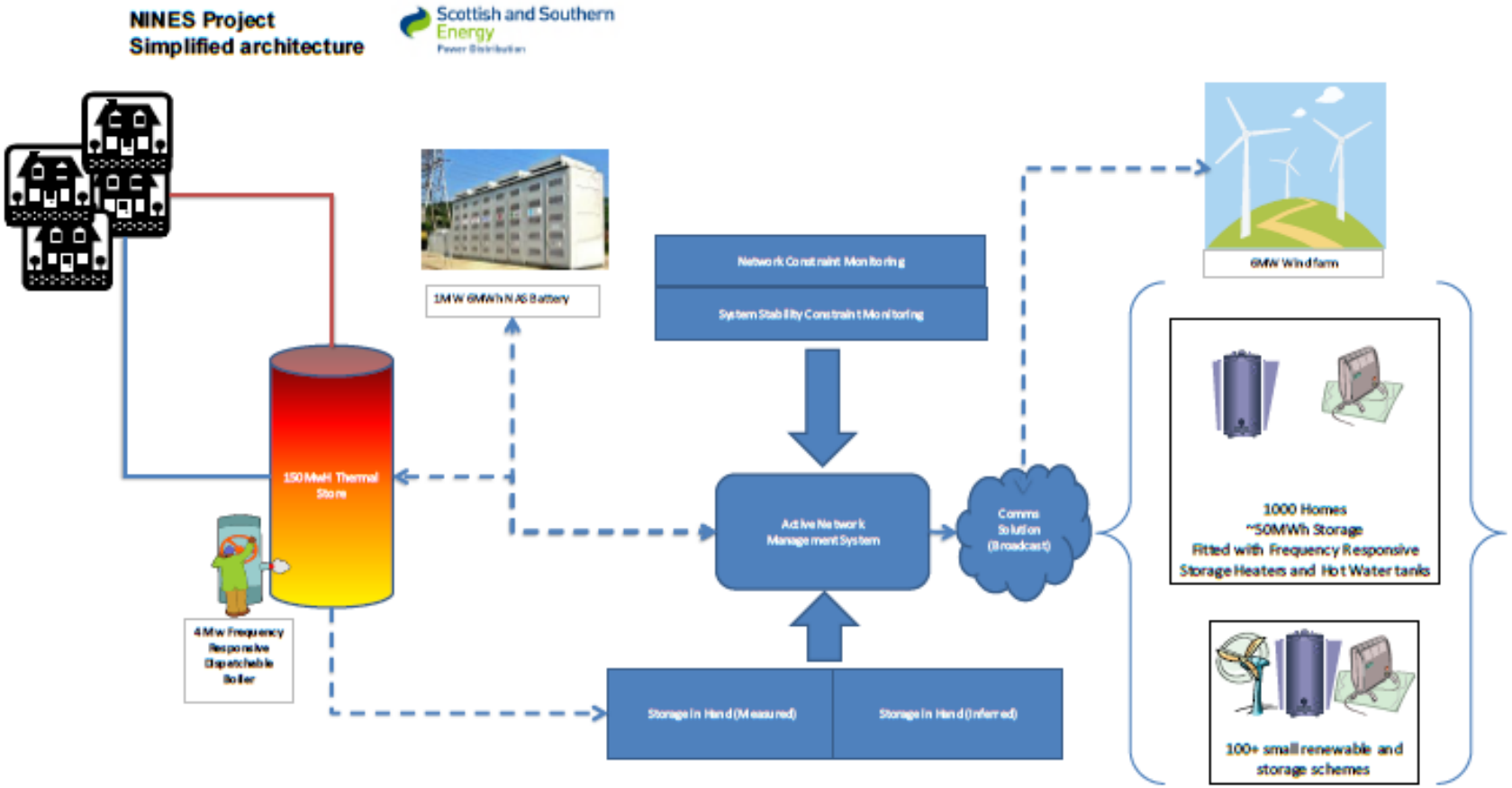
6.14. As with the Low Carbon Network Fund, it is important that SHEPD is not unduly exposed to penalties as a consequence of trialling innovation. The focus of any incentive must be on driving the right behaviours, which in this case is ensuring that customers are not exposed to rising or inefficient costs, and SHEPD is given sufficient reward to drive it to take all reasonable steps to deliver the desired outputs. To this end, we propose a simple mechanism, whereby SHEPD is subject to the following rewards / penalties in return for its delivering against the below listed measures:-

Table 3: Output Measures

OUTPUT MEASURE (as a percentage of customer funding)	UPSIDE	DOWNSIDE
Installed storage: 1MW of storage to the Shetland system through the NAS battery and new domestic storage heaters for 400 homes	1%	-1%
Managing demand: first stages of an active network management system, i.e. one that actively manages the NAS battery and domestic storage heaters and enables monitoring of the Shetland system to facilitate a coordinated, active response	1%	-1%
Commercial innovation: a framework that facilitates and promotes the effective provision of managed demand connection	1%	-1%
Phase 2 learning: develop and begin to validate a model of the Shetland system to accurately determine the application of Phase 1 learning of the Integrated Plan	1%	-1%
Disseminate that learning to interested parties	1%	-1%

7. CONCLUSION

7.1. The implementation of Phase 1 of the Integrated Plan (the "NINES" project) is an excellent opportunity to trial an innovative approach to active network management on an isolated system. This is also the ideal time and unique opportunity to commence the project as change is already imminent on the islands, ahead of Phase 2 of the Integrated Plan. Using the learning obtained from Phase 1, Phase 2 of the Integrated Plan will deliver a more informed and cost-effective solution to Shetland Repowering and will ensure a best-fit for consumers both on the islands and GB-wide.


NINES Project
Simplified architecture
Scottish and Southern Energy
Power Distribution
1MW 6MWh NAS Battery
6MW Windfarm
Network Constraint Monitoring
System Stability Constraint Monitoring
150 MwH Thermal Store
4 Mw Frequency Responsive Dispatchable Boiler
Active Network Management System
Comms Solution (Broadcast)
Storage in Hand (Measured)
Storage in Hand (Inferred)
1000 Homes
~50MWh Storage
Fitted with Frequency Responsive Storage Heaters and Hot Water tanks
100+ small renewable and storage schemes