IS Connection Options Summary

Executive Summary:
The objective of this work stream is to shed a light on the necessary reinforcement's on the transmission system in Iceland for operating the proposed IceLink interconnector between Iceland and GB.

The focus of this work stream is on connection point of the link to the grid in eastern Iceland. This has been decided in collaboration with Landsvirkjun and National Grid. Necessary reinforcements, with respect to other landfall options (i.e. southern and south-eastern Iceland), have previously been analyzed (report in Icelandic from October 2012).

To be able to supply the proposed power for the IceLink interconnector, approximately 1,000 MW, new transmission lines will have to be built. Furthermore, given the present market situation, i.e. with respect to current power production capacity and consumption pattern, only a small excess power is available to supply the link, therefore it is assumed in the analysis that new power plants will be built.

Load flow simulations have been carried out with three different scenarios of system reinforcement to see to what degree the system needs to be strengthened for each scenario. All new transmission lines are either built/operated at 220 kV or 400 kV using AC-technology. The scenarios are outlined in the following table:

Scenario#	Number of new transmisson lines	Total length of new transmission lines (km)	Total cost range, incl.substations etc. (bISK)
1	3	320	38 - 64
2	4	400	43 - 71
3	6	530	53 - 99

Dynamic studies are carried out as well to see how fast the exchange through the IceLink interconnector can change from full export to full import.

Finally, a cost assessment of the proposed reinforcements necessary for supplying IceLink is presented. These proposed reinforcements are the extra reinforcements, considered necessary for the IceLink, beyond the reinforcements proposed in Landsnet's System Plan report. The cost associated with the reinforcements should be considered as indicative, since, normally, there is more than one way to strengthen the system such that the desired capacity and reliability of delivery to the link is achieved.

The load flow results show that, with 800 MW power demand of the interconnector, at least two 220 kV transmission lines are required from the southern part of the grid to the connection point of the interconnector. In all three scenarios analysed, units for reactive power generation (such as Static Var Compensators (SVC)) are required, of the size of 50-200 MVAR, to keep the voltage level within operational limits.

With 1,000-1,200 MW power through the interconnector, 220 kV transmission lines are not an option as they get heavily loaded and require large SVC units to keep the voltage level within operational limits; instead two 400 kV transmission lines are required from the southern part of the grid to the landfall. With 400 kV transmission lines the voltage level is within operational limits and limited SVC units are required.

During ramp down of load connected to the interconnection, ramping rate is mainly dependent on system status at each time and how quick system operators can decrease production and disconnect production units from the grid.

During ramp up of load connected to the interconnection the ramping rate varies depending on the range of the demanded ramp up power. During startup of load, from zero to full power (0-1,200 MW) the ramping rate should not exceed 30 MW/min due to frequency drop in the power system. During ramp up in a degree of 50-300 MW total the ramping rate should not exceed 60 MW/min in order not to jeopardize the system stability.

The estimated extra cost for the proposed system strengthening when exporting 800 MW through interconnection is in the range of 20 – 30 billion ISK, depending on the chosen line route. The estimated cost, when exporting 1,000-1,200 MW through the interconnection, is in the range of 40 – 80 billion ISK. As before this is the additional cost on top of the cost of reinforcing the central grid. These cost figures are to be handled with the same proviso as above.

Background:
The transmission capacity between regions in the present Icelandic transmission system is insufficient due to low capacity of transmission lines between the northern and south east part of Iceland.

Landsnet has put forth a ten years network plan (i.e. the System Plan report), illustrating two main scenarios of reinforcing the transmission system. This work stream focuses on proposed reinforcements, in addition to these, needed to supply power to the IceLink interconnector with N-1 delivery reliability.

Next steps:
In the present study only one landfall case is presented. Also, only one production scenario has been analyzed. Exact location and size of new generating plant has not been included in the study, thus the cost of connecting these to the transmission grid is not included in the cost assessment. The characteristics of the new power plants are also not known in detail. The operating modes of the new plants are of importance, e.g. to what extent the plants are hydro power, geothermal or wind. The hydro power plants have some more advantages for following the load pattern of the link.

Also not included in the cost assessment is the cost of connecting the link itself to the transmission grid.

GB Connection Options Summary

Executive Summary:

To identify the preferred connection point to the GB Transmission System, National Grid Electricity Transmission (NGET) was approached to undertake a feasibility study to arrive at the most appropriate connection location. Initially 11 locations across the NGET, Scottish Power Transmission (SPT) and Scottish Hydro Electric Transmission Limited (SHETL) networks were identified and evaluated, and from these 6 locations were progressed into a full cost-benefit analysis. The three Transmission System Operators (TSO) undertook a detailed feasibility study.

In parallel to the TSO studies, environmental consultants were employed to assess the potential connection sites to validate that the potential areas were suitable for a HVDC converter together with achievable cable corridors.

From the feasibility study and the work undertaken by the environmental consultants a number of locations were identified as not being suitable for a grid connection in GB. A number of connections points are still deemed viable and the project partners are undertaking an updated review of these options.

In terms of obtaining a grid connection the process is very well defined and understood. Once a grid connection application has been made to NGET, they have 3 months to provide an connection offer which is valid for 3 months. The developer must either sign the connection offer within 3 months or the offer lapses.