Network Innovation Competition Full Submission

Supplementary Answer Form

Tick if this answer is Confidential: ☐

Tick if this answer has been provided verbally: ☐

<table>
<tr><td>Project code:</td><td>SSEEN01</td><td>Question Number</td><td>22</td></tr>
<tr><td>Question date</td><td>3 September 2013</td><td>Answer date</td><td>5 September 2013</td></tr>
<tr><td>Submission section question relates to</td><td colspan="3">Section 2</td></tr>
<tr><td>Topic</td><td colspan="3">Project description</td></tr>
<tr><td>Question</td><td colspan="3">What are the agreed project priorities and required MTTE capabilities? In particular, what is the balance between real-time control/protection studies and offline transmission planning studies in the overall functionality of the facility?</td></tr>
<tr><td>Notes on question</td><td colspan="3"></td></tr>
<tr><td>Answer</td><td colspan="3">The MTTE's project priorities are to maximise the benefits of the significant expected investment in HVDC systems in GB, by:
Supporting transmission planning and improve specification of HVDC schemes;
Facilitating multi-terminal solutions;
De-risking control interactions between multi-terminal and electrically connected converters, and with other active controlled equipment;
Facilitating competition and multi-vendor HVDC schemes;
Training and developing Transmission Planning and Operational Engineers;
Undertaking post-commissioning scenario planning and operational optimisation;
Modelling new HVDC technologies.
To achieve this, the MTTE requires the following capabilities:<table><tr><th>Project Priority</th><th>MTTE Capabilities</th></tr><tr><td>Supporting transmission planning and improve specification of HVDC schemes</td><td>• The ability to model complex HVDC schemes (and the associated AC network) under a comprehensive range of operating conditions to ensure the optimum balance</td></tr></table></td></tr>
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	of security, efficiency and reliability. • The ability to test and study the control, protection, interactions and operational issues associated with the DC and AC systems. • The ability to assess the impact of planned HVDC systems alongside future expansions. • The ability to model the details of HVDC systems, which will enable more accurate specification of the requirements, to reduce the risks and ensure value for money on HVDC schemes.
Facilitating multi-terminal solutions	• The ability to simulate 3, 4 & 5 terminal multi-terminal schemes. • The ability to incorporate replica control panels of HVDC links to improve the accuracy and therefore confidence in the results of the studies performed. • The ability to provide investment level confidence in the operation and interactions of multi-terminal schemes.
De-risking control interactions between multi-terminal and electrically connected converters, and with other active controlled equipment	• The ability to test control interactions in a safe environment, using replica panels to accurately simulate responses, to mitigate the risk of adverse control interaction in the live system. • The ability to simulate: the AC network (as a reduced equivalent model), LCC/VSC and VSC MMC Converters, SVC (TCR + TSC) and STATCOM devices, wind turbine generators, and the complex interactions between these devices in electric proximity. • The ability to simulate the impact of the connection of offshore renewable projects prior to construction.
Facilitating competition and multi-vendor HVDC schemes	• The ability to test the interactions between the control and protection systems from different suppliers utilising replica control panels. • The ability to demonstrate the interoperability between suppliers' equipment. • The ability to demonstrate the operation of equipment from new entrants to the European market. • The ability to undertake Acceptance Testing of multi-vendor HVDC systems and/or electrically connected systems (e.g. co-located).
Training and developing Transmission Planning and	• The ability to train staff on the operation of the system, during the lifetime of the scheme, in a 'safe' simulated environment,

	<table><tr><td>Operational Engineers</td><td>with access to replica control panels identical to those in operation.</td></tr><tr><td>Undertaking post-commissioning scenario planning and operational optimisation</td><td>• The ability to optimise the performance of the HVDC systems using replica equipment. • The ability to run multiple scenarios to optimise the performance of the overall network as well as the HVDC scheme, within a safe simulated environment. • The ability to simulate the impact of control and protection system software changes/updates in a safe environment.</td></tr><tr><td>Modelling new HVDC technologies.</td><td>• The ability to study and assess the impact of future developments in HVDC technology as they are brought to market.</td></tr></table> **Balance of Real-time and Off-line Studies** • Digital models, as developed in the off-line studies, are by their nature "perfect", but are often found wanting when confronted by the reality of the physical implementation in a control cubicle as tested in a laboratory or ultimately in the field, hence the need for real-time Factory System Testing (FST). • The MTTE will be able to perform FST on multiple HVDC controllers, sourced from multiple vendors. However, this does not preclude the need for off-line studies to be performed, either within the MTTE or in the owner's planning department, to provide checks on the results achieved in the testing of replica control panels. • It is normal practice to create a reduced model of the AC transmission network, using off-line study tools, to minimise the computation duty on the real-time computer processors. • Validation studies need to be performed to ensure that the dynamic response of the reduced network as implemented on the RTS facility give the same results as achieved in full system off-line studies. This level of confidence is required prior to the start of a significant system study on the RTS facility.
Attachments	N/A
Verbal Clarifications (Consultants)	N/A