Ofgem Low Carbon Network Fund Tier 2 Evaluations - 2013

Western Power Distribution – Clean Energy Balance (CEB)

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Authorisation

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History

Issue	Date	Originator	Checker	Description
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02	20 September 2013	J Cunningham	R Lane	Draft
03	11 October 2013	J Cunningham	R Lane	Draft following 2nd Expert Panel meeting.
04	22 October 2013	J Cunningham	R Lane	Resubmission Draft
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Explanatory Note

This report, including the “traffic light” indicators that reflect the salient points and material issues of concern identified during the evaluation process, (other than Section 9) is based on:-

- the original full submissions received from the DNOs in August 2013;
- subsequent question responses through the formal written question process;
- discussions held at the initial bilateral meetings between the DNOs and the Expert Panel on 28 August 2013;
- discussions held at the Consultant-DNO meeting on 4 September 2013
- discussions held at the second bilateral meeting between DNO and the Expert Panel on 27 September 2013; and
- subsequent clarifications by the DNO.

In October 2013 the DNOs were given an opportunity to submit revised proposals. The traffic light indicators and the metrics shown in Sections 1 to 8 do not reflect any changes made by the DNOs in these revised submissions.

Section 9 of this report contain an addendum, which summarises the main changes made between the original and revised submissions, and the impact this has on the evaluation of the project against the criteria. Any significant changes to figures/metrics noted in this addendum.

Project Summary

Full name:	Clean Energy Balance – Circumventing Electricity Network Constraints
DNO Group:	Western Power Distribution (WPD) (South West)
The Problem(s):	Western Power Distribution (WPD) (South West) proposes the 'Clean Energy Balance' project as an alternative to significant network reinforcement to deal with the onset of the low carbon economy. In addition electricity network constraints are preventing the full use of renewable generation. Decarbonisation of heating and transport coupled with an increase in renewable generation will require significant electricity network reinforcement. Existing commercial renewable generation (Wind & Solar) in the Wadebridge area of Cornwall has taken all the spare electricity distribution/grid network capacity. Consequently any proposed community based renewable project would be faced with prohibitive reinforcement charges. The project seeks to find alternative approaches to store and/or transport energy to bypass constraints of the electricity network.
The Method(s):	Conversion of constrained generation into hydrogen by electrolysis for storage until it can be released as either hydrogen injected into the gas mains, or converted back to electricity. The conversion back to electricity can either take place at the constrained wind/PV farm via a gas engine or the injected gas together with the natural gas be utilised by small CHP units in the town of Wadebridge.
The Trial(s):	To take renewable energy from a remote constrained location to the town of Wadebridge either via gas injection, or electrical demand reduction via CHP units within the town. Seven trial methods and evaluation are considered: Constraint scheme; Gas-enabled peak shifting; Constraint circumventing via the gas network; Network Arbitrage Model (desk top); CHP as a means of reinforcement avoidance; and End-to-end value chain (two methods). A "Generation Zone" consisting of a 6MW wind farm (constrained to 3MW), a 1MW electrolyser, a hydrogen store, a gas injection module and a 1.4MWe gas engine. A "Demand Zone" (Wadebridge town) with two 200kW+ CHP systems and 50 micro CHP units for domestic trials. Forecasting of local demand to control and match local CHP requirements.
The Solution(s):	The project delivery will employs the following methods:- 1-A Constraint Scheme 2- Gas Enabled Peak Shifting 3- A method for Constraint Circumnavigation via the Gas Network 4 - A Network Arbitrage Model (for cross network utilisation)

	5 – A method to use CHP for Reinforcement Avoidance 6 – An End to End Model to combine all of the above.
Key strengths and weaknesses against the criteria	
Strengths:	If this proves a viable alternative to network reinforcement, then the trials would indicate which parts of the project are appropriate in differing environments and constraint profiles.
Weaknesses:	Risks associated with planning permissions, electrolyser sizing, gas injection derogation to 2%. A highly complex programme of installation and approvals required.

1. Summary of Assessment against Evaluation Criteria

Criteria	Overall Assessment	
(a) Low Carbon and Benefits	Red	The low carbon benefits would only be achieved if it allowed more renewably generated electricity to be fed into the network and unconstrained times.
(b) Value for Money	Red	This project appears not to provide value for money for either dissemination of learning or for the customers of the DNO.
(c) Generates New Knowledge	Green	Although this project uses well proven technologies, it would demonstrate which of the seven methods employed in the trial are economic. Equally, failure of any one part of the trials would also provide significant learning to other DNOs considering such a scheme.
(d) Partners and Funding	Amber	The Partners selected for the project are appropriate and can certainly bring a great deal of knowledge and experience to these complex trials.
(e) Relevance and Timing	Amber	The timing is relevant for the Wadebridge area and could apply to other situations where renewable generation is being constrained due to network limitations.
(f) Methodology	Amber	The Methodology employed is sound and the comparisons between the Methods and combination of Methods would provide much information about the viability of such a project. Even partial implementation for some other locations may be of benefit.
(g) SDRC	Red	The eight SDRC criterion and evidence are appropriate, but it leaves the main issue of the full trial in each Method to be operational and assessed for viability not covered.

Key to Traffic Light Colour Codes

The "traffic light" system used in the table above gives an indication of BPI's assessment of the information provided by the DNO in support of the project in its detail, alignment with the LCNF evaluation criteria, identification and management of project risk and other aspects for each of the criteria. This is not intended to suggest whether projects should be funded or not, but to point out those areas which BPI believes merit particular scrutiny or consideration. Thus:-

(Green)	• Seems to be generally in line with the objectives and requirements of the LCNF evaluation criteria; • Whilst there are some areas where additional information would be useful, that provided is generally comprehensive and provides no immediate cause for concern.
(Amber)	• Some indication that the project is in line with the objectives and requirements of the LCNF evaluation criteria. However, further scrutiny is required to ensure to ensure this; • There are some gaps in the information provided; • Further assurance is needed to confirm that the project is viable and that risks are appropriately managed.
(Red)	• Significantly more assurance is required that the project is in line with the objectives and requirements of the LCNF evaluation criteria; • There are some major gaps in the information provided; • Considerable scrutiny is needed to confirm that the project is viable and that risks are appropriately managed; • Potential major risks to the viability of the project.

In the following evaluations against the criteria, if the project is addressing various problems and/or trialling several methods and solutions, separate analysis of metrics and sub-criteria will be provided, if appropriate, for relevant criteria.

2. Criterion (a) Low Carbon and Benefits

Criterion:	Accelerates the development of the low carbon energy sector and has the potential to deliver net financial benefits to existing and/or future customers.
Overall assessment:	The low carbon benefits would only be achieved if it allowed more renewably generated electricity to be fed into the network and unconstrained times.
Metrics (as quoted by the project):	
	Method 6 is considered here as the complete technical solution but without the network arbitrage arrangements.
Net financial benefit (£)[1]:	£4.5m (Method 6 – Spread sheet tab 'Net benefits').
Network capacity release (kW)[2]:	56.6MW (Includes 50MW from Method 1.) as stated in the submission. However, Method 6 does not release capacity but seeks to utilise as much unconstrained capacity as may be available at any time. At the time of the submission the DNO indicated that the available unconstrained capacity for renewable generation was 3MW. At the meeting between the Consultants and the DNO and Partners on 4 September 2013 the DNO indicated that the unconstrained capacity had now reduced to 1MW.
Base case time to release capacity (months)[3]:	24 months
Method time to release capacity (months)[4]:	7 to 12 months

[1] The financial benefit of each method (at the trial scale) compared to the most efficient existing method; **Net financial benefit = Base case costs** (the lowest cost of delivering the Solution (on the scale outlined as part of the project) which has been proven on the GB Distribution Systems) – **Method cost** (the cost of replicating the method at the trial scale once it has been proven successful)

[2] The network capacity released by each method (the additional headroom released on the distribution system following implementation of the Method)

[3] The time it would take in months to deliver the capacity shown in "Network capacity released" using the Base Case

[4] The time it would take in months to deliver the capacity shown in "Network capacity released" using the replicated Method

Potential for replication[5]:	If the project proved any of the seven Methods successful, then there may be an opportunity for another DNO or community to replicate some or all of the scheme. There are 500 crossover points in GB where the electricity network and gas distributions systems coincide. Some of these locations may provide the option of gas injection.

Sub-criteria	**Assessment**
Carbon claims (including quantitative, if provided)	No quantitative figures found for actual carbon savings in the submission. Both the gas engine and CHP units will burn a combination of natural gas and hydrogen. In the case of the gas engine, the proportion of hydrogen injected could rise to 20%. However, at the DNO & Partner meeting presentation, slide 5 gives CO_2 savings at around 7,000 Tonnes per annum.
Quantitative analysis	Difficult to verify the claims of 7,000 Tonnes per annum saved as this is dependent upon a number of items listed in the risk register and uncertainty of the allowable gas injection.
Robustness of financial benefits	The financial costs are presented in many different scenarios. Looking at Method 6 shows a non-wind cost of £5.15m for an output of 17.35GWh per annum.
Capacity released (and how quickly)	Since the electrolyser is rated at 1MW for this trial, this would equate to the amount of energy that can be used in the system at other than peak constraint times. There is also mention of thrashing the electrolyser. Our understanding is that either the 1MW electrolyser could be run at 2MW for a short time or that a small 500kW electrolyser could be run at 1MW for short bursts.
Replication (applicability of technology, dependence on specific network characteristics)	Some of the Methods may be replicated in other DNOs, but it would be a limited number of locations that could adopt the whole scheme.

[5] The estimated number of sites or % of the GB Distribution System where the method could be rolled out, up to 2040

3. Criterion (b) Value for Money

Criterion:	Provides value for money to distribution customers
Overall assessment:	This project appears not to provide value for money for either dissemination of learning or for the customers of the DNO.
Metrics (where available):	
Size of benefits to distribution system[6]	The claims are that connection cost will reduce if this technology is employed for the DNO, customers and generators.

Sub-criteria	**Assessment**
Proportion of benefits attributable to distribution system (as opposed to elsewhere in the supply chain)	The scheme is aimed at utilising every last MW of available capacity in the constrained network. However, a similar technique (if economically viable) could be used to store renewable energy for use at peak demand times.
How learning relates to the distribution system	There would certainly be a significant volume of learning for the partners involved, but learning for the DNO would be limited as the process is aimed at avoiding the electricity network or using the network at unconstrained times. If higher volumes of energy could be stored and recovered economically, then the DNO would be interested in such systems to avoid reinforcement costs.
Approach to ensuring best value for money in delivering projects	The approach has been to select the most appropriate partners with previous experience. CGI was competitively contracted by Toshiba. There are few stages in this trial that could be competitively tendered as some a regulatory bodies such as HSL or the local community WREN.
Identify and review major cost items, examine justification for relevant costs, assess choice of discount rates	Electrolyser and Gas engine at £3.8m. Control system at ££3m. Infrastructure £2.6m

[6] Size of benefits attributable or applicable to the Distribution System verses elsewhere

4. Criterion (c) Generates New Knowledge

Criterion:	Generates knowledge that can be shared amongst all DNOs
Overall assessment:	Although this project uses well proven technologies, it would demonstrate which of the seven methods employed in the trial are economic. Equally, failure of any one part of the trials would also provide significant learning to other DNOs considering such a scheme.
Metrics (where available):	
Conforming to default IPR arrangements:	YES [p27]

Sub-criteria	**Assessment**
Potential for new/incremental learning to be generated by the project	The methods of using arbitrage between the constrained electricity output and the timing of gas injection into the mains or electricity generation via a gas engine will provide learning for any future schemes. Although hydrogen gas injection has been undertaken in other countries there is no experience of this technology in the UK. Therefore this trial would provide for new knowledge regarding the technical, legal and commercial obstacles to be overcome. As far as using a 1MW gas engine or smaller CHP units in the town of Wadebridge, this is not new technology and is commercially available from many suppliers.
Applicability of learning to other DNOs	This project may prove use full for DNOs, both on the Mainland GB and some Island populations.
Proposed IP management and any deviations from default IP principles	There is no information in Section 5 regarding the IPR relating to existing equipment, but a statement to share and disseminate information. Clause 5.2 states that the Partners will agree to the default IPR conditions.
Credibility of proposed methodology for capturing learning from the trial and plans for disseminating	All the proposed methods of knowledge dissemination are appropriate and comprehensive. Starting with the involvement of the Wadebridge community who are keen to become a 'green energy' town. A web portal will be provided for the public/open access to the data gathered and to reports/white papers. Social media such as Twitter will be employed during the trials for updating stakeholders.

5. Criterion (d) Partners and Funding

Criterion:	Involvement of other partners and external funding.		
Overall assessment:	The Partners selected for the project are appropriate and can certainly bring a great deal of knowledge and experience to these complex trials.		
Metrics (where available):			
Total cost of project (£):	£16,102,600	Number of consortium members:	(including DNO)
Cost met by DNO (£):	£1,492,270	Cost met by DNO (% of total cost):	9.3%
LCNF support (£):	£13,430,440	LCNF support (% of total cost):	83%
Cost met by others (£):	£1,179,890	Cost met by others (% of total cost):	7.3%

Sub-criteria	Assessment
Appropriateness of collaborators (including experience, expertise and robustness of commitments)	The selection of Partners is appropriate for this project and includes a combination technical, IT, management and local participants. Toshiba is a key player in this project providing both hardware and experience. Toshiba has already implemented some 33 similar sites Worldwide, but none in GB. Prior to the start of the programme, ITM will have designed, built and installed three rapid response PEM electrolyser systems, one in Germany and two in the UK. The first unit, due to be delivered in September 2013 is a 0.3MW system for the injection of hydrogen into the gas network in Frankfurt and will be operated one of Germany's largest Stadtwerk (municipal utilities). The second integrated 0.3MW system will be delivered to the Isle of Wight in April 2014 and will be due to commence trials in November 2014 concluding in October 2015. The third is a smaller15kg/day unit, also to be located on the Isle of Wight, to provide fuel for a boat. This calls into question why this is new knowledge requiring funded trials.
Level of external funding (presented on a comparable	The level of external funding is midway been other comparable projects. Each partner is contributing at least 10% of the contract value. However

Sub-criteria	Assessment
basis with other projects)	there is linkage of this trial to the Gas NIC funding.
Effectiveness of process for seeking and identifying new project partners and ideas	A full IT partner selection process has been undertaken with CGI being selected from a list of 10 potential candidates.

6. Criterion (e) Relevance and Timing

Criterion:	Relevance and timing.		
Overall assessment:	The timing is relevant for the Wadebridge area and could apply to other situations where renewable generation is being constrained due to network limitations.		
Metrics (where available):			
Start date:	1st January 2014	Elapsed time of project:	31st December 2017 [4 years]

Sub-criteria	**Assessment**
Significance in the project in: (a) overcoming current obstacles to a low carbon future	This project is trying to shift coincidental green generation and provide a combination of storage and transportation via the gas network. The overall scheme (Methods 6 & 7) is highly complex and the efficiency is likely to be very low. Traditional network reinforcement is likely to be a better alternative. The fundamental question is who pays for reinforcement.
(b) trialling new technologies that could have a major low carbon impact	Each of the technologies involved in this trial are well proven. However, the combination of each technology on this scale in GB has not been tried before. Where storage options are limited and if the level of hydrogen injection can be increased significantly above the 2% threshold, perhaps to 20% (post 1996 gas appliances should be capable of burning 20% hydrogen 80% natural gas mixtures).
(c) demonstrating new system approaches that could have widespread application	The proposer has indicated that there are potentially some 500 locations within GB where the gas mains and electricity systems coincide in such a way that would facilitate similar gas storage schemes. This type of scheme whether in part or whole would have very limited applications within other DNOs. Once a project involving gas injection has been implemented in a particular area it would almost certainly prevent any other party using the same technology. Thus further renewable schemes in the same area would either have to look for other methods to circumvent constraints or pay for network reinforcement.
Applicability of the project to future business plans, regardless of uptake of Low Carbon	This project would not have any relevance to situations where renewable generation was not being constrained. The end-to-end model is complex, unproven, heavily dependent on DNO/GDN cooperation and hence will not happen without industry support.

Sub-criteria	Assessment
Technologies (LCTs)	

7. Criterion (f) Methodology

Criterion:	Demonstration of a robust methodology and that the project is ready to implement.		
Overall assessment:	The Methodology employed is sound and the comparisons between the Methods and combination of Methods would provide much information about the viability of such a project. Even partial implementation for some other locations may be of benefit.		
Metrics (where available):			
Requested level of protection against cost over runs (default 5%) (%):	10% [p34 cl.6.3]	Requested level of protection against direct benefits (default 50%) (%):	Nil [p34 cl.6.3]

Sub-criteria	**Assessment**
Feasibility of project proposal	There are a number of unknowns before this project even starts. The planning permission has not yet been applied for by the developers. The proportion of hydrogen that can be injected into the medium pressure distribution gas mains has not yet received a derogation for higher levels that the 0.1% currently permitted.
All risks, including customer impact, exceeding forecast costs and missing delivery date	A significant risk to the costs of the project is the potential to be obliged to measure the quality and calorific value of the gas injection of hydrogen into the gas mains.
Whether items within project budget provide value for money	Appendix M deals with the Value for Money aspect, but has no detailed figures. Slide 9 from the presentation on 4 September does give some insight to the level of costs for each partner. Programme Management by CDC at £2.8m; Learning and Control Systems (Toshiba) at £5m; Electrolyser & Gas Engine (ITM Power) £3.8m; Infrastructure (CGI) £2.6m; and WREN community £631k.
Project methodology (including depth and robustness of project management plan)	The project methodology is comprehensive and professional using PRINCE 2 with the Cornwall Development Company taking over the Project Management functions. The management plan being shown in detail in Appendix F.
Appropriateness of Successful Delivery Award Criteria	There are eight criterion listed and the time to completion of progressing to actual hardware being installed is considerable. There are concerns that the full implementation of Methods 6 & 7 may be delivered late. Additionally, a six monthly progress report should be

Sub-criteria	Assessment
(SDRC)	provided.

8. Successful Delivery Reward Criteria

Criterion:	Appropriateness of the SDRC definitions and timing and adequacy of links to key project milestones.
Overall assessment:	The eight SDRC criterion and evidence are appropriate, but it leaves the main issue of the full trial in each Method to be operational and assessed for viability not covered.
Review:	The most critical omission from the SDRC is that each part of the trial installations have been completed and commissioned into service. There appears to be no reference in Section 9 to the actual operation of the Methods by 29 December 2017. An additional requirement should be included for six monthly progress reports.

9. Addendum: Changes made in Re-submission

9.1 Summary of Changes		WPD has significantly amended the volume of CO2 potential savings and reduced the funding request by 5%. It is not clear how the savings have been achieved, particularly in respect of the reduced costs for knowledge capture and dissemination.
9.1.1 Cost Allocation between LCNF and NIC		WPD has included details of the proposed sharing of costs between the two submissions for funding as follows: *"Shared activities (PM, IT, Learning) have been primarily allocated in line with the ratio of initial direct strand costs. This results in approximately 20% of shared costs being allocated to the NIC and 80% to the LCNF".*
9.2 Impact on LCN Funding Application		The LCN Funding request has been reduced by £680k partly due to changes in knowledge capture and dissemination.
9.2.1 Criterion (a) Low Carbon Benefits		Section 3.6 indicates the potential savings of carbon, if the scheme could be rolled out across GB as a whole. *"Given there are 50 points of cross-over in Cornwall's sparse networks, the full solution could potentially be reproduced in over 1000 sites (100 in SW region x 14). Assuming a more conservative 500 sites, the carbon savings, based on the Carbon figures from either Method 2 or 3 from the table in section 3.3, would be at least 6,000 x 500 = 3 million tons of carbon saved per annum."*
9.2.2 Criterion (b) Value for Money		The benefits of the project have been re-assed as shown in the table below. Of significance is the correction to the level of CO2 benefits from 0.3 terra tonnes to 3 million tonnes per annum. *"The benefits of the project in the context of Wadebridge are illustrated by the table below, assuming a 6MW wind farm is developed. The assumptions upon which this is based can be found in Appendix H.*

Method Performance	Connection + Non-Wind Costs (£m)	GWh/ Anum	Tonnes C02/ Annum saved	20 Year IRR	20 Year NPV (£m)	Pay Back Year
1MW/1MW	0.60	2.76	1,261	10.53%	1.61	12
Method 0	7.40	18.43	**8,422**	8.44%	8.33	14
Method 1	0.76	15.54	7,103	12.96%	10.01	10
Method 2	2.57	25.20	7,559	11.58%	9.77	11
Method 3	2.33	16.83	7,559	11.32%	9.21	11
Method 4	3.17	25.20	7,559	10.48%	8.59	12
Method 5	3.01	2.28	811	**24.92%**	4.78	**6**
Method 6	5.34	19.11	7,559	13.17%	13.36	10
Method 7	6.18	**27.48**	7,559	13.45%	15.76	10
Method 1+5	3.77	17.83	7,103	**14.79%**	14.18	**9**
Method 2+5	5.58	**27.48**	7,559	13.22%	13.60	10
ELY Utilisation:			**19.5%**			

* Figures based on pre-tax cashflows

Key Scenario Parameters	
Wind (MW):	**6**
PV (MW):	**3**
ELY (MW):	**1**
Firm Wind (MW):	**1**
Gas Engine (MW):	**1.4**
uCHP Numbers (K):	**1**
Gas Price (£/MW):	**22**
Electricity Price (£/MW):	**55**
CPI	**2.5%**
Energy Price Inflation	**0.5%**
Discount Rate	**3.5%**

This demonstrates how each of the key Methods provides benefits over and above those attainable by either a wind farm sized to the available 1MW unconstrained connection or the reinforcement option to deliver a 6MW unconstrained wind farm. In the Wadebridge scenario, where there is significant diverse generation, the Constraint Scheme, Method 1, is obviously the most attractive. However, this is a toolkit of options. Hence in circumstances with less diverse generation and/or where lower firm connection requires a larger electrolyser to compensate, Methods 2 and 3 (and 6 and 7) prevail, as demonstrated in Section 3.3."

"Irrespective of the scenario, the Methods provide benefits to the renewable generators by enabling them to connect to constrained networks where previously connection would have been financially prohibitive. This benefits the UK by enabling the cost-effective penetration of low carbon generation, especially in areas of optimal renewable resource, where existing constraints are currently limiting further renewable rollout. There are also key benefits through decarbonising the gas network alongside the electrical network. If the technical system designed for this programme is widely replicated, the overall impact on the volume of CO2 saved would be significant, potentially in the region of 3 million tonnes of CO2 per annum."

Section 3.3 of the business case has been substantially modified to cope with different scenarios of constrained connections, type of generation (wind, solar etc.), and which of the seven methods described in the submission is most applicable.

A new version of Appendix B has been included to show the comparisons between Battery storage and a Hydrogen system.

9.2.3	**Criterion (c) Generates Knowledge**		The section on learning has been enhanced by the inclusion of the following: *"The above learning will be used by the DNOs to determine the optimal use of these Methods ahead of any longer-term reinforcement. Specifically, WPD will learn how to develop and contract for the various Methods being explored, such as:* • *Either a constraint scheme solution or a Constraint Scheme as a service, in order to defer reinforcement and maximise the early connection of renewable generation* • *A CHP model to defer urban reinforcement* • *The solution sets required of generators to enable early connection in constrained areas."* Further information on the Customer CHP Installations has been included in section 8 of the resubmission.
9.2.4	**Criterion (d) Partners and Funding**		There is a reduction in the funding request of 5% against the original submission. There are no changes to the Partners.
9.2.5	**Criterion (e) Relevance and Timing**		An additional bullet point has been included in the section relation to the prospects of the project starting on-time, due to potential delays in obtaining planning consent from local authorities. *"Risk Mitigation – one of the key delivery risks is the ability to develop the wind farm within the required timescales. Due to the planning risks inherent within this, two alternative PV generating sets are also being progressed in parallel until planning has been achieved".*
9.2.6	**Criterion (f) Methodology**		The various Methods employed in the original submission have been substantially amended to reflect a new set of calculations for the green energy opportunities under constrained network conditions. Further changes to the modelling have been included in the resubmission, these include the following: *"The model has been updated to include a CPI rate of 2.5%, a 0.5% PA energy price increase as standard (based on DECC's future fossil fuel price projections); The control system costs are now modelled on a shared service model; DSM payments have been realigned to reflect those directly within the operator's control (i.e. reduction in Gas Engine output during times of over generation); The wind farm modelling has been revised to overcome inaccuracies in the resultant generation duration curve. The modelling approach now used (described in Appendix H) more accurately reflects turbine performance; and KCD costs have been revised down to £300k to improve Value For Money."*
9.2.7	**Successful Delivery Reward Criteria (SDRC)**		There are only minor amendments to the SDRC section.