Medworth Energy from Waste
Combined Heat and Power Facility

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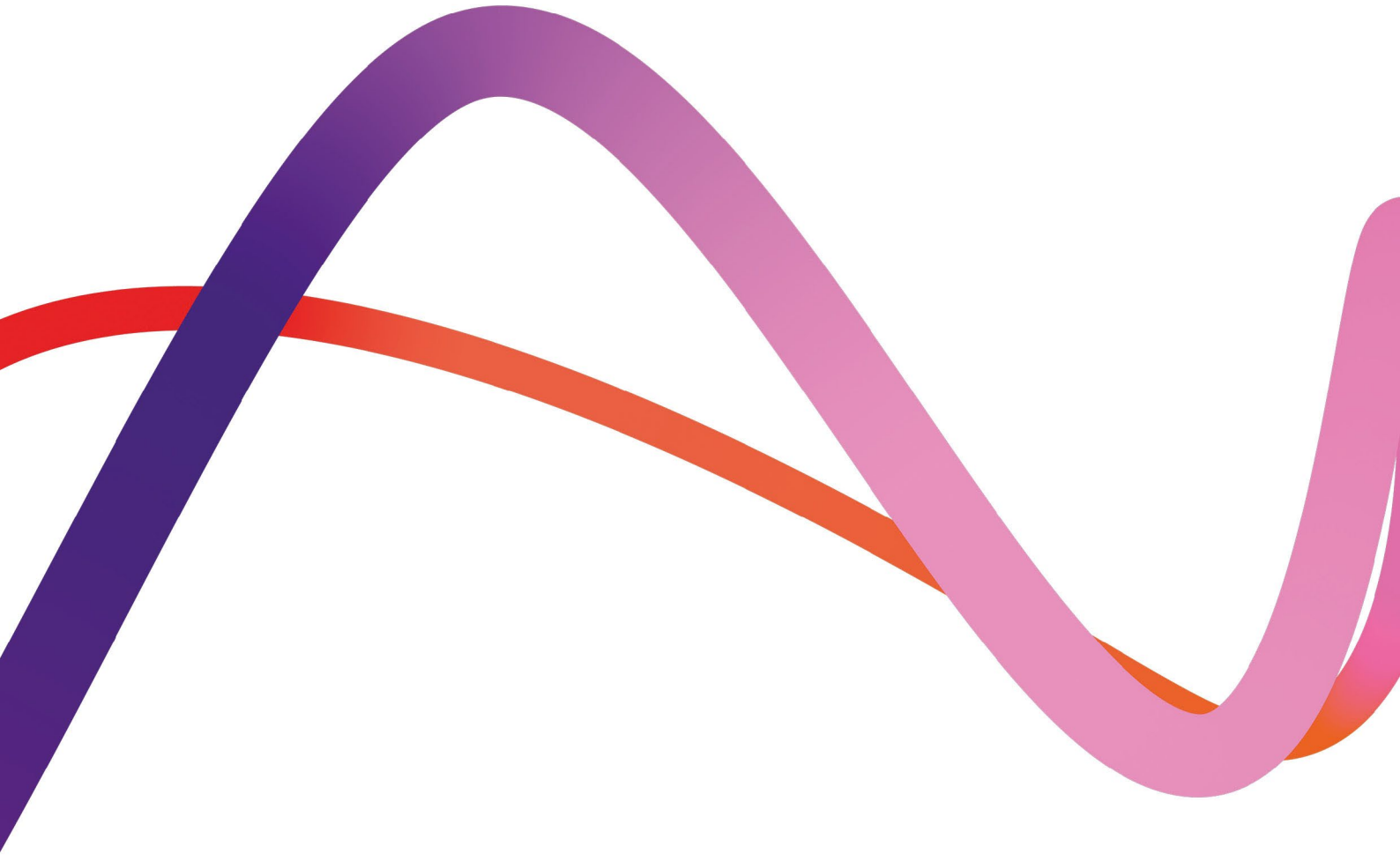

Technical Note:

R1 Calculation

We inspire
with energy.

Contents

1. R1 Calculation

Overview

1.1.1 To comply with the revised Waste Framework Directive (rWFD) in the UK, an applicant is required to demonstrate their proposed development is capable of achieving an R1 value in excess of 0.65. Therefore, rather than being classified as an inefficient "disposal" operation it is an efficient energy "recovery" operation. To qualify as an R1 recovery operation, the plant must:

- Have or will have an environmental permit;
- Be capable of treating mixed municipal solid waste, including refuse derived fuel or solid recovered fuel if the fuel's been made from mixed municipal solid waste; and
- Not be a co-incinerator

1.1.2 The Environment Agency is the certification body for R1 status in England. An application for certification of R1 status has been made at the same time as the application made for an Environmental Permit and details of the Proposed Development's initial R1 calculation accompany the Applicant's application for an Environmental Permit. The R1 design calculation for the EfW CHP Facility is 0.81.

1.1.3 During commissioning of the EfW CHP Facility, the Applicant will undertake a re-assessment of the R1 calculation to ensure the EfW CHP Facility does/will continue to achieve R1 status. The R1 status will also be required to be re-validated on an annual basis using actual energy inputs and outputs.

1.1.4 The R1 status of the EfW CHP facility will be validated by the Environment Agency as part of annual reporting under the EfW CHP Facility's Environmental Permit.

Guidance

1.1.5 To calculate the R1 value, the Applicant used the Environment Agency's guidance:

- *Waste incinerator plant: apply for R1 status (Aug 2021).*

1.1.6 As part of this guidance, the Environment Agency has developed a spreadsheet pro-forma that provides a calculation of the R1 value using the method in the European Commission's "*Guidelines on the interpretation of the R1 energy efficiency formula for incineration facilities dedicated to the processing of municipal solid waste according to Annex II of Directive 2008/98/EC on waste*". The Environment Agency's pro-forma was used to calculate the R1 value for the EfW CHP Facility.

1.1.7 Commission Directive (EU) 2015/1127 establishes that, to achieve a level playing field, it is reasonable to apply a climate correction factor (CCF) to the R1 formula based on local climatic conditions. For new installations, the CCF ranges between a value of 1 and 1.12 dependent on the local heating degree days with a formula for the calculation of the CCF provided in the Annex of Commission Directive (EU) 2015/1127.

R1 Calculation

1.1.8 The EfW CHP Facility has a design R1 value of 0.81 (0.90 with application of climate change correction factor based on regional heating degree day analysis) at design load conditions (DLC) without the export of heat, ensuring that the installation can be classed as an energy recovery operation irrespective of the level of heat export. **Appendix A** provides a CHP-R assessment and details of the R1 calculation. Operational data will be collected during commissioning and each subsequent year, with a re-assessment of the R1 calculation made to ensure the EfW CHP Facility does/can continue to achieve R1 status.

1.2 Conclusion

1.2.1 The Proposed development will be designed to achieve an R1 value of 0.81, therefore be classified as a waste “recovery” operation.

Appendix A Environment Agency Guidance R1 Calculation

	A	B	C	D	E	F	G	H	I
1	**PROFORMA FOR DETERMINING ENERGY EFFICIENCY USING R1**								
2	**Site name, address and grid reference**	Medworth Energy from Waste Combined Heat and Power Facility, Algores Way, Wisbech, Cambridgeshire, PE13 2TQ	**EPR Permit reference (if known)**		EPR/VP3705BL/A001				
3	**Operator name**	Medworth CHP Ltd	**Application fee (£)**		Included with permit application fee				
4	**Details of who to contact if we have any queries regarding this form**	Per the contact details provided on form Part A							
5	**What data has been used in the application? →**		Design data						
6	Indicative R1 factor (subject to confirmation)	0.81	Quantity in reporting year	Units	U_c	Properties (Average over reporting year)	Units	Note which parameters that have been estimated	Reference to Supporting information
7	Climate change correction factor (optional)	1.12							
8	R1 after CCF adjustment	0.90							
9	1. Gross electricity meter (Electricity produced at turbine)		480000	MWh					
10	2. Electricity exported - Net input/output meter		440000	MWh					
11	3. Electricity imported - Net input/output meter		352.72	MWh					
12	4. Other fuel inputs								
13		4.1 Light fuel oil	1622850	litres		0.85	kg/l		
14						42600	kJ/kg		Digest of UK Energy St
15		4.2 Natural gas		Nm^3		34200	kJ/Nm^3		
16									
17		4.3 LPG		Nm^3			kg/Nm^3		
18							kJ/kg		
19		4.4 Other fuels similar to light fuel oil		litres			kg/l		
20							kJ/kg		
21	5. Primary combustion air (as supplied to furnace)		2169002123	m^3		0.942	kg/Nm^3		
22						99.97	°C		
23						75.7197	kJ/kg		
24	6. Secondary combustion air (as supplied to furnace)		971588133	m^3		1.146	kg/Nm^3		
25						33.72	°C		
26						8.8072	kJ/kg		
27	7. Recycled flue gas (as supplied to furnace)			m^3			kg/Nm^3		
28							°C		
29						0	kJ/kg		
30	8. Heat exported outside R1 boundary								
31		8.1 steam exported		tonnes			°C		
32							kPa		
33							kJ/kg		
34		condensate returned		tonnes			°C		
35							kPa		
36							kJ/kg		
37		8.2 hot water exported		tonnes			°C		
38							kPa		
39							kJ/kg		
40		hot water returned		tonnes			°C		
41							kPa		
42							kJ/kg		
43									
44	9. Internal steam use								
45		9.1 for soot blowing (no backflow)		tonnes			°C		
46							kPa		
47							kJ/kg		
48		9.2 for steam driven devices		tonnes			°C		
49							kPa		
50							kJ/kg		
51		backflow as steam		tonnes			°C		
52							kPa		
53							kJ/kg		
54		9.3 for trace heating		tonnes			°C		
55							kPa		
56							kJ/kg		
57		backflow as condensate		tonnes			°C		
58							kPa		
59							kJ/kg		
60		9.4 for re-heating flue gas		tonnes			°C		
61							kPa		
62							kJ/kg		
63		backflow as condensate		tonnes			°C		
64							kPa		
65							kJ/kg		
66		9.5 for concentration processes		tonnes			°C		
67							kPa		
68							kJ/kg		
69		backflow as condensate		tonnes			°C		

	A	B	C	D	E	F	G	H	I
70							kPa		
71							kJ/kg		
72		9.6 for building, equipment, tank heating		tonnes			°C		
73							kPa		
74							kJ/kg		
75		backflow as condensate		tonnes			°C		
76							kPa		
77							kJ/kg		
78		9.7 for deaeration and demineralisation		tonnes			°C		
79							kPa		
80							kJ/kg		
81		backflow as condensate		tonnes			°C		
82							kPa		
83							kJ/kg		
84		9.8 other internal applications, in line with commission guidance, to be specified		tonnes			°C		
85							kPa		
86							kJ/kg		
87		backflow as condensate		tonnes			°C		
88							kPa		
89							kJ/kg		
90		9.9 other internal applications, in line with commission guidance, to be specified		tonnes			°C		
91							kPa		
92							kJ/kg		
93		backflow as condensate		tonnes			°C		
94							kPa		
95							kJ/kg		
96	10. Use of condensing energy from steam in flue gas			GJ					
97	11. Superheated steam at boiler outlet		2011200	tonnes		380	°C		
98						4619	kPa		
99						3155	kJ/kg		
100	12. Boiler feedwater		2030400	tonnes		131.3	°C		
101						6369	kPa		
102						556.2	kJ/kg		
103	13. Boiler Efficiency (Design)		90%	±	1.5%				
104	**Instructions for completing this spreadsheet**								
105	1.	Ensure that you have completed the first three rows of the application form							
106	2.	This form should be accompanied by supporting information for the figures quoted. Where this information is in the permit application, reference to the relevant sections of the application can be made.							
107		A Sankey diagram (or equivalent) reflecting the boundaries of the installation used as well as any references to physical properties is the absolute minimum that should be provided for an application based on design information							
108	3.	We have colour coded the cells in this spreadsheet to assist you in completing this form, an explanation of the colour codes is provided below. The colour will disappear when data has been entered.							
109		Blue cells require data that is essential for the R1 calculation, where information on uncertainty of the data is available it would be useful (but not mandatory) for this to be included for these parameters.							
110		Beige Cells indicate that any data entered will be used in the R1 calculation. They have been used where there is a choice of inputs but not all plants will have data for all the input options.							
111		Where you are entering data into beige cells you need to make sure that you enter data into all the beige cells associated with the input as they are all needed for carrying out the calculation.							
112		Yellow cells have been used to provide flexibility to include fuels or energy uses not identified elsewhere. Supporting information to explain why the standard fields were not appropriate or adequate will need to be provided where these cells are used.							
113		Data entered in uncoloured cells are not used when calculating the R1 energy efficiency factor but can be completed to provide a more complete data set.							
114		Data in the purple cell for the CCF factor is optional. If used the way it was calculated must be explained in supporting information							
115	4.	Ensure the temperatures entered into cells F19 and F22 (and F25) are the actual temperatures of the heated air in ^{o}C.							
116		The spreadsheet uses these values to calculate the specific enthalpy associated with heating the air from ambient 25 ^{o}C in cells F20 and F23 (and F26).							
117	5.	Densities used in cells F18 and F21 (and F24) should be at the temperatures at which the flows quoted in C18 and C21 (and C24) are reported.							
118		The spreadsheet multiplies these pairs of entries to generate a mass of air.							
119	6.	If you believe that any of the information that you have submitted in this application form is commercially confidential please identify the confidential information and the grounds on which you believe it to be confidential in your covering letter							
120	LIT 5753								
121	EAD/0812/xls/v3