GSHP association

MANNVIT

1963 2013 50

The use of heat pumps in true geothermal

26 November 2014

GSHPA Technical Seminar

DeMontfort University

Trust

Open- mindedness

Knowledge

Well-being

The problem...

Geothermal for direct heat use is very common in a variety of countries

What can be done to mitigate the risk on temperatures and flow?

Gratuitous Photo

Outline

Existing borehole provides 60l/s @ F = 74 Deg C & R = 52 Deg C

Contribute ~ 5MW thermal in this configuration via PHE

Gas Boilers add top up to 36MW

How can this be improved?

Solution

Existing borehole provides 60l/s @ F = 74 Deg C & R = 52 Deg C

Contribute ~ 5MW thermal in this configuration via PHE

Install heat pump to take 60l/s @ F = 52 Deg C & R = 15 Deg C

Increase thermal delivery by 12MW and output temperature to ~80 Deg C for total of 17MW. Heat Pump @ >450% eff.

Gas boilers reduced to 19MW

Control

5 MW Direct Geothermal

Then

12 MW Heat Pump

Then

17MW Gas Boiler

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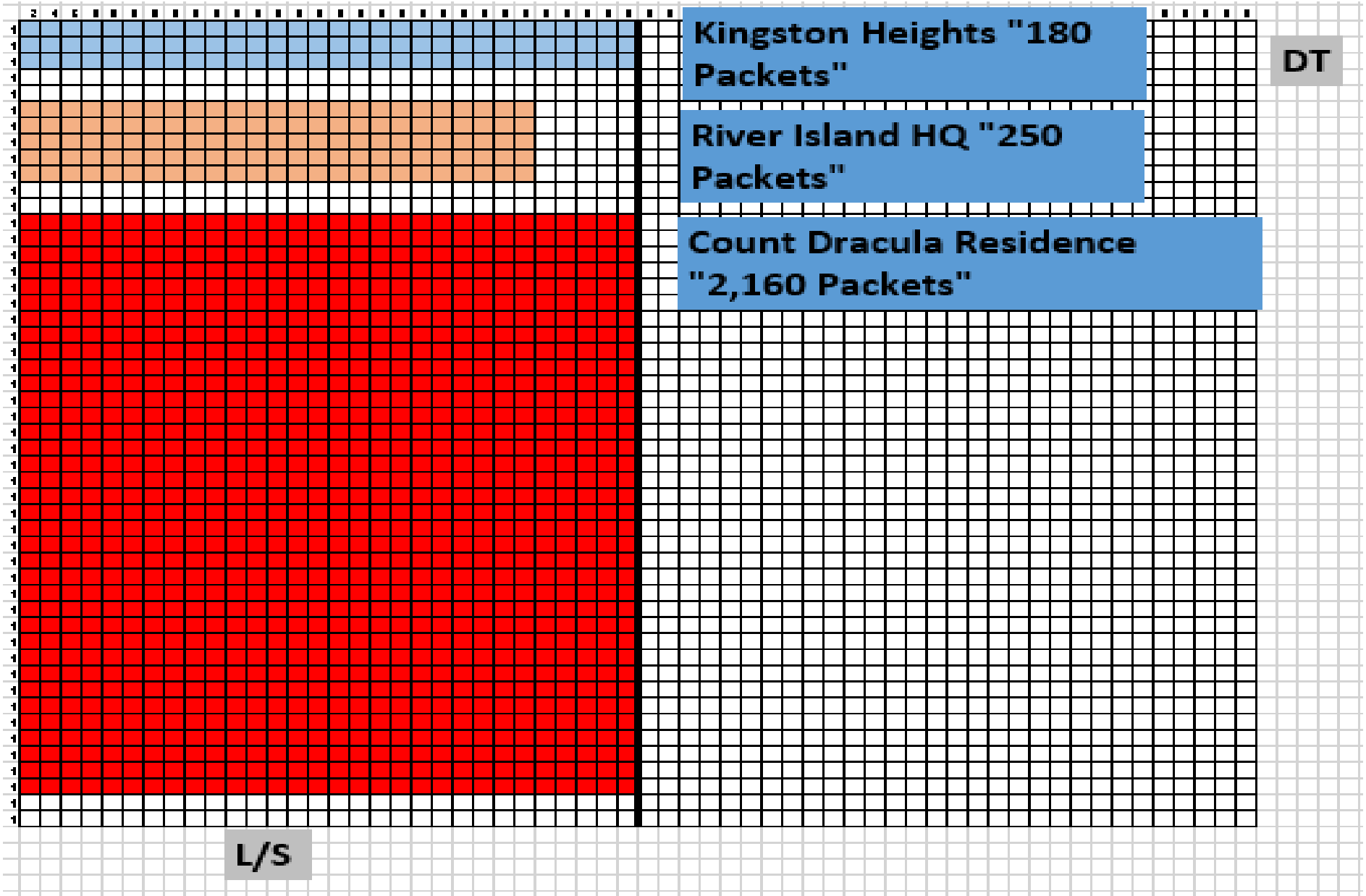

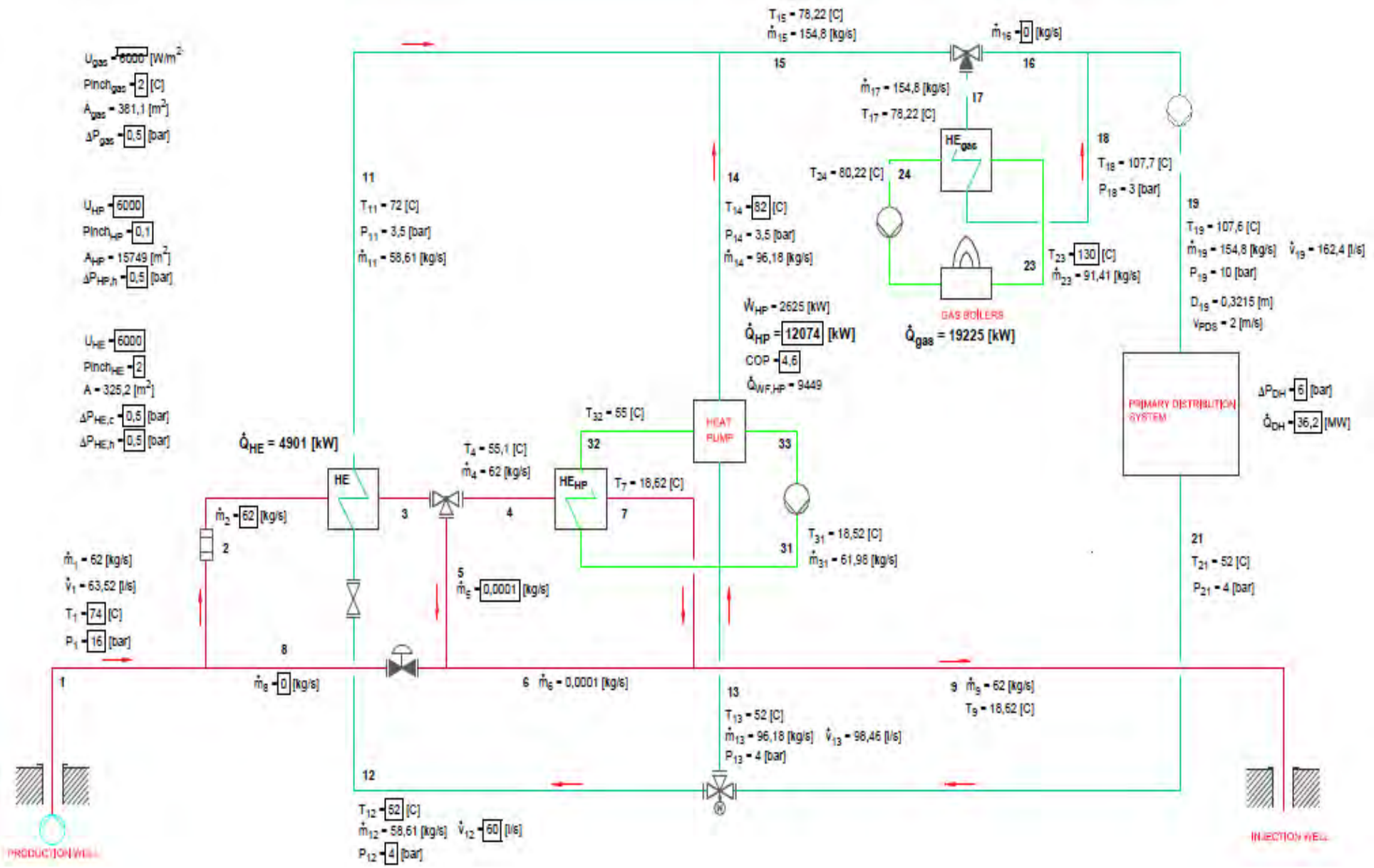
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MANNVIT
U_{gas} = 6000 [W/m²]
$Pinch_{gas}$ = 2 [C]
A_{gas} = 381,1 [m²]
ΔP_{gas} = 0,5 [bar]
U_{HP} = 6000
$Pinch_{HP}$ = 0,1
A_{HP} = 15749 [m²]
$\Delta P_{HP,h}$ = 0,5 [bar]
U_{HE} = 6000
$Pinch_{HE}$ = 2
A = 325,2 [m²]
$\Delta P_{HE,c}$ = 0,5 [bar]
$\Delta P_{HE,h}$ = 0,5 [bar]
$\dot{Q}_{HE}$ = 4901 [kW]
$\dot{m}_1$ = 62 [kg/s]
$\dot{V}_1$ = 63,52 [l/s]
T_1 = 74 [C]
P_1 = 16 [bar]
$\dot{m}_2$ = 62 [kg/s]
T_4 = 55,1 [C]
$\dot{m}_4$ = 62 [kg/s]
T_7 = 18,62 [C]
$\dot{m}_5$ = 0,0001 [kg/s]
$\dot{m}_8$ = 0 [kg/s]
$\dot{m}_6$ = 0,0001 [kg/s]
T_{15} = 78,22 [C]
$\dot{m}_{15}$ = 154,8 [kg/s]
$\dot{m}_{16}$ = 0 [kg/s]
$\dot{m}_{17}$ = 154,8 [kg/s]
T_{17} = 78,22 [C]
T_{24} = 80,22 [C]
T_{23} = 130 [C]
$\dot{m}_{23}$ = 91,41 [kg/s]
$\dot{Q}_{gas}$ = 19225 [kW]
T_{11} = 72 [C]
P_{11} = 3,5 [bar]
$\dot{m}_{11}$ = 58,61 [kg/s]
T_{14} = 82 [C]
P_{14} = 3,5 [bar]
$\dot{m}_{14}$ = 96,18 [kg/s]
$\dot{W}_{HP}$ = 2625 [kW]
$\dot{Q}_{HP}$ = 12074 [kW]
COP = 4,6
$\dot{Q}_{WF,HP}$ = 9449
T_{32} = 55 [C]
T_{31} = 18,52 [C]
$\dot{m}_{31}$ = 61,98 [kg/s]
T_{18} = 107,7 [C]
P_{18} = 3 [bar]
T_{19} = 107,6 [C]
$\dot{m}_{19}$ = 154,8 [kg/s]
$\dot{V}_{19}$ = 162,4 [l/s]
P_{19} = 10 [bar]
D_{19} = 0,3215 [m]
v_{PDS} = 2 [m/s]
ΔP_{DH} = 6 [bar]
$\dot{Q}_{DH}$ = 36,2 [MW]
T_{21} = 52 [C]
P_{21} = 4 [bar]
T_{13} = 52 [C]
$\dot{m}_{13}$ = 96,18 [kg/s]
$\dot{V}_{13}$ = 98,46 [l/s]
P_{13} = 4 [bar]
$\dot{m}_9$ = 62 [kg/s]
T_9 = 18,62 [C]
T_{12} = 52 [C]
$\dot{m}_{12}$ = 58,61 [kg/s]
$\dot{V}_{12}$ = 60 [l/s]
P_{12} = 4 [bar]
HE
HE_HP
HE_gas
HEAT PUMP
GAS BOILERS
PRIMARY DISTRIBUTION SYSTEM
PRODUCTION WELL
INJECTION WELL

What about the Money!!!

- So, if in the UK….
- 17,000kW x 4,000 run hours = 68GWh
- 3p bill plus 5p RHI less 2p run cost = 6p net
- 68 GWh x £0.06 = £4.08M
- 7yr return = **£28.56M**

THANK YOU!

www.mannvit.com

Vatnaskil
Land & Water Resource Consultants Ltd