**4EM70 A.3.2 Flash Geothermal CHP plant**

date

|  |  |  |
| --- | --- | --- |
| name | student ID | e-mail |
| name | student ID | e-mail |

\*Please include all group members

**INSERT BASE DESIGN A.2 AT THE END OF THIS DOCUMENT (STARTING ON A NEW PAGE)**

**PLEASE USE THE FOLLOWING NOTATION:**

* express values in the units as given in the tables
* separate the [integer](https://en.wikipedia.org/wiki/Integer) part from the [fractional](https://en.wikipedia.org/wiki/Fraction_(mathematics)) part of a [number](https://en.wikipedia.org/wiki/Number) by a **dot**; e.g. “4.56”
* use **“e”** to express powers of 10 in scientific notation; e.g. “4.6e3”
* separate multiples of 1000 etc by **spaces**; e.g. 3 467 176

**Personalized reference temperature** value °C

**Personalized reference pressure** value bar

**NOTE: flash and condensor pressures must be chosen according to personalized design constraints.**

1. **State variables and heat/work exchange**

**Case 1:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| * **Flash pressure 1: value bar** * **Condensor pressure 1: value bar** | °̊  bar | °C | kJkg-1 | kJkg-1K-1 | kJkg-1 | kJkg-1 |
| 1 saturated vapour (after separator) | value | value | value | value | X | X |
| 3 wet steam (turbine work) | value | value | value | value | X | value |
| 4 saturated liquid (condensor heat) | value | value | value | value | value | X |
| steam mass flow kgs-1 | value |
| steam quality @ turbine exit | value |
| power output MW | value |

**Case 2:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| * **Flash pressure 1: value bar** * **Condensor pressure 2: value bar** | °̊  bar | °C | kJkg-1 | kJkg-1K-1 | kJkg-1 | kJkg-1 |
| 1 saturated vapour (after separator) | value | value | value | value | X | X |
| 3 wet steam (turbine work) | value | value | value | value | X | value |
| 4 saturated liquid (condensor heat) | value | value | value | value | value | X |
| steam mass flow kgs-1 | value |
| steam quality @ turbine exit | value |
| power output MW | value |

**Case 3:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| * **Flash pressure 2: value bar** * **Condensor pressure 1: value bar** | °̊  bar | °C | kJkg-1 | kJkg-1K-1 | kJkg-1 | kJkg-1 |
| 1 saturated vapour (after separator) | value | value | value | value | X | X |
| 3 wet steam (turbine work) | value | value | value | value | X | value |
| 4 saturated liquid (condensor heat) | value | value | value | value | value | X |
| steam mass flow kgs-1 | value |
| steam quality @ turbine exit | value |
| power output MW | value |

**2 Design and costs**

**Case 1:**

Separator design

|  |  |
| --- | --- |
| total mass flow kgs-1 | value |
| inlet steam quality | value |
| mass flow separated liquid kgs-1 | value |
| demister type | value |
| rationale | |
| loading factor K ms-1 | value |
| vapour velocity ms-1 | value |
| diameter m3 | value |
| volume m3 | value |

Condensor design

|  |  |  |
| --- | --- | --- |
| heat exchanger type | District Heating | Flash plant |
| Inlet temperature °C | value | value |
| outlet temperature °C | value |
| heat transferred kW | value | |
| logarithmic mean temperature difference °C | value | |
| mass flow kgs-1 | value | value |
| average heat capacity Jkg-1K-1 | value | - |
| overall heat transfer coefficient Wm-2K-1 | value | |
| heat transferring surface m2 | value | |
| number of transfer units (NTU) | value | |
| effectiveness () | value | |
| capacity flow ratio (CR) | value | |

Additional investment for electricity production

|  |  |
| --- | --- |
| electricity retail price US$/kWh | 0.09 |

|  |  |
| --- | --- |
| separator installed costs US$ | value |
| turbine/condensor installed costs US$ | value |
| total installed costs | value |

|  |  |
| --- | --- |
| additional costs for electricity production US$ | value |
| additional installed costs per kWh work produced US$/kWh | value |
| payback time in hours | value |

**Case 2:**

Separator design

|  |  |
| --- | --- |
| total mass flow kgs-1 | value |
| inlet steam quality | value |
| mass flow separated liquid kgs-1 | value |
| demister type | value |
| rationale | |
| loading factor K ms-1 | value |
| vapour velocity ms-1 | value |
| diameter m3 | value |
| volume m3 | value |

Condensor design

|  |  |  |
| --- | --- | --- |
| heat exchanger type | District Heating | Flash plant |
| Inlet temperature °C | value | value |
| outlet temperature °C | value |
| heat transferred kW | value | |
| logarithmic mean temperature difference °C | value | |
| mass flow kgs-1 | value | value |
| average heat capacity Jkg-1K-1 | value | - |
| overall heat transfer coefficient Wm-2K-1 | value | |
| heat transferring surface m2 | value | |
| number of transfer units (NTU) | value | |
| effectiveness () | value | |
| capacity flow ratio (CR) | value | |

Additional investment for electricity production

|  |  |
| --- | --- |
| electricity retail price US$/kWh | 0.09 |

|  |  |
| --- | --- |
| separator installed costs US$ | value |
| turbine/condensor installed costs US$ | value |
| total installed costs | value |

|  |  |
| --- | --- |
| additional costs for electricity production US$ | value |
| additional installed costs per kWh work produced US$/kWh | value |
| payback time in hours | value |

**Case 3:**

Separator design

|  |  |
| --- | --- |
| total mass flow kgs-1 | value |
| inlet steam quality | value |
| mass flow separated liquid kgs-1 | value |
| demister type | value |
| rationale | |
| loading factor K ms-1 | value |
| vapour velocity ms-1 | value |
| diameter m3 | value |
| volume m3 | value |

Condensor design

|  |  |  |
| --- | --- | --- |
| heat exchanger type | District Heating | Flash plant |
| Inlet temperature °C | value | value |
| outlet temperature °C | value |
| heat transferred kW | value | |
| logarithmic mean temperature difference °C | value | |
| mass flow kgs-1 | value | value |
| average heat capacity Jkg-1K-1 | value | - |
| overall heat transfer coefficient Wm-2K-1 | value | |
| heat transferring surface m2 | value | |
| number of transfer units (NTU) | value | |
| effectiveness () | value | |
| capacity flow ratio (CR) | value | |

Additional investment for electricity production

|  |  |
| --- | --- |
| electricity retail price US$/kWh | 0.09 |

|  |  |
| --- | --- |
| separator installed costs US$ | value |
| turbine/condensor installed costs US$ | value |
| total installed costs | value |

|  |  |
| --- | --- |
| additional costs for electricity production US$ | value |
| additional installed costs per kWh work produced US$/kWh | value |
| payback time in hours | value |

|  |
| --- |
| Pinch diagram of each flash plant combined in one diagram |

|  |
| --- |
| Assumptions (mandatory) |

|  |
| --- |
| Further comments (optional) |

|  |
| --- |
| Conclusions (mandatory)   * Is the flash plant e.g. indeed thermodynamically less efficient? Why (not)? * Is this e.g. an economically attractive redesign? Why (not)? * … |

|  |
| --- |
| Recommendations (mandatory)   * Can you e.g. recommend this redesign unconditionally, only under certain circumstances or not at all? Why (not)? * … |