District cooling system in Gera

chiller plant Brueckenstrasse
steam jet chiller: 600 kW
compression chiller: 600 kW

temperatures:
flow line: 6 °C
return line: 12 °C

beginning of operation:
January 1998

operator:
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Cold supply as an energy service

Cold supply as a service basically means that the customer is furnished directly with the final product »cold« by the supplier. This relieves the customer of capital expenditures and the operation of expensive plants. The supplier can replace part of his power supply by a product which can be priced independently and which ensures that customers are linked to the supply company in the long term. Utilization of district heating networks and CHP plants can be improved by thermal cold generation. The use of (waste) heat from CHP plants saves primary energy and reduces CO₂ output.

The district cooling network Gera

In 1997 EGG, Energieversorgung Gera GmbH (Energy Supply Gera Ltd.), the local utility company in Gera, built a district cooling network in the downtown area. This network was based upon a concept for cold supply developed by Fraunhofer UMSICHT. At present, it is fed by the chiller plant Brueckenstrasse, whose output is designed to meet the base load of the network. In the near future, it is planned to extend the network and to set up second chiller plant with a cooling capacity of 3 MW.

The construction of the chiller plant Brueckenstrasse with a steam jet ejector chiller and a compression chiller was carried out in the second half of 1997 within the scope of a pilot project sponsored by the Federal Ministry for Education, Science, Research and Technology. It was part of the cooperative project »Combined heat, cold and power with steam jet ejector chillers«. Operation of the district cooling network and the chiller plant began at the turn of the year 1997. Supply operation started in January 1998. Due to increased demand of cold and good initial operational experiences in the summer of 1998, the planning of the second chiller plant was assigned to Fraunhofer UM SICHT.

Generation of cold with steam jet ejector chillers

In a steam jet ejector chilling process the mechanical compressor of a compression chiller is replaced by a steam jet ejector compressor. In this process the pressure energy of the steam is converted into flow energy. Refrigerant steam (water steam) is drawn from the evaporator by momentum exchange. The evaporating refrigerant withdraws energy from the return water from the cold water network, thereby cooling it down. Here temperatures below 0 °C (32 °F) can be obtained. A separation of the cold water network from the steam jet ejector chiller by a heat exchanger, as it is common for other chillers, is not necessary. The kinetic energy of the steam is converted back into pressure energy within the diffuser of the ejoctor so that the steam can be precipitated in the condenser at higher temperatures. The heat is being transferred to the re-cooling circuit.

The heat ratio (COP) of a steam jet ejector chiller strongly depends on the condenser back-pressure and thus from the re-cooling water temperature. The latter in turn is determined by the condition of the environmental air. During midsummer with high humidity and high outside temperature, the heat ratio is lower than that of absorption chillers. However, the annual average of the re-cooling water temperatures is significantly lower under these conditions so that a COP > 1 can be reached. The resulting decreased requirements in driving heat lead to savings in operational costs of up to 30 % compared to an absorption chiller. Hot-water temperatures of about 75 °C (167 °F) are necessary for the generation of steam.

The chiller plant Brueckenstrasse

The total capacity of the chiller plant generated by a steam jet ejector chiller and a compression chiller at 600 kW each. This partitioning guarantees optimal operating conditions for the steam jet ejector chiller on the one hand and a secured supply on the other hand.

The steam jet ejector chiller consists of two stages with three jet ejectors each. The water is cooled down from 12 °C (53,6 °F) to 9 °C (48,2 °F) in the first stage, then down to 6 °C (42,8 °F) in the second stage. The capacity can be adjusted stepwise to the cold demand so that a precise flow temperature control is possible for the cooling network. A steam saving control, regulating the steam pressure (and thus the steam consumption) in dependence of the condenser pressure, is used to reduce the steam consumption.