

## *Nuclear physics in the service of health*



<b>Line of Business:</b>	Air conditioning
<b>Application:</b>	Air conditioning
<b>Country / City:</b>	Germany / Munich
<b>Fluid:</b>	Glycol
<b>Product:</b>	Drycooler GFH

The newly-built RINECKER PROTON THERAPY CENTER (RPTC) in Munich is a privately managed and financed Cancer Center with nuclear physics technology. In Europe, it is the first of its size, and after the centers in Loma Linda University, Los Angeles, and Harvard University, Boston, the third therapy center of its kind worldwide. M+W Zander Gebäudetechnik GmbH from Stuttgart is responsible for the cooling system of this innovative Therapy Center and equipped the system with nine drycoolers of Güntner as well as two hybrid coolers of Jäggi/Güntner (Switzerland) AG.



A successful transport following the motto „right time, right place“: from the dispatching at Güntner in Fürstenfeldbruck ...



... and the delivery ...



... to the mounting on the rooftop of the Rinecker Proton Therapy Center.

Contrary to the hitherto customary photon radiation, the new 3-D targeting used in the RPTC, and the innovative proton technology promise a significantly higher chance of remission with less damage to healthy tissues. The Center is designed for the ambulatory treatment of 4,000 patients per year. Planning and configuration of the complete refrigerating plant in the RPTC were lead-managed by M+W Zander Gebäudetechnik GmbH from Stuttgart and were carried out in cooperation with Güntner, Fürstenfeldbruck, and the South Germany office of Jäggi/Güntner (Switzerland) AG in Filderstadt.

### Central water chiller systems

To maintain the operation, the cooling system designed by M+W Zander holds ready a total refrigeration capacity of approx. 3.5 MW. The exterior and interior cooling load are compensated by air conditioning systems, air circulation coolers and ceiling-mounted cooling elements. To this end, two central chilled water generation systems with compression refrigerating systems were installed. The water chiller system 6/12 °C has a capacity of 1,050 kW and supplies the conditioning systems for outside air and different areas of the medical equipment.

The water chiller system 12/18 °C has a capacity of 1,250 kW and supplies the air circulation cooling units and the natural convection cooling as well as the second process cooling water cycle. Gebhard Raub, project manager for refrigeration at M+W Zander Gebäudetechnik GmbH, explains: "When we designed and implemented the refrigeration and cooling units for the RPTC in Munich, the most significant aspects were the security of supply and the operating safety. Therefore, the refrigerating systems, drycooling systems and the installation have been equipped with redundant systems."

### Drycooling in a single cycle

The drycooling of all refrigerating systems, including the redundant systems, is carried out by means of a collective, closed, frost-protected cooling water cycle with a total of nine Güntner drycoolers, model S-GFH 102C/2x5-S(D)-F4/2P.

The drycoolers are designed for a total of 3,500 kW capacity with a reserve capacity of 500 kW, cooling the water-brine-mixture from 47.5 °C down to 41 °C, at outdoor temperatures of maximal 34 °C. Mounted in pairs on the roof of the clinic, the unit groups have a clearance of about 2.5 meters between them to ensure a sufficient ventilation during operation.



On the rooftop of the RPTC, there are 9 Güntneraxial drycoolers, model S-GFH 102C/2x5-S(D)-F4/2P.

### Operation adapted to the clinic's requirements

For the fan control, five of the Güntner drycoolers were delivered with directly attached control panels by Güntner Controls: Each of the control panels is designed for a five-stage control, so that two fans of the total of 10 fans per unit are controlled jointly. The sound pressure is suitable for the clinic and amounts to 50 db(A) during the day during maximal operation, measured at 10 meters distance per unit.

During the night, the sound emissions are even lower due to the night reduction provided for in the control. Otto Schmid from the Güntner selling agency South explains: "Especially with regard to the high technical requirements and the precise design of the construction in this project, Güntner was able to put forth a lot of know-how." The cooling water cycle is also used between the seasons and in winter for the free cooling of the cold water system 12/18 °C: "In winter, the water-brine-mixture can be transported through the coolers by pump operation, so that the refrigerating system is not needed. Thus, specifically in the field of operational current, a sizeable reduction of costs can be attained", says Schmid.

### Cooling of the proton apparatus

The nuclear physics equipment of the RPTC Munich consists of a superconductive cyclotron, a radiation guide with numerous magnets, the so-called gantries for the treatment of patients and the electric facilities. The complete system has a cooling demand of approximately 1.6 MW. To satisfy this demand, M+W Zander, under the direction of Dipl.-Ing. Horst Wiercioch, provided the installation of two separate process cooling water systems.

- Process cooling water system I with a capacity of 1,200 kW supplies the cyclotron, the magnets and gantries.
- Process cooling water system II with a capacity of 400 kW supplies the electric facility, the high frequency emitters and the helium compressors.

The cooling cycle I must satisfy specific requirements regarding the water quality; therefore, these cooling water loads were combined in one system and hydraulically separated. The process cooling water in system II is catered for by the water chiller system 12/18 °C.

### Drycooling with hybrid drycoolers

The process cooling water system I is primarily supplied through "free cooling". To achieve this, M+W Zander installed a separate, frost-protected cooling water cycle with two hybrid dry cooling towers of Jäggi/Güntner, model HTK 1.8-52-2S-B6-BU-SX3 with a total capacity of 1,110 kW. Thomas Rack of Jäggi/Güntner explains: "The units were manufactured in accordance with our high standards, and therefore they have stainless steel casing, attached control panels by Güntner Controls and a complete wiring of all integrated components."



Hybrid coolers of Jäggi/Güntner: Ideal for the application in clinical areas due to the absence of legionella and the emission protection suitable for clinics. Photo above: 2 HTK, model 1.8-52-2S-B6-BU-SX3.

As the Jäggi coolers render a refrigeration capacity of 700 kW with a very low power consumption of 5.8 kW for each cooler, this equipment makes an important contribution to the cost-effectiveness of the plant. Thomas Rack says: "To achieve the same refrigerating capacity with a refrigerating system, you'd need at least 40 - 50 kW." The hybrid coolers are able to maintain the required cooling temperature

of 23.5 °C up to an ambient temperature of 30 °C and relative humidity of 60 %. At higher ambient temperatures, the refrigerating system is used for additional cooling. Dry operation of the coolers at a 100 % load is possible up to a temperature of 13 °C, at 60 % load it is possible up to a temperature of 17 °C.

Therefore, the plant in Munich is able to attain 60 to 70 % of the annual capacity through dry operation of the coolers. If the load is higher, the heat exchanger surfaces are moistened in order to achieve a cost-efficient use of the latent evaporative cooling. If the "free cooling" is insufficient, the process cooling water is automatically additionally cooled by the water chiller system 12/18 °C. Moreover, the hybrid coolers are especially appropriate for the use in clinics due to their additional positive characteristics:

- Absence of legionella: As the water used for moistening is not sprayed and the coolers are absolutely vapour-free, the risk that legionella might appear is almost non-existent. "Especially in France, where for the last two years legionella have been a very important topic, we sell more and more hybrid coolers for use in clinics. Europe-wide and in 2004 alone, we have already provided hybrid coolers for 14 clinic projects, four of which were realised in Germany", explains Thomas Rack.
- Emission protection suitable for the clinic: Due to the fact that the units are equipped with low-noise fans having a special blade design, the hybrid coolers of Jäggi/ Güntner have a maximum sound pressure level of 75 db(A) per fan. This corresponds to a sound pressure level of 47 db(A) per cooler measured at 10 meters distance.

### The Proton Therapy

In radiotherapy, radiation ionizes tissue molecules. This ionization leads to damages at the nucleus, among other things, eventually interrupting cell division and thus causing the death of this cell. Protons deposit their maximum en-

ergy at the end of their travel through tissue, i.e. the proton energy is determined such that the maximum energy is deposited directly in the tumor site. Compared to conventional radiotherapy, the proton therapy has a lot of advantages:

- No energy is deposited in the healthy tissue behind the tumor.
- Protons deposit much less energy in front of the tumor than photons.
- Very few adverse reactions
- Possibility to deposit higher radiation doses inside the tumor
- Much higher probability of stopping tumor growth
- Reduced number of developing secondary tumors

Therefore, the proton therapy is especially suited for younger patients as well as tumors that are located close to radiosensitive organs and body parts.

### Hybrid coolers: saving of costs with efficient planning

- Hybrid dry coolers are characterised by especially low operating costs. For this reason, according to experience, even high purchase costs amortise themselves inside of two to three years.
- Jäggi/Güntner deliver their hybrid coolers as plug-in-units with all required components readily installed –including electronics and controls. When arriving on the site, the units are already assembled and can be put into operation directly after the installation.