The Evolution of the Brewery Chiller System

A 20 year retrospective

By Jim VanderGiessen Jr, Pro Refrigeration Inc.

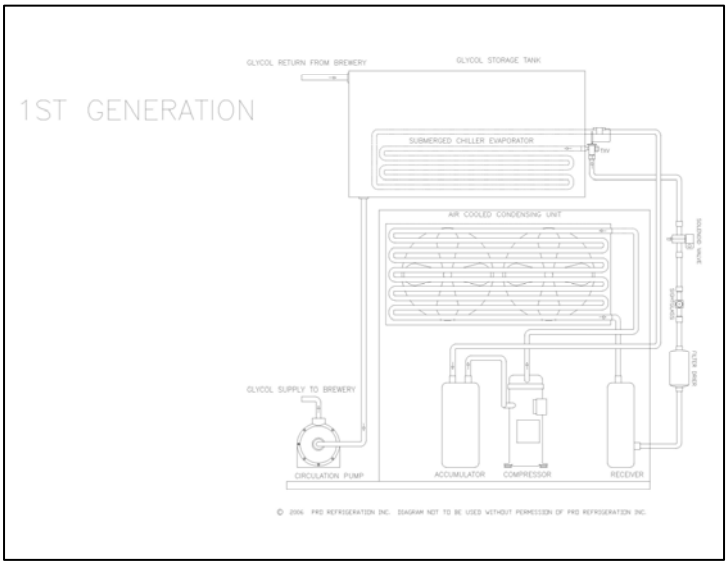
It is hard to believe it's been almost 20 years since we manufactured our first "brewery" chiller system for a small brewpub in Seattle. A look back over the past 20 years reminds us of the great challenges and advancements this market has presented. We owe the brewing industry a great deal of credit for development changes we have applied across our product line to all of the markets we serve.

A list of just a few early challenges the brewery chiller systems:

- **Operating at 25 to 27 F Glycol Solution Temperature.** Prior to breweries our chiller systems operated at 35 F Glycol Solution temperature. The challenge wasn't reaching the lower temperature, but supplying this reliably and efficiently.
- **The fluctuating cooling load.** The only constant found in breweries is the constantly fluctuating load conditions- in a short span the chiller load could jump from 10% to 100%. As loads change, flow rates change- causing even more variables.
- **Extreme Ambient Conditions.** There is an obvious correlation between hot weather and increased beer production. Another obvious connection is that a cooling system operating under a heavy load during hot weather is extremely challenging. Although it wouldn't seem to be as big of an issue, it is as difficult for a refrigeration system to operate under extreme cold conditions too.
- **Fermenter Jacket Cooling.** In addition to the challenge of keeping the glycol supply line pressure below the cooling jacket pressure rating, the glycol flow had to meet the breweries ever changing flow requirements.

There has been three main "generations" of chiller systems supplied to this market during the past two decades, with many of each style still in operation today.

The 1st Generation Systems, were often assembled the same way many of the early breweries were. One part was salvaged from one place, another part purchased from another, and then an expert, or adventurous amateur, somehow assemble it all together and made it work.

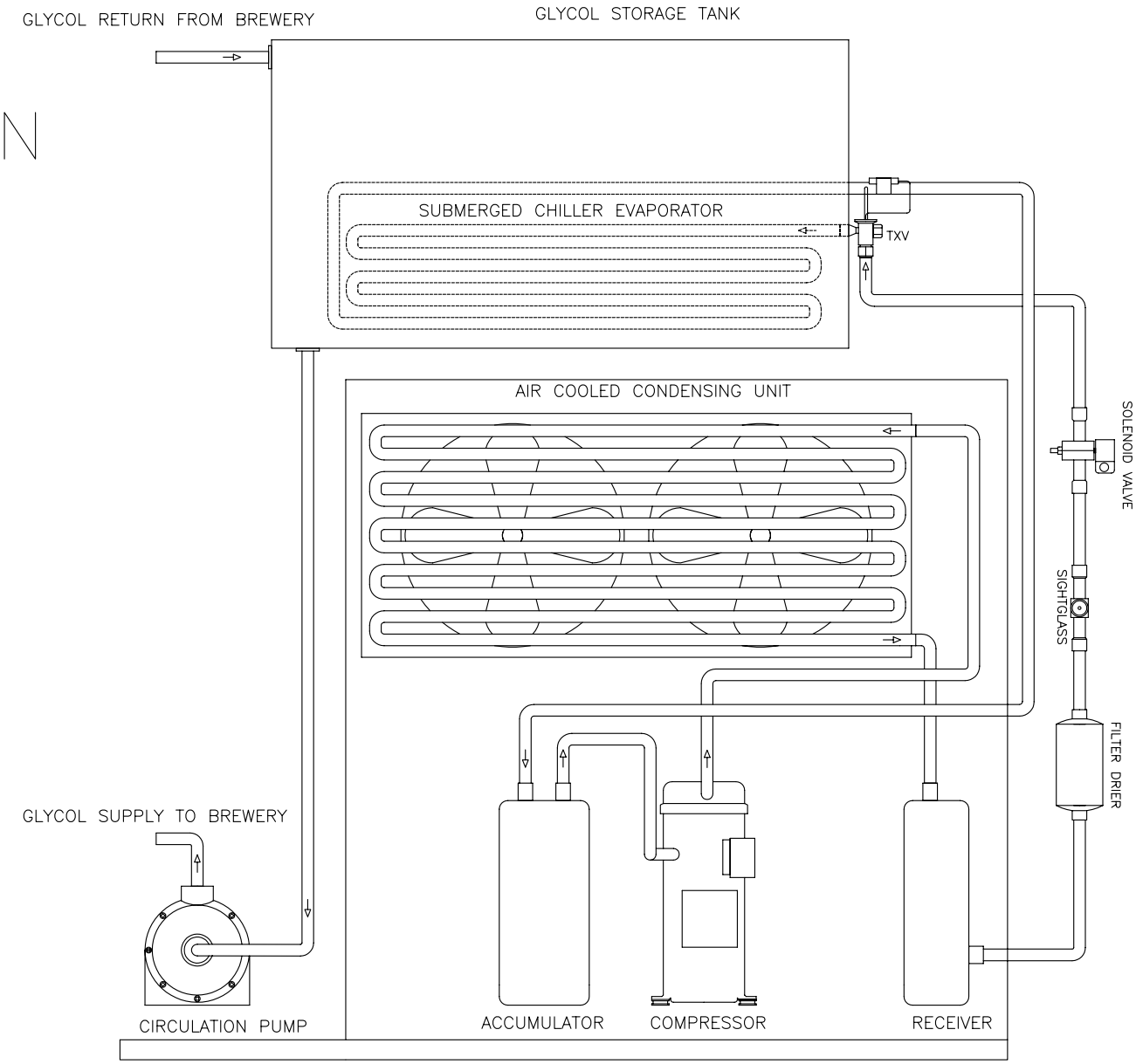


The basic components of each chiller system are:

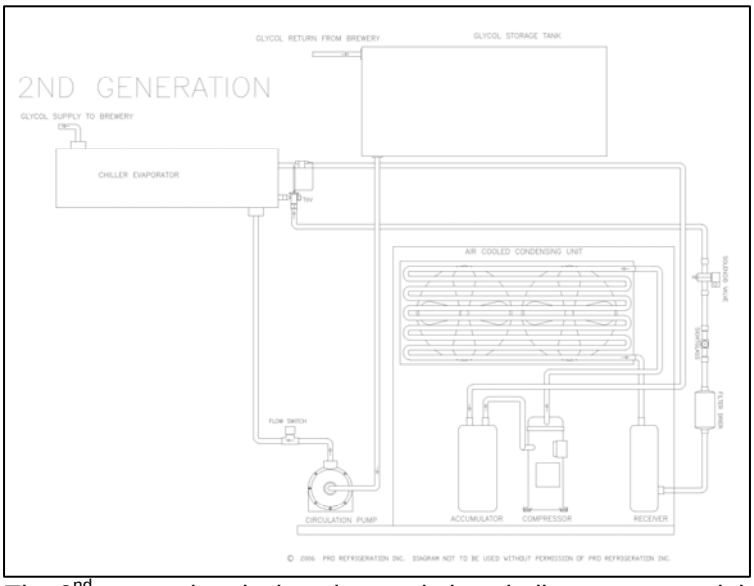
- Condensing Unit consisting of a compressor, condenser, receiver, and sometimes a suction accumulator.
- Glycol Pump
- Chiller Evaporator
- Chilled Glycol Storage Tank.

The 1st Generation System brought many challenges. The biggest was the passive, inefficient, heat exchange. By simply submerging a coil there was no forced heat exchange between the glycol solution and refrigerant. To operate at 27 F Glycol, required a very low refrigerant temperature. As the refrigerant temperature dropped, so did the compressor capacity and efficiency. This led to liquid flood back and slugging of the compressors- causing numerous system failures.

1ST GENERATION



The 2nd Generation introduced the external, “shell and tube” chiller evaporator. Although commonly used on higher temperature air conditioning systems, the manufacturers were hesitant to approve them for this lower temperature application due to risk of freeze up.



Although the heat exchange ability improved, a new challenge surfaced. They were unable to supply enough glycol flow to the Fermenters. The flow was limited to what could be pushed through the chiller evaporator, often less than optimum for the expanding brewery.

The 2nd generation design also made it a challenge to control the flow of refrigerant to the evaporator. As the number of Fermenters calling for cooling fluctuated, the flow through the evaporator would change, sometimes dramatically. As the flow decreases, the amount of heat exchange in the evaporator decreases, the refrigerant control valve (TXV) must adjust accordingly- often an impossible task.

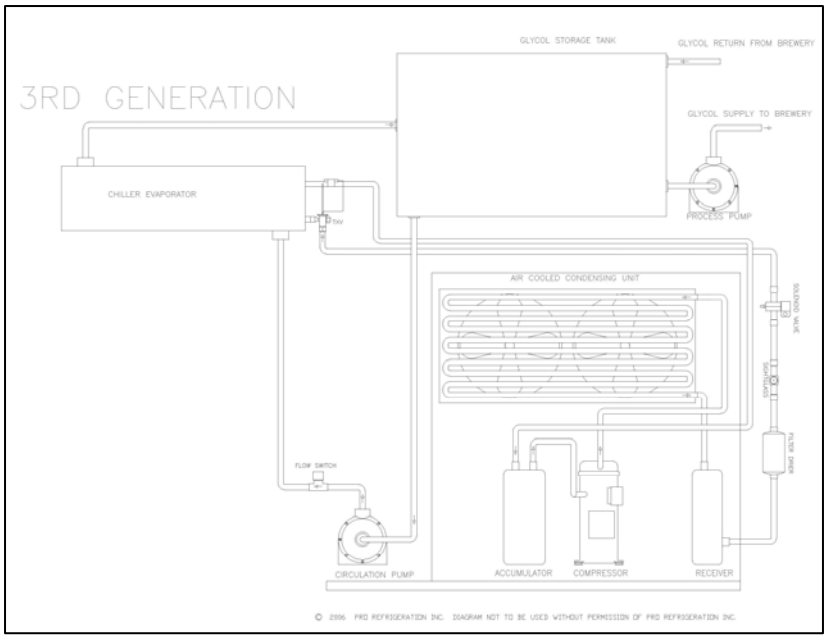
Many of the challenges have been overcome with improved system design and operating controls. Today you will still find a number of systems manufactured in this “2nd Generation” design, operating quite effectively and reliably. The optimum application for these systems is a constant, steady load with little fluctuation.

Our biggest contribution to the development of the brewery chiller system was the introduction of the Two Pump Glycol Design. The two pump design simply provided constant flow through the chiller evaporator at all times.

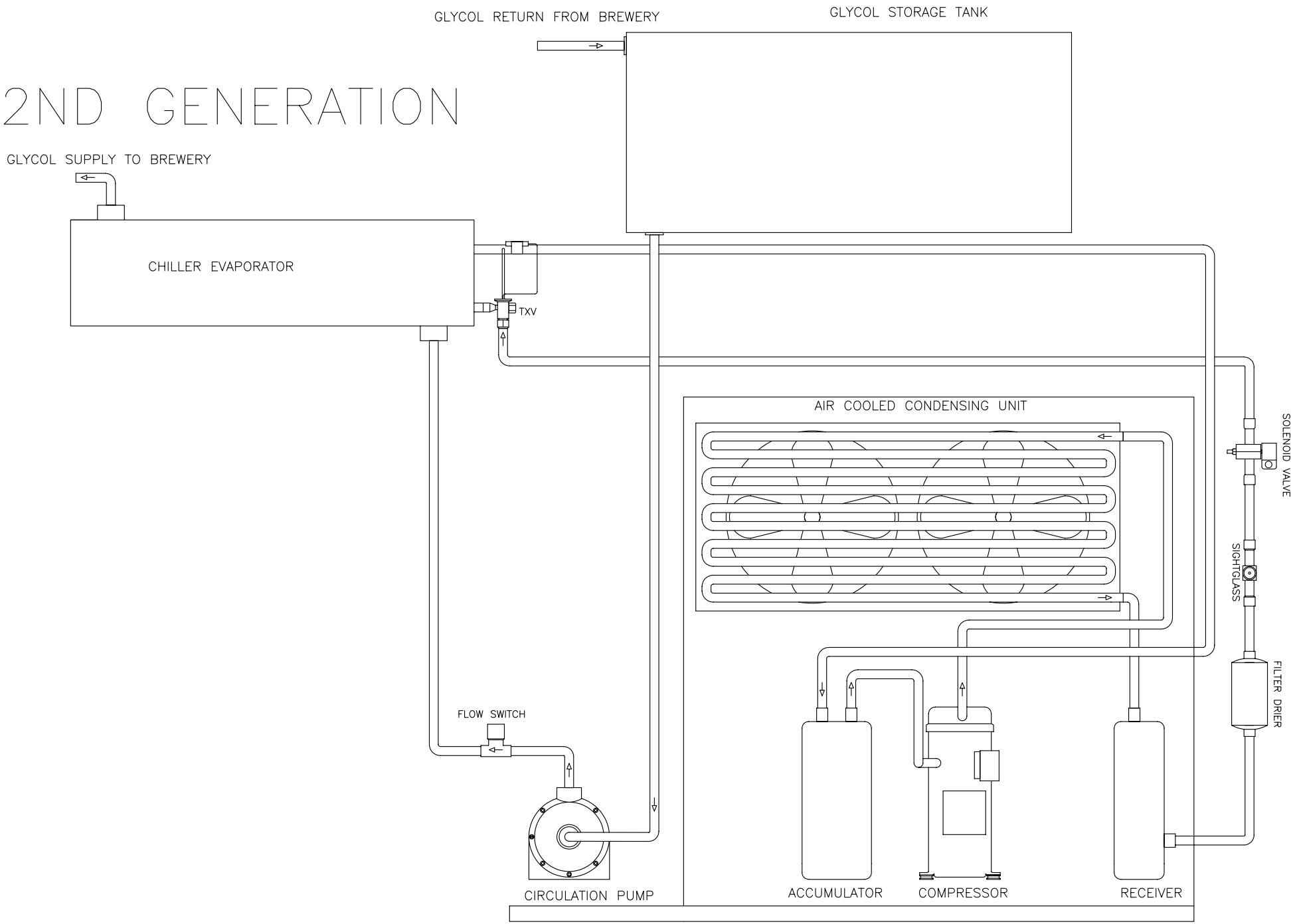
With a dedicated Circulation Pump (Pump 1) the highest evaporator efficiencies are achieved at all times.

The dedicated Process Pump (Pump 2) is sized specifically for the brewery load, no longer was our flow limited to what could be pushed through the chiller evaporator.

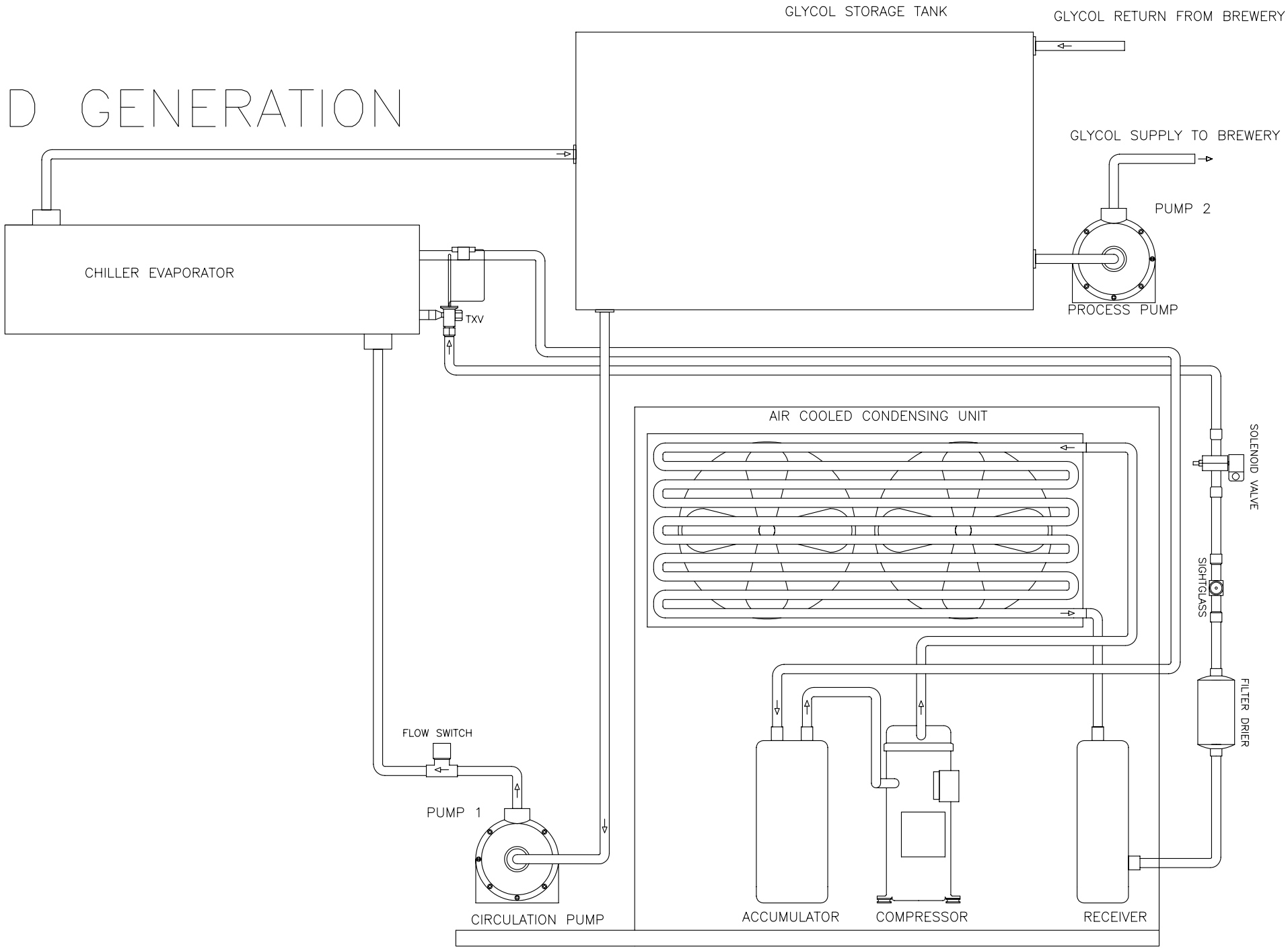
This design has improved continuously over the years with the addition of the center baffled storage tank, improved pump operation, high efficient evaporators, and many other features and controls.



2ND GENERATION



3RD GENERATION

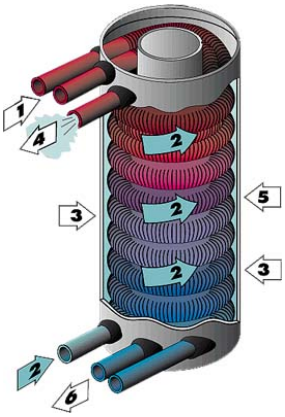


Throughout the development process, there have been two main chiller system controls; a thermostat to control the glycol solution temperature and a flow switch to protect from freeze up damage.

Thermostats have evolved from a basic mechanical device to today's microprocessor or PLC based controllers that actually trend and anticipate temperature loads and changes. In addition to superior temperature control, brewers are requesting the remote monitoring and notification ability these controllers provide.

The Freeze Protection has also shifted from the mechanical paddle switches to refrigerant pressure monitors, highly accurate and reliable flow sensors, and pump motor monitoring providing unmatched system protection.

We have come along way from the submerged copper coil that was placed inside the glycol reservoir. Today's systems are supplied with compact high efficient evaporators, providing very close approach temperatures (the Temperature Difference between the refrigerant and glycol) plus providing reliable and durable operation. The introduction of electronic expansion valves has helped increase the operating efficiencies and reliability of today's systems.



The single biggest advancement is the total system control now provided. No longer does a customer need to purchase the brewery chiller system from multiple vendors and assemble onsite, today there are a number of chiller system manufacturers providing the total package for just about any size facility.

There are numerous interesting technologies being introduced to this market including absorption technology, screw compressors, the application of variable frequency drives, new refrigerants, utilization of heat reclaim for building or water heating, and many more. Looking forward we are very excited, we can only assume the next twenty years will be as interesting and full of challenges as the previous.

Jim VanderGiessen Jr. is CEO and general manager of Pro Refrigeration Inc., Auburn, WA., a 17 Year Company specializing in manufacturing Glycol Chiller System for numerous Food and Beverage Markets.