Saving Energy in pumped system

with Vapor Quality Control

PRODUCED BY

Pumped refrigeration systems are a popular and reliable choice in many industries. However, they can be inefficient when running at partial load, which they often do. Vapor quality control can help solve this problem, increasing energy efficiency and reducing refrigerant charge at the same time.

When cooling systems run at partial loads, circulation rates tend to increase as less heat is supplied to the evaporators. With higher circulation rates, an increased amount of liquid needs to be transported back to the separator, which causes increased pressure loss in the wet suction line and the compressors must work harder to maintain a sufficiently low suction pressure.

The lowest energy consumption is therefore achieved when the circulation rate is optimized for current freezing capacity. However, if the circulation drops too low, the liquid distribution might be inadequate, and the capacity of the system may be reduced.

To alleviate this problem, HB Products has developed the vapor quality control sensor measuring the amount of liquid present in the gas leaving an evaporator. To maintain a consistent liquid content in the gas, the circulation rate can be adjusted by installing a valve between the pump and the evaporator, or with frequency control of the liquid pumps.

By reducing the liquid feed, the system continues to operate effectively, allowing the suction pressure to be maintained or even increased, resulting in lower energy consumption. A reduction of the circulation rate also reduce the needed charge because the excess amount of liquid is not accumulated in the suction line. In many systems using vapor quality control, it has been possible to expand the system with additional evaporators without increasing the charge and piping size, just by controlling the circulation rate.

New Zealand meat processor ANZCO incorporated the vapor quality sensor into an ammonia tunnel freezer system in 2021. The system design was complex, with the location of the freezers requiring a 9m suction lift, and very low ammonia suction vapor density at the temperatures required (-44°C). With some fine tuning of the system, however, the commissioning team were able to set up the vapor quality sensor in a way that provided a wetness of around 1.2:1.

"The installation of the HB Products vapor quality sensors made the project operate successfully at extremely low temperatures. We are still not sure how this project could have been installed without their use."

Dennis Carswell, ANZCO FOODS LTD

HB Products

REPORT

ANZCO FOODS LTD WAITARA NEW ZEALAND

ULP FREEZER PROJECT 2021

Undertaken by:
Excel Taranaki Ltd
Hawera New Zealand
Prepared by:
D.Carswell (Project Design)

HB Products

OVERVIEW

Excel Taranaki Ltd installed the reticulated ammonia refrigeration system for three Pattie Freezer Tunnel Freezers (supplied by the client)
This included, but not limited to:

- 2 x new Mycom screw compressors skids
- 1 x ULP suction separator c/w 2 x ammonia liquid pumps
- 1 x new ammonia liquid receiver
- 1 x ULP compressor discharge desuperheater system
- Ammonia Liquid and Suction mains

OPERATING PARAMETERS

- 3 x freezers each with 3 coils
- Each of the 9 coils is 76kW @ -44°C
- Coil circ rate required by the manufacturer was 4:1
- Freezers run to fail, frosted coils) before cleaning and defrosting
- Suction lift around 9m
- Compressor suction -47°C
- Ammonia Mains Freezer to plant room around 100m

OPERATIONAL DESIGN CONSTRAINTS

The freezers were in the middle of a production hall. The only way to get the ammonia to-and-from the freezers was from the roof above. This then required a 9m suction lift.

The very low ammonia suction vapour density, at -44°C, made the suction riser design rather complex when each of the 9 coils needed to be individually supplied with liquid, suctions and defrosting.

To assist with defrosting Danfoss ICFD defrost modules were installed on each coil along with individual liquid control valves.

While this completed the liquid and defrosting design the suction lift was still an unresolved operational issue. At that time we were introduced to the HB Products range of products and it was noted the VQS (Vapour Quality Sensor) system may well be the solution.

After consulting with the HB Products design team it was decided that the VQS units could be the answer.

INSTALLATION

The VQS, ICDF defrost modules and modulating liquid level control valves were incorporated into the design.

It was then noted that these products had a minimum temperature limit higher than the required operating temperature of the refrigerated space.

Research was conducted on how to overcome this temperature issue.
This included:

- Insulated and heated boxes around the valves
- Relocate the valves to a warmer space above the freezers

The thoughts around the heated boxes were dismissed as impractical and relocation became the only viable opinion. This meant the VQS, ICDF defrost modules and modulating liquid level control valves were not located in the ideal position, adjacent to the coils, but some 3m above.

OPERATING

At commissioning time it was proven that the freezers would operate at the desired temperature even with the control valves etc not ideally located. The VQS sensor were able to be set up in a manner that provided a wetness of around 1.2:1.

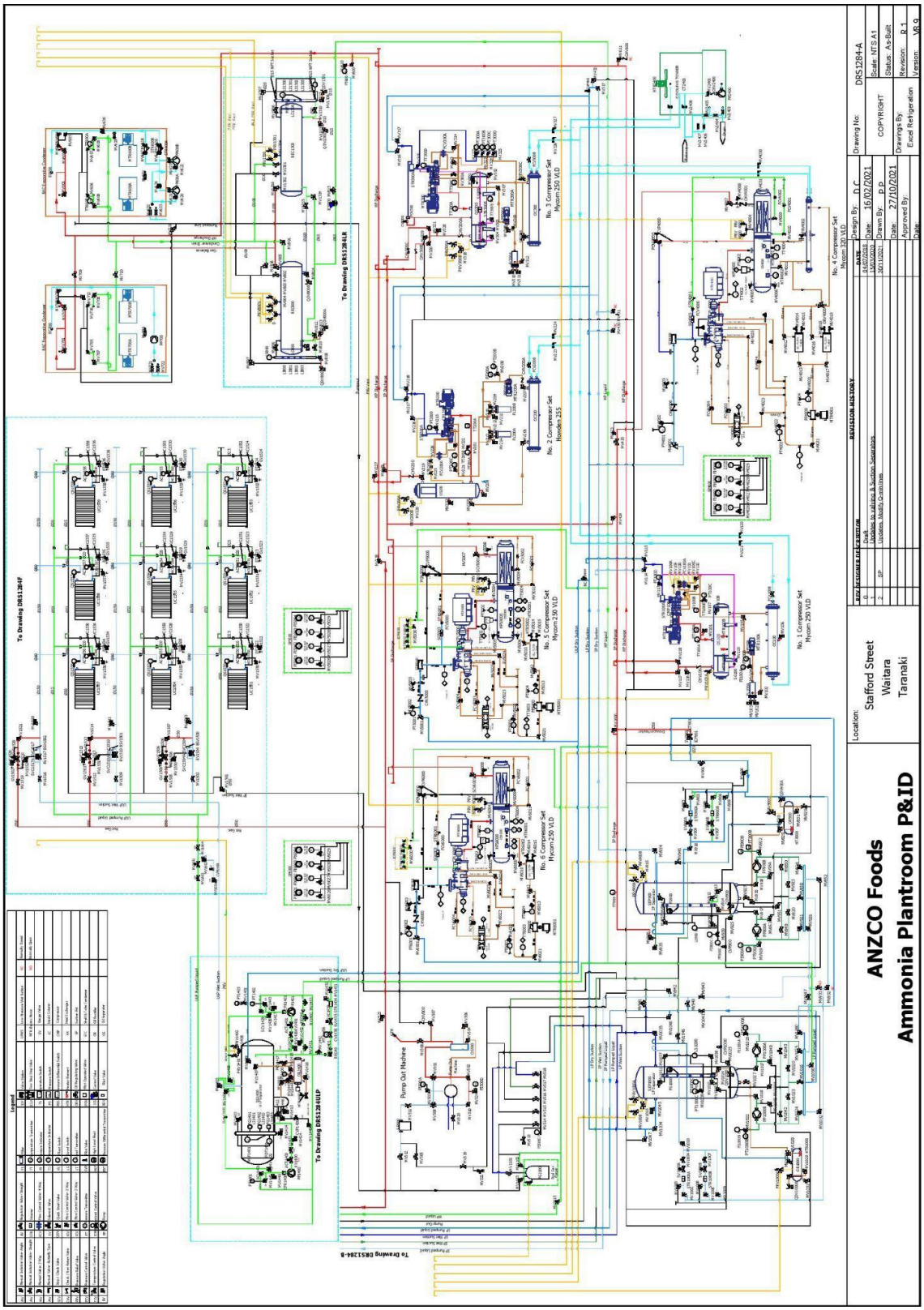
While this took the commissioning team a little time to fine tune the system it was able to maintain the desired temperature in the rooms even with the very high 9m suction risers.

SUMMARY

The installation of the HB Products VQS sensors made the project operate successfully at the extremely low temperatures. We are still not sure how this project could have been installed without their use.

We have not integrated the VQSs into any other designs only because the need has not presented itself but we would use these products again as the design allowed.

P&ID


ANZCO Foods
Ammonia Plantroom P&ID
Location:
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Drawing No: DRS1284-A
Scale: NTS A1
Status: As-Built
Revision: R_1
Version: V6.9
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