Johnson Controls
Building Efficiency - Refrigeration
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Galleon Centre Ice Rink
99 Tichfield Street
Kilmarnock
Ayrshire
KA1 1QY

E-mail

22 April 2013
Ref: JB/C10614e/td

For the attention of: Mr David Carey

Dear Sir,

Re: Replacement Refrigeration System

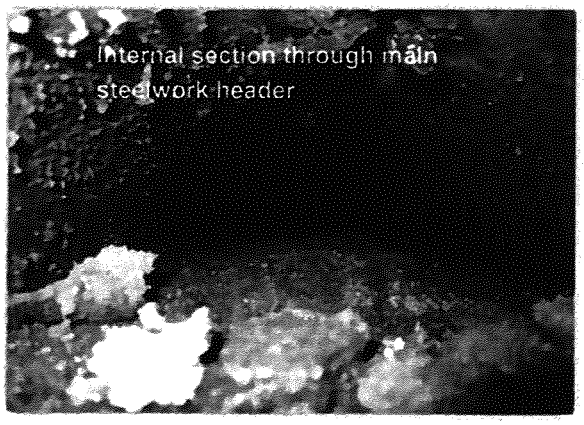
Further to our recent discussions, we take pleasure in updating our proposals to accommodate your requirements.

We understand you have a requirement to replace the refrigeration system currently serving the Ice Rink and are also investigating the installation of a dehumidification system.

Following on from an installation recently carried out, I believe it would be advisable to offer a more robust system that greatly reduces the risks of leaks from the connections of the pipework sunk into the concrete floor and the main return header. As we will also provide a 12-month warranty, we would be confident that our new proposal would offer a higher level of comfortability around the integrity of the system.

It would consist of changing the main Ice Pad headers to HDPE pipework and the type of connections on the return ends and the main header to electrofusion type.

By removing the secondary metal header, there is a significant reduction in risk. Most leaks occur with secondary headers through corrosion of the internal walls of the metal pipe or failures in the coupling where the cooling pipes are attached to the header nipples. Another cause of leaks or pipe bursts in this area is caused by a build-up of rust deposits at the return loop, causing a blockage which places additional pressure on the internal walls and joints. Another cause of leaks in metal secondary headers is a failure of the weld at the nipple. We understand this was the cause of a leak at a similar Ice Rink. By removing the metal header, this risk is eliminate



There is an estimation that more than 80% of all UK rinks have at one time or another experienced a leak in the cooling floor system resulting in a loss of the secondary refrigerant after several years of use. In some cases, the leaks have been quickly identified and coolant losses have been kept to a minimum. In others, a significant charge has been lost, often in its entirety resulting in a system shut down, loss of ice and closure of the ice rink. Through experience, we now recommend the use

of electrofusion connections rather than the connection clips currently being proposed and originally installed. These clips can corrode and loosen under vibration and there is an increased risk of a leak in future in these specific areas. As we have seen, the clips fail and leak, this would not be good if it was underneath the concrete.

New return ends in HDPE pipework will be manufactured off-site in advance of the next stage of works. The new returns are placed on to the chairs, and the adjoining pipes cut to size so that the new and existing pipes can butt up to one another. An electrofusion coupler is used to join the old pipe to the new pipe, with the steel chairs either side acting as a secondary support. Once all pipes are connected, the re-enforcement mesh is laid over the pipes and secured to the chairs using clips. We would also recommend this kind of jointing at the main header end.

Refrigeration System

We would offer to replace the existing system with an industrial design system utilising two open-drive compressors, surge drum / PLHE assembly matched to your existing evaporative condenser.

We would like to offer the following for your consideration.

Site built R507 refrigeration system. This would consist of two off open drive reciprocating compressors to accommodate the replacement of the current system's capacity. Matched to this would be a refrigerant surge vessel and secondary plate heat exchanger. This heat exchanger would utilise the cold refrigerant on the primary circuit and reduce the rink brine to -13°C in its secondary circuit. The heat rejection would be accommodated by the existing externally mounted evaporative condenser. If required, we can include a discharge line desuperheater for underfloor heating purposes.

Our proposal would include the following:-

- Decommissioning of existing refrigeration system.
- Safe disposal of refrigerant.
- Supply and installation of new refrigeration system.
- New control panels for replacement equipment.
- Supply and installation of new starter for compressor motors, pumps and condenser.
- All refrigeration pipework connections.
- All connections within the plantroom to Ice Pad underfloor pipework header.
- Supply of desuperheater (see optional price).
- Digging up the rink at the return ends to enable replacement bends to be installed.
- New Ice Pad pipework headers at either end of the rink.
- New Ice Pad distribution circulating pumps.
- Insulation to low temperature pipework and vessels.
- Colour code pipework to JCI standards.
- All required isolation valves.
- Test system and commission.
- Handover on completion.

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System Overview

The system we propose shall utilise the latest technology in terms of compressor design, with capacity control to ensure the capacity is always adjusted to suit requirements. This then leads to lowest possible operating costs. Each compressor comes complete with its own state-of-the-art microprocessor which makes efficient running easy to control ensuring better operating economics.

The monitoring system is based around tested and proven refrigeration control modules used in PLC and SCADA workstations. It will provide information displayed in graphic form on PC screens. The standardised control modules are designed to meet the control and system management requirement associated with this design.

A complete overview of the plant operation is available, from which it is possible to monitor running data and operating parameters such as set points, timers, alarm shut downs and start / stop times. This is all web based therefore it is possible to view this on any computer once logged in.

The benefits of this is, it is easy to understand and makes centralised operation straight forward, savings on manpower, plant can be constantly analysed paving the way for optimisation that boosts performance and cuts energy costs. It will also meet traceability and documentation requirements.

Mechanical Specifications

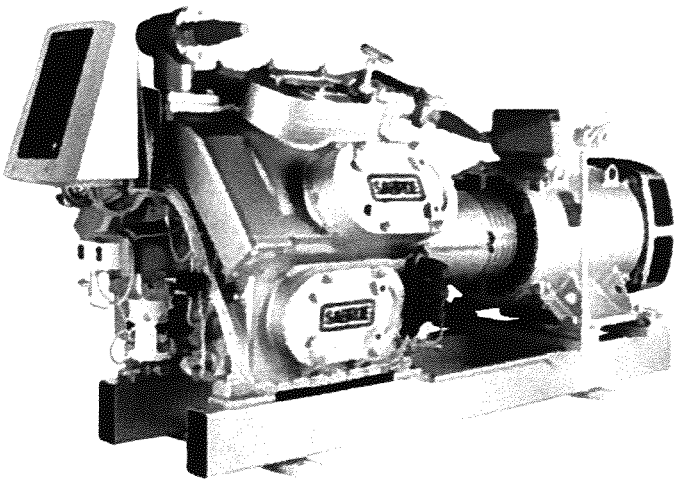
Compressors

We shall offer two off reciprocating compressors as per existing design.

The refrigerant we have selected has a GWP of 1610 which is lower than the current phase out target of 2500.

Compressor Selections

Manufacturer	: Sabroe
Type	: Open drive reciprocating
Refrigerant	: R407C
Quantity	: 2 off fixed speed
Evaporating temperature	: -16°C
Condensing temperature	: +32°C
Cooling capacity (each)	: 148.1kW
Shaft power (each)	: 586kW
Motor size	: 75kW
COP	: 2.53



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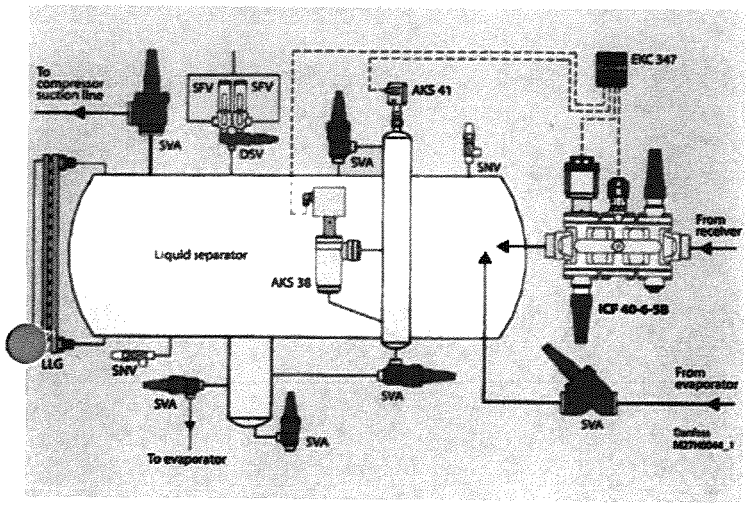
Evaporative Condensers

The current condenser has been checked and will accommodate our proposed design.

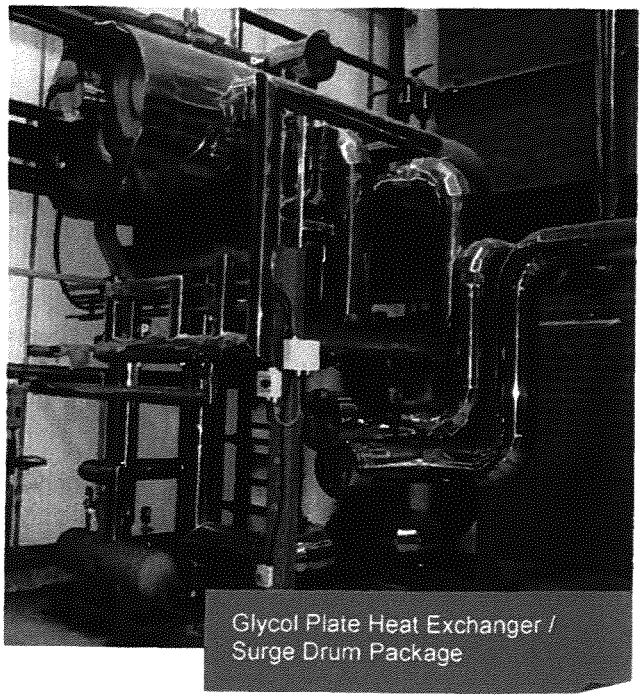
Refrigerant Surge Drum Assembly

Evaporating temperature	: -16°C
Condensing temperature	: 32°C
Duty	: 296.2kW
Design code	: PD5500:2003
Manufactured to	: DIR97/23/EC
Refrigerant	: R407C
Design pressure	: 16 bar
Design temperature	: -5°C / +50°C (dual rated to -45°C @ 5 bar)
Dual pressure relief valve assembly	: Set at 16 bar
Electric heater fitted in oil vessel	: 800W
Level probe and column	: Column fitted
Level controller	: Fitted with 4-20mA output
Dimensions	: 4900mm x 1400mm

Please note: Pipework to PED 97/23/EC



Typical Surge Drum Valve Arrangement



Glycol Plate Heat Exchanger / Surge Drum Package

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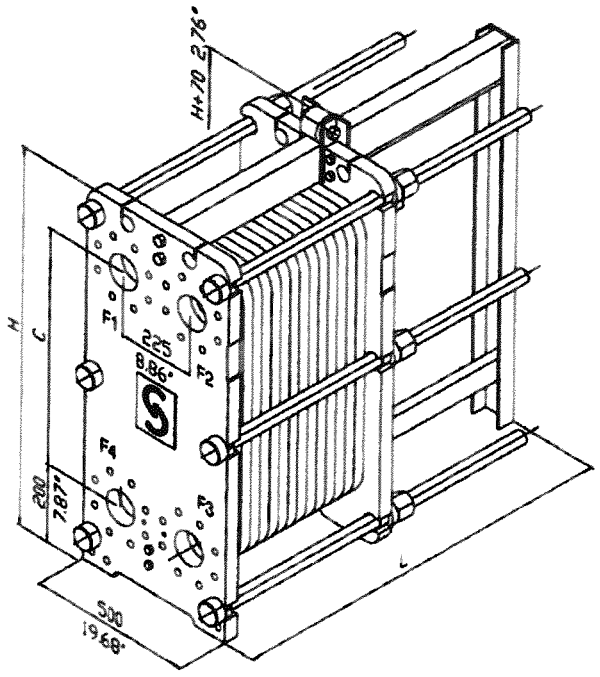
Evaporator Plate Heat Exchanger

No off	**1 x Process**
Cooling duty	: 300kW
Fluid	: 25% CaCl
Mass flow rate	: 20.3kg/s
Inlet temperature	: -9°C
Outlet temperature	: -13°C
Plate material	: 304
Refrigerant temperature	: -15°C



L= 600 - 3000
L= 23.62" - 118.11"

FRAME SIZE	DIMENSION H	DIMENSION C
SW26a	1039/40.91"	655/25.79"

Electrical

Control Panel

Compressor No1
This section will house a starter for a Star Delta compressor as detailed, with the following auxiliaries:-
- Running light
- Tripped light
- Power on light
- Sabroe interlocks as required

Compressor No2
This section will house a starter for a Star Delta compressor as detailed, with the following auxiliaries:-
- Running light
- Tripped light
- Power on light
- Sabroe interlocks as required

Condenser and Vessel Control, etc
This will consist of the following starters and controls:-
- Fan starter complete with run and fault lights
- Pump starter complete with run and fault lights
- Heater supplies
- Set of water level and temperature control interlocks
- Surge drum oil heater supply
- Set of surge drum level controls and make up valves
- Glycol pumps complete with run and fault lights

Site Wiring

To supply and install site wiring consisting of galvanised cable trays and ladder racks in void, armoured cabling, and screened cabling for the temperature probes and pressure transducers. Suitable isolation will be provided for each item of equipment.

Refrigerant Detection Panel

A new panel and detection system shall be installed.

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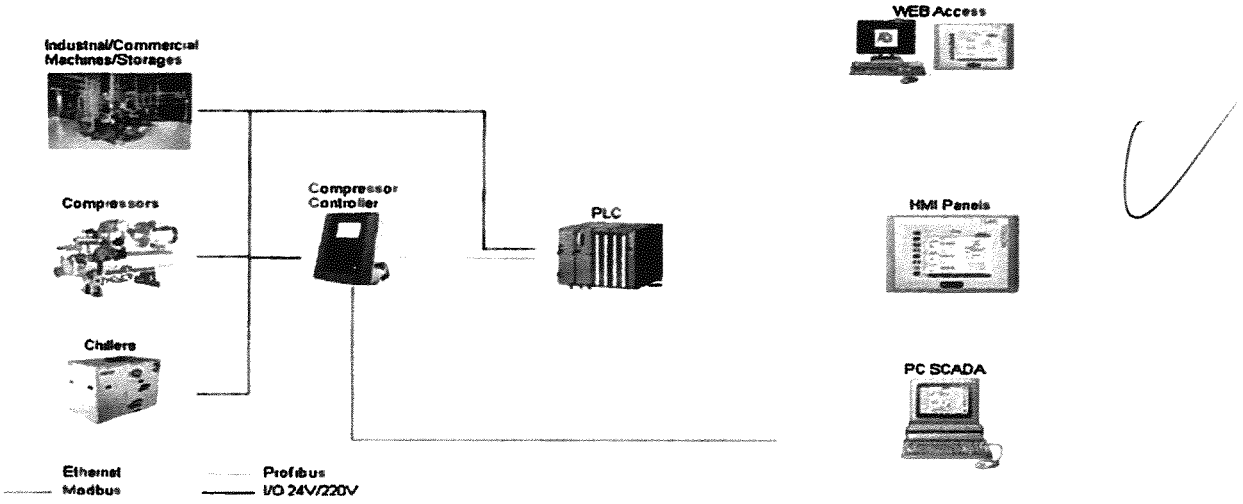
Monitoring

To supply and install an integrated monitoring package giving running status of the equipment, pressures and operating conditions of the compressors (running and fault), trends and graphs of temperatures, records of faults, dial-out on fault and dial-in facility to interrogate the system if required (free issued telephone lines will be required). We have allowed for yourselves to download the information to CD and print as required for records as previously installed on other sites by ourselves. We have allowed for the unit to be installed in the switchroom.



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Pipework and Valves

Our Company includes for the design, supply and installation of one complete set of interconnecting refrigeration pipework, which shall be installed in accordance with accepted refrigeration practices EN378.

Pipework bracketing shall be designed in accordance with accepted practices and all low temperature pipework supports shall have high density thermal break supports.

We further include all required system safety shut off and regulating valves required within the system, in order to allow for the local isolation of each major vessel and components.

Valves & Controls

Adequate valving will be provided for isolation and maintenance.

- Isolating valves - Danvalve or equivalent
- Non return valves - Danfoss or equivalent
- Refrigerant regulators - Danfoss or equivalent

Pressure Testing

On completion of the pipework installation a pneumatic leak pressure test will be carried out by our engineers. This will be witnessed by a member of Zurich Insurance to comply with PED regulations. The tests will be carried out using oxygen-free nitrogen and the pressures will be 1-1.1 x PS respectively.

Any free-issue equipment and existing PRV's are to be supplied to JCI certified (by others) otherwise there may be additional charges for re-certification or new replacements may be required. Further, in the event of pressure test failure on free-issue equipment, any additional pressure tests will be charged.

Floor Works

Removal of Brine from the System

We will remove the existing secondary refrigerant (brine) from the cooling system and pump the liquid into clean, uncontaminated IBC containers for storage on site until it is required again.

Pressure Testing to Unblock Pipes

Once the brine is successfully removed, we will pressure test the cooling floor circuit to 1.5x operating conditions in a bid to remove any remaining rust deposits which may be causing blockages.

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Removal of the Existing Main Header System

We will remove the header pipes and transfer the cut sections into metal skips located in the service yard area. The waste metal will be disposed of using an accredited waste metal dealer, preferably one specialising in recycling.

With the header removed, we will clean the header trench making this available for inspection to determine whether it is structurally sound. Any remedial works required to the header trench floors or walls, drainage system or otherwise is not included in this quotation.

Removal of 600mm-800mm of Concrete

We will commence removal of the concrete floor at the far end of the ice pad. Initially, this will involve the drilling of several trial holes to determine the depth of the concrete above the pipes.

The concrete needs to be removed in an 'archeological' manner insofar as it is vital that the cooling pipes beneath the retained concrete are not damaged, bent or cut.

As the concrete is removed, the debris is transferred on to a large plastic membrane, placed over the existing and retained ice pad. The debris is then transferred to a waste skip positioned in the service yard for onward disposal.

Any redundant reinforcement metal is cut into smaller sections and will be transferred to waste metal skip for onward disposal using an accredited contractor.

We will remove all the concrete and reinforcement mesh, steel chairs, debris and dust leaving an exposed section of cooling pipe, secondary header and the Visqueen slip plane.

Removal of the Secondary Header and Approximately 600mm of Cooling Pipe

Once fully exposed, the secondary header is cut into smaller sections and removed. Smaller cooling floor pipes will be cut back leaving approximately 300mm exposed beyond the cut back concrete.

New steel chairs will be installed beneath the exposed pipes approximately 100mm from the end to provide a new support ahead of welding works. Each pipe will be clipped to the steel chair.

- Plastic HDPE or MDPE pipes will be cut using pipe cutters.
- Steel pipes are cut out using grinders.
- A hot works permit is required.
- During hot works, the Visqueen membrane is protected with fire blankets to avoid puncture or burning.

Installation of New Return Ends and Adjoining Pipes

A further line of steel chairs is installed approximately 350mm from the ice rink perimeter upstand.

New return ends will be manufactured off site in advance of the next stage of works.

The new returns are placed on to the chairs, and the adjoining pipes cut to size so that the new and existing pipes can butt up to one another.

An electrofusion coupler is used to join the old pipe to the new pipe, with the steel chairs either side acting as a secondary support.

Once all pipes are connected, the re-enforcement mesh is laid over the pipes and secured to the chairs using clips.

Installation of a New Header Pipe System

We propose to supply 2No header OD SDR21 HDPE pipes, 12mm wall thickness c/w top loading saddles (pre-fabricated off site in advance). These will be supplied in 6m lengths with an electrofusion welded coupler at each joint.

Blanking plates are supplied (4 off) for pressure testing only, and one saddle on the flow circuit shall be fitted with a coupler for connection to our compressors. One of the blanking plates will have an air bleed point. One 25mm drain point is supplied on each of the header pipes nearest the refrigeration plant entry point. We will supply all pipe support brackets and collars as required. The header pipes will be installed with a very small fall back towards the refrigeration plant entry point.


Plastic header arrangement

Connection of the Existing Cooling Pipes to the Header

We will connect the existing cooling pipes to the new header via the saddle using electrofusion welding. An allowance is made for 10% of the pipes to be re-routed with additional couplers

Pressure Testing Prior to Concrete Pour

We will test the installation of the cooling floor circuit at a minimum 1.5x operating conditions. The test will be monitored over a 48-hour period.

Once we are satisfied that there are no leaks, pouring of the concrete can commence.

Pressure will be held in the system at all times during the concrete pour.

Concrete Pour and Power Floating

We will supply concrete, designed by Cemex and approved for use by a Chartered Structural Engineer. We will pour the concrete as a single pour. The concrete will be induction jointed and power floated to a tolerance of +/- 6mm (subject to the existing and adjoining floor being of the same tolerance).

Curing

A period of 4 to 6 weeks is required for curing before the cooling floor can be taken below 0°C.

Sealing of the Crack Joint (if required)

There will be a crack joint between the old and the new floor once curing has been completed. We will provide a Thioflex 600 sealant to the joint which takes 5 days to cure at 10°C.

Charging the System

The system will be recharged using the existing brine from stored IBC's.

Filtering of the existing brine will be done as the brine is being charged back into the system.

There is no allowance for re-testing of the brine solution, however, we do recommend that this is carried out prior to pull down of the plant.

Pressure Equipment Directive (PED)

Where applicable the pressure equipment and assemblies contained within our proposal will comply with the PED (Pressure Equipment Directive).

The directive applies to the design, manufacture and conformity assessment of pressure equipment and assemblies of pressure equipment with a maximum allowable pressure greater than 0.5 bar above atmospheric pressure.

- Under the directive - pressure equipment and assemblies above the specified pressure / volume thresholds will;
- Be safe
- Meet essential safety requirements covering design, manufacture and testing
- Satisfy appropriate conformity assessment procedures
- Carry the CE marking

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Painting and Finishing

We have allowed for all pipework, other than insulated low temperature pipework, to receive a gloss paint finish in accordance with our colour coding. Further to which we shall remove from site all waste materials associated with the plant installation. All valves will be tagged in accordance with our numbered flow scheme.

Refrigerant Charge

A new charge of R407C refrigerant has been included.

Compressor Oil

We have included for a complete new charge of oil for the refrigeration system.

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Insulation Specification

In Situ Polyurethane Foam (Or Similar)

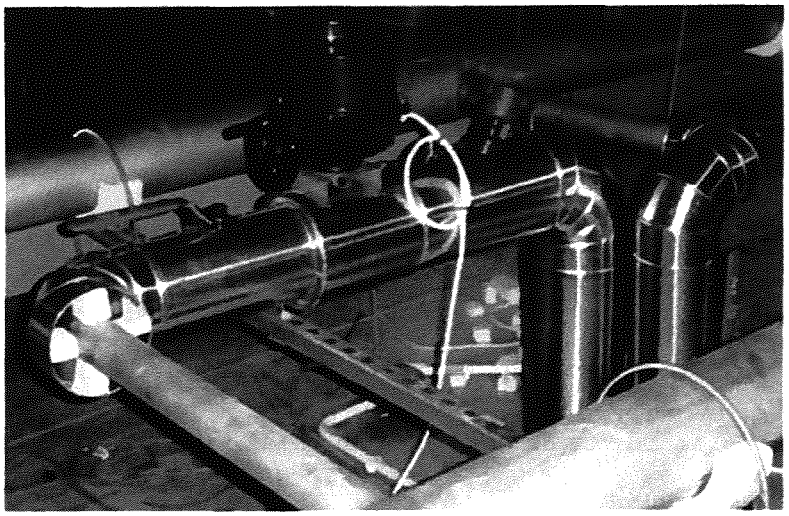
The polyurethane is injected through a 3.3mm drilled hole in the aluminium cladding and to be closed with a rivet foaming. The foam is self-extinguishing.

Vapour Barrier

As the vapour barrier is one of the most important parts of the insulation construction, and to secure a complete continuous unbroken vapour barrier by the final aluminium cladding, the foam will during rising create a vapour barrier foil against the cladding.

Protective Cladding

- The insulation to be finished with pre-fabricated aluminium cladding, quality AL MG 3,0 throughout.
- The final surface (cladding) to be installed water-repellent.



Please note: The basis of our calculated insulation thickness is that no condensation shall form on the external surface of the insulation, provided ambient still air conditions of +20°C / 85% RH and dewpoint of +17.5°C are not exceeded. Roof void ventilation may be required, by others.

Please advise if this will be exceeded and we will update our insulation specification to accommodate.

Please note:
The type of refrigeration system we have proposed is of an industrial nature, as reliability, longevity and power efficiency are important factors when offering systems of this nature.

We can also offer an alternative option to the industrial system we recommend.

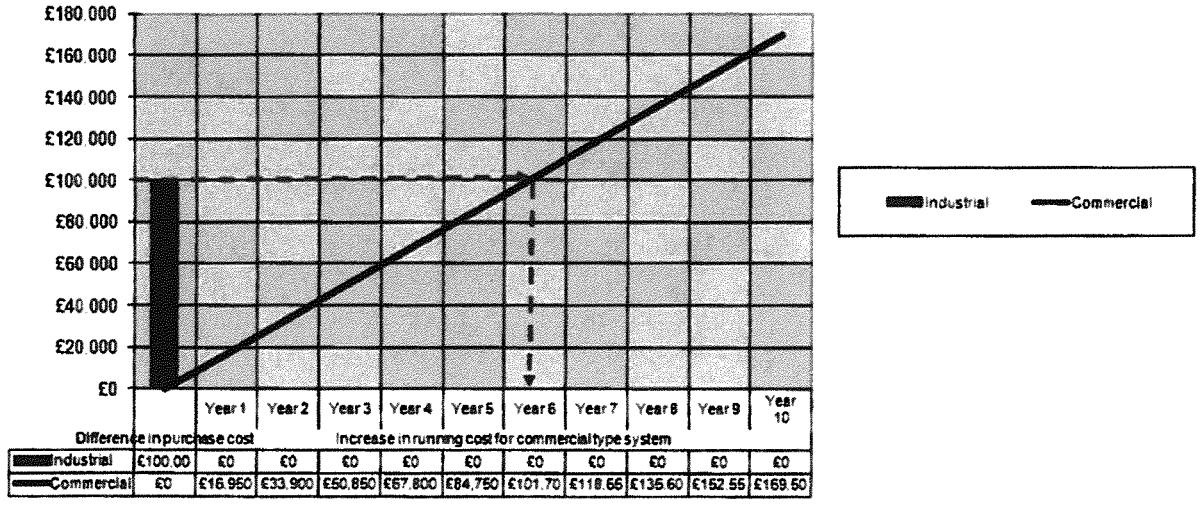
There are various types of systems on the market ranging from light commercial through to heavy industrial and they all have different build quality to accommodate the environment they operate in. Commercial can be seen as air conditioning units whereas industrial can be seen as systems proposed, they all have their own position in the market place.

Generally, the alternative systems operate on the water / glycol chilling processes and can only be classed as commercial.

With regards to life span, there is no general rule in the industry, however, we also need to consider how "hard" the plant runs.

In your application, it will be a constant running load leading to prolonged running times. In such instances, we have found the commercial type systems have less than a 10-year lifespan before a marked increase in maintenance, nuisance trips and breakdowns / failures. Whereas 20-25 years is classed as the norm for the more industrial type unit that we have put forward as our recommendation option.

We have investigated the operating cost of a high efficiency industrial system verses a commercial plant previously discussed.



		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Difference in purchase cost	Increase in running cost for commercial type system									
Industrial	£100.00	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Commercial	£0	£16.950	£33.900	£50.850	£67.800	£84.750	£101.70	£118.66	£135.60	£152.55	£169.50

You can see from the above graph that by just comparing the compressor selections even though there is a £100,000.00 difference between the two options in terms of initial outlay, a payback of only 6 years can be justified. After 10 years, there would be a £70,000.00 return on the investment for the industrial-type system.

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Costing

Our cost for the design, supply and installation of the above shall be for the sum of:

Refrigeration – Including Underfloor Heater Mat, Desuperheater and Pump Installation

£406,972.00 plus V.A.T. (Four Hundred and Six Thousand, Nine Hundred and Seventy Two Pounds Plus V.A.T.)

Training

We would include for in-house training on the new refrigerant installation. We assume this would be carried out over 2 sessions to accommodate the shift patterns of the personnel.

Terms & Conditions

This quotation is subject to receiving the signed official order, confirmation of the end date and agreed Terms and Conditions and is valid for 30 days. After 30 days, JCI reserves the right to modify the price and any other conditions of the quotation at its sole discretion.

We further require full and uninterrupted access throughout the installation period. Should this not be achievable, we will advise additional costs for your approval prior to continuation of the installation.

All orders or contracts arising from this quotation are subject exclusively to Johnson Controls Ltd (JCL) standard terms and conditions of sale a copy of which is available on application. JCL terms and conditions override and exclude any other terms stipulated or incorporated or referred to by the customer, whether in the customer's order, during negotiations or any previous course of dealing.

This tender remains strictly subject to contract pending negotiation of mutually acceptable terms and conditions.

This quotation is based on an estimated time of completion of 20 weeks from the written acceptance of a Purchase Order by JCI. JCI reserves the right to seek financial compensation for any changes to the work schedule not caused by JCI.

Our standard payment terms are:-

30% on receipt of official order.
65% on equipment delivery to site.
5% on commissioning, to be paid no later than 30 days after practical completion.

The above is based upon payment being received within 30 days of invoice.

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Site Cleanliness

During the course of the installation, all Johnson Controls' personnel and associated contractors shall maintain the working environment in a clean and tidy condition. All waste materials shall, on a regular weekly basis, be removed and deposited in skips provided by the main contractor.

Site Supervision

A supervisor shall be nominated for the duration of the installation period to oversee the site at regular intervals and shall be available to attend all required site meetings on a weekly basis if necessary. We do, of course, allow for the overall overseeing of the contract to be monitored.

Principal Contractor / CDM Co-ordinator

It is the client's responsibility to appoint a Principal Contractor or CDM Co-ordinator until the end of the construction phase.

Health & Safety

With regard to on-site contractual requirements, we would confirm that we shall abide by all site rules and regulations wherever practically possible.

Items Not Included For

a. Access for delivery and cranes.
b. Condenser water treatment.
c. Removal of asbestos, etc.
d. Addition of brine.
e. Underfloor heater mat modifications.
f. Any noise attenuation equipment.
g. Any main contractors discount.
h. Hire chilling equipment during the installation.
i. Temporary lighting / power.
j. Written scheme of examination for pressurised systems regulation.
k. Mains electrical connections.
l. Work outside of normal working hours.
m. The supply of spare parts, etc.
n. Anything not specifically mentioned.

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Our Company assumes that electrical power and lighting shall be made available to us during the course of the installation. Further, we assume reasonable access to canteen and washroom facilities shall be given to our site staff.

Our Company shall, of course, ensure Johnson Controls' personnel observe all required safety rules and regulations during the course of the installation period.

I would hope that we have interpreted your requirements correctly, however should our quotation prove favourable we shall be pleased to complete a full site survey in order to confirm our costings.

Assuring you of our best attention at all times.

Yours faithfully,

John Burden
Industrial Sales and Design Manager
National Contracting UK & Ireland
Building Efficiency - Refrigeration