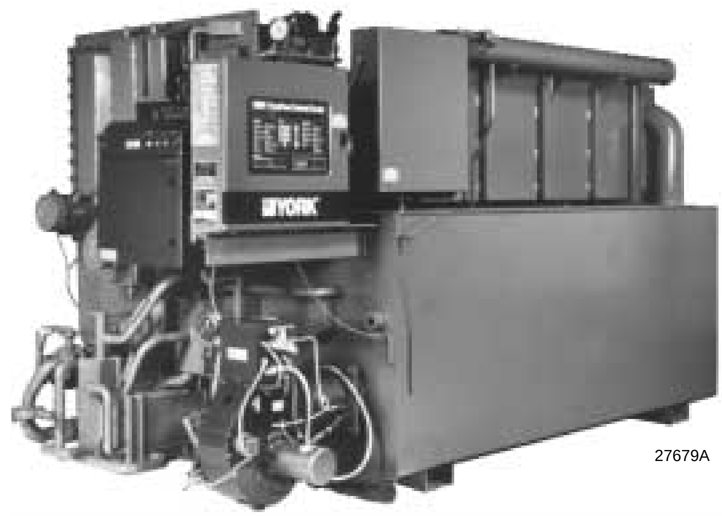
YORK®	YPC TWO-STAGE DIRECT-FIRED AND STEAM ABSORPTION CHILLER/HEATERS	
OPERATION & MAINTENANCE	New Release	Form 155.17-OM1 (700)

MODELS

DIRECT-FIRED
YPC-FA-12SC THROUGH YPC-FZ-19S
YPC-FD-19G THROUGH YPC-FD-20G

STEAM-FIRED
YPC-ST-14SC – YPC-ST-19S
YPC-ST-19G THROUGH YPC-ST-22GL



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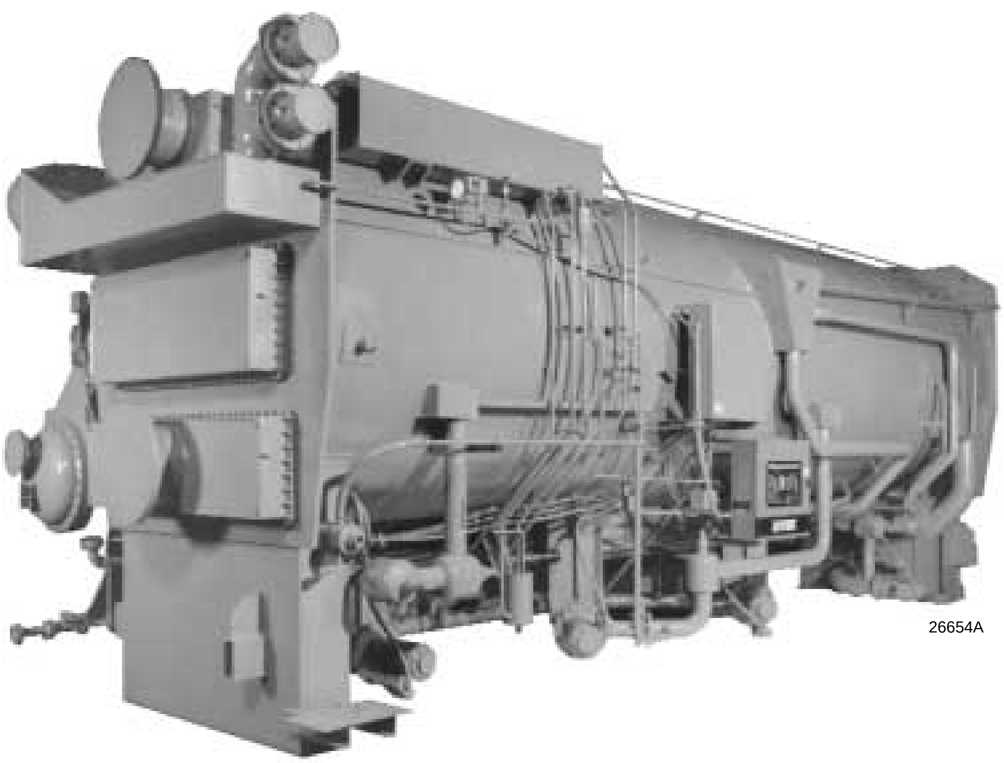

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UNITS SHOWN:
DIRECT-FIRED "S" MODEL
STEAM-FIRED "G" MODEL

IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

This equipment is a relatively complicated apparatus. During installation, operation, maintenance or service, individuals may be exposed to certain components or conditions including, but not limited to: refrigerants, oils, materials under pressure, rotating components, and both high and low voltage. Each of these items has the potential, if misused or handled improperly, to cause bodily injury or death. It is the obligation and responsibility of operating/service personnel to identify and recognize these inherent hazards, protect themselves, and proceed safely in completing their tasks. Failure to comply with any of these requirements could result in serious damage to the equipment and the property in which it is situated, as well as severe personal injury or death to themselves and people at the site.

This document is intended for use by owner-authorized operating/service personnel. It is expected that this individual possesses independent training that will enable them to perform their assigned tasks properly and safely. It is essential that, prior to performing any task on this equipment, this individual shall have read and understood this document and any referenced materials. This individual shall also be familiar with and comply with all applicable governmental standards and regulations pertaining to the task in question.

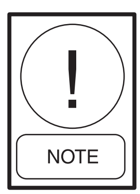
SAFETY SYMBOLS

The following symbols are used in this document to alert the reader to areas of potential hazard:

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

CAUTION identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution. Usually an instruction will be given, together with a brief explanation.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



NOTE is used to highlight additional information which may be helpful to you.

CHANGEABILITY OF THIS DOCUMENT

In complying with YORK's policy for continuous product improvement, the information contained in this document is subject to change without notice. While YORK makes no commitment to update or provide current information automatically to the manual owner, that information, if applicable, can be obtained by contacting the nearest YORK Engineered Systems Service office.

It is the responsibility of operating/service personnel as to the applicability of these documents to the equipment in question. If there is any question in the mind of operating/service personnel as to the applicability of these documents, then, prior to working on the equipment, they should verify with the owner whether the equipment has been modified and if current literature is available.

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NOMENCLATURE

The model number denotes the following characteristics of the unit:

YPC – FN – 13S – 46 – H – S – C

Modification Level (C)
A = Molybdate Inhibitor
B = 122 Alloy In Abs., Cond.
C = Smart Purge

Tube Type (S)
S = Standard Tubes
A = Tube Option “A”
B = Tube Option “B”
C = Tube Option “C”
X = Special Tubes

Hot Water Heater (H)
S = Standard Heater
H = High Temperature Heater
C = Cooling Only

Electrical (46)
17 = 208-3-60
28 = 230-3-60
46 = 460-3-60
50 = 380-3-50

Size (13S)
12SC through 19S
19G through 22GL

Heat Source (FN)
FN = Direct-Fired (with Power Flame burner) (natural gas)
FD = Direct-Fired (with natural gas / No. 2 oil)
FO = Direct-Fired (with No. 2 oil)
FX = Direct-Fired (with Other Fuels)
FL = Direct-Fired (with natural gas with low NOx FGR)
FP = Direct-Fired (with natural gas with low NOx FGR / No. 2 oil)

FE = Direct-Fired (with Weishaupt Burner) (natural gas)
FZ = Direct-Fired (with natural gas / No. 2 oil)
FB = Direct-Fired (with No. 2 oil)
FA = Direct-Fired (with other fuels)
FR = Direct-Fired (with natural gas with low NOx FGR)
FC = Direct-Fired (with natural gas with low NOx FGR / No. 2 oil)
ST = Steam-Fired

Model (YPC) = York ParaFlow Chiller

SECTION 1 – INTRODUCTION

INTRODUCTION

The purpose of this manual is to provide the operator with practical information in the operation and maintenance of a YORK ParaFlow™ Two-Stage Absorption Chiller/Heater.

Proper maintenance of a YORK ParaFlow™ Absorption chiller will ensure continuous efficient operation, prolonged unit life, and reduced service requirements.

The maintenance requirements are fairly simple; however it is vital that the recommendations are followed to ensure long term reliable operation and minimal down time.

To simplify the maintenance tasks, tables are provided listing the recommended schedules. The maintenance recommendations are for this York International product only. Refer to the appropriate manufacturer's instructions for operation and maintenance requirements for auxiliary equipment.

Absorption chillers use heat energy directly to chill the circulating medium, usually water. This absorption cycle uses an absorbent (lithium bromide) and a refrigerant (water). Absorption chillers are usually classified according to the type of heat energy used as the input and whether it is a single or two-stage generator design.

Chillers using steam or hot water as the energy source are referred to as indirect-fired while those that have their own flame source are called direct-fired. Machines having one generator are called single-stage absorption chillers and those having two generators are referred to as two-stage absorption chillers.

This manual covers all ParaFlow™ Two-Stage absorption chillers. It should be used in conjunction with Form 155.17-O2 (Control Center - Installation Operation and Maintenance Manual).

COMPARISON OF CYCLES

The absorption cycle is not much different from the more familiar vapor compression cycle. Refer to Figures 1 and 2. In the mechanical refrigeration cycle, refrigerant vapor is drawn by the compressor (1). It is then compressed to a high temperature and pressure and discharged into the condenser (2). In the condenser, the vapor is cooled and condensed to a high-pressure, high-temperature liquid by the relatively cooler water flowing through the condenser tubes.

The heat removed from the refrigerant is absorbed by the condenser water and is rejected to the atmosphere by the cooling tower.

The hot refrigerant liquid is metered through an expansion valve (3) into the low pressure evaporator (4). The lower pressure causes some of the refrigerant to evaporate (flash), chilling the remaining liquid to a still lower temperature.

Heat is transferred from the warm system water, flowing through the evaporator to the cool refrigerant. This exchange of heat causes the refrigerant to evaporate and the system water to cool.

To draw a parallel between the mechanical refrigeration and the two-stage absorption cycle, the solution pump (1), pumps the lithium bromide solution from the low pressure absorber to the relatively higher pressure high and low temperature generators. In both these sections, heat is used to produce refrigerant vapor.

The refrigerant vapor is cooled and condensed into liquid by the cooling water flowing through the condenser tubes (2). Liquid refrigerant from the condenser is metered through a metering orifice (3), similar to the expansion valve of the mechanical system and flows to the evaporator (4) where it is sprayed over the evaporator tubes.

The extremely low vacuum in the evaporator causes some of the refrigerant to evaporate. Heat is transferred from the relatively warm system water flowing through the evaporator tubes to the cooler refrigerant during this process.

In the absorber, solution spray and refrigerant liquid/vapor mix (causing the solution to become dilute) and the resultant heat of absorption is removed by the cooling water flowing through the tubes.

Note that in this system, heat is removed from both the absorber and condenser sections by the cooling water and it is finally rejected to the atmosphere by the cooling tower in the same manner as in the mechanical system.

To further clarify, the compressor in the vapor compression cycle basically serves the same function as the absorber, solution pump and generators. Both convert the working fluid back to its original state so the cycle can continue.

In the case of the absorption unit, a constant supply of concentrated solution is required to the absorber sprays for the absorption process to continue. Because the solution is diluted in the absorber, the generators are needed to reconcentrate this solution and create a supply of refrigerant. The solution pump simply transports the solution from the absorber to the generators.

HOW IT WORKS

The next several pages illustrate the flow schematic of a typical York Two-Stage Absorption Chiller/Heater. Breaking the cycle into several components helps to simplify the explanation of how the cycle works.

COOLING CYCLE

1. **Solution Pump/Heat Exchanger**

   A dilute solution of lithium bromide and water descends from the absorber to the Solution Pump. This flow of dilute solution is split into two streams and is pumped through heat exchangers to the High- and Low-Temperature Generators.

   This parallel flow configuration minimizes the possibility of crystallization by allowing the unit to operate at much lower solution concentrations and temperatures than series flow configurations.

2. **High-Temperature Generator (Refer To Fig. 3)**

   An energy source (either steam or a direct flame) heats the dilute lithium bromide solution coming from the solution pump/heat exchangers. This produces hot refrigerant vapor, which is sent to the low-temperature generator, leaving a concentrated solution that is returned to the heat exchangers.

3. **Low-Temperature Generator (Refer To Fig. 5)**

   The energy source for the production of refrigerant vapor in the Low-Temperature Generator is the hot refrigerant vapor produced by the High-Temperature Generator.

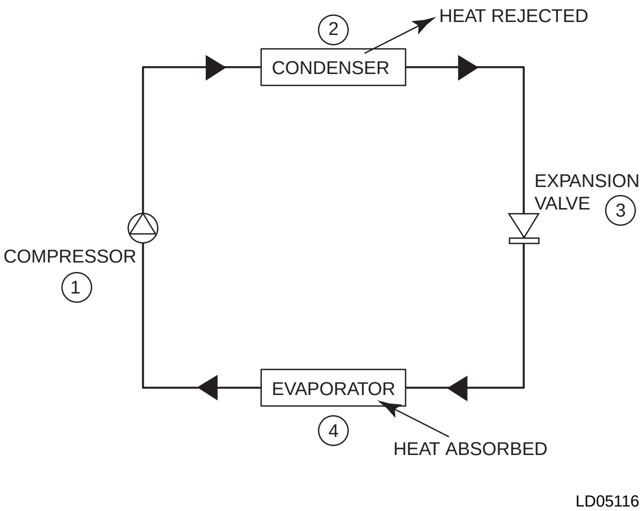

FIG. 1 – MECHANICAL REFRIGERATION CYCLE

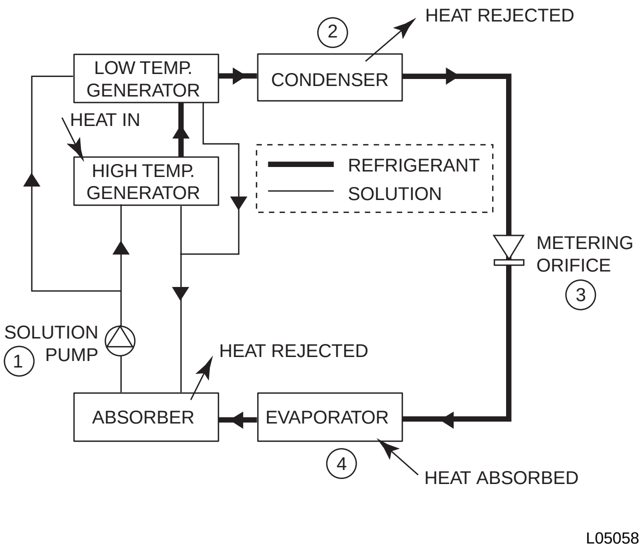

FIG. 2 – TWO-STAGE ABSORPTION REFRIGERATION CYCLE

Approximately 40% additional refrigerant is produced at no additional expense of fuel. The result is a much higher efficiency than in conventional single-stage absorption chillers.

This additional refrigerant vapor is produced when dilute solution from the heat exchanger is heated by the refrigerant vapor coming from the High-Temperature Generator.

The additional concentrated solution that results is returned to the heat exchanger where it is mixed with the concentrated solution returning from the High-Temperature Generator.

The refrigerant vapor from the high-temperature generator is condensed into a liquid (tube side of the Low-Temperature generator), giving up its heat. This condensed refrigerant then travels to the condenser.

4. **Condenser (Refer To Figure 6)**

Refrigerant from two sources - (1) liquid resulting from the condensed vapor coming from the High-Temperature Generator, and (2) vapor produced

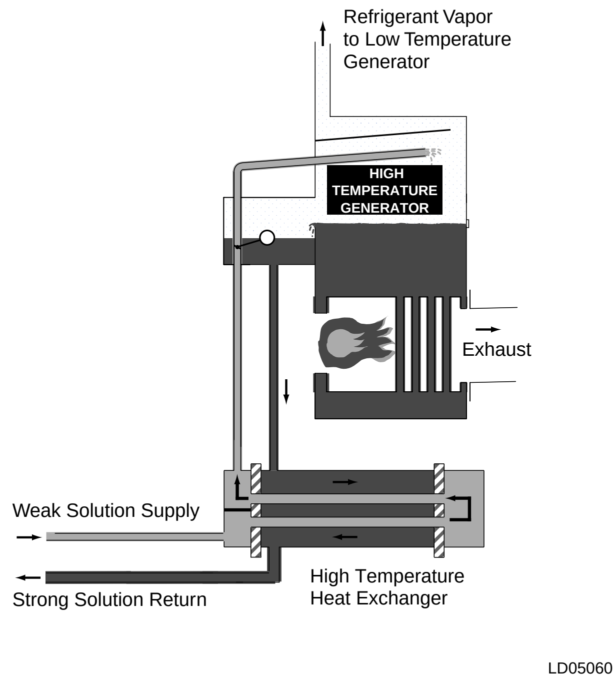

FIG. 3 – HIGH-TEMPERATURE GENERATOR

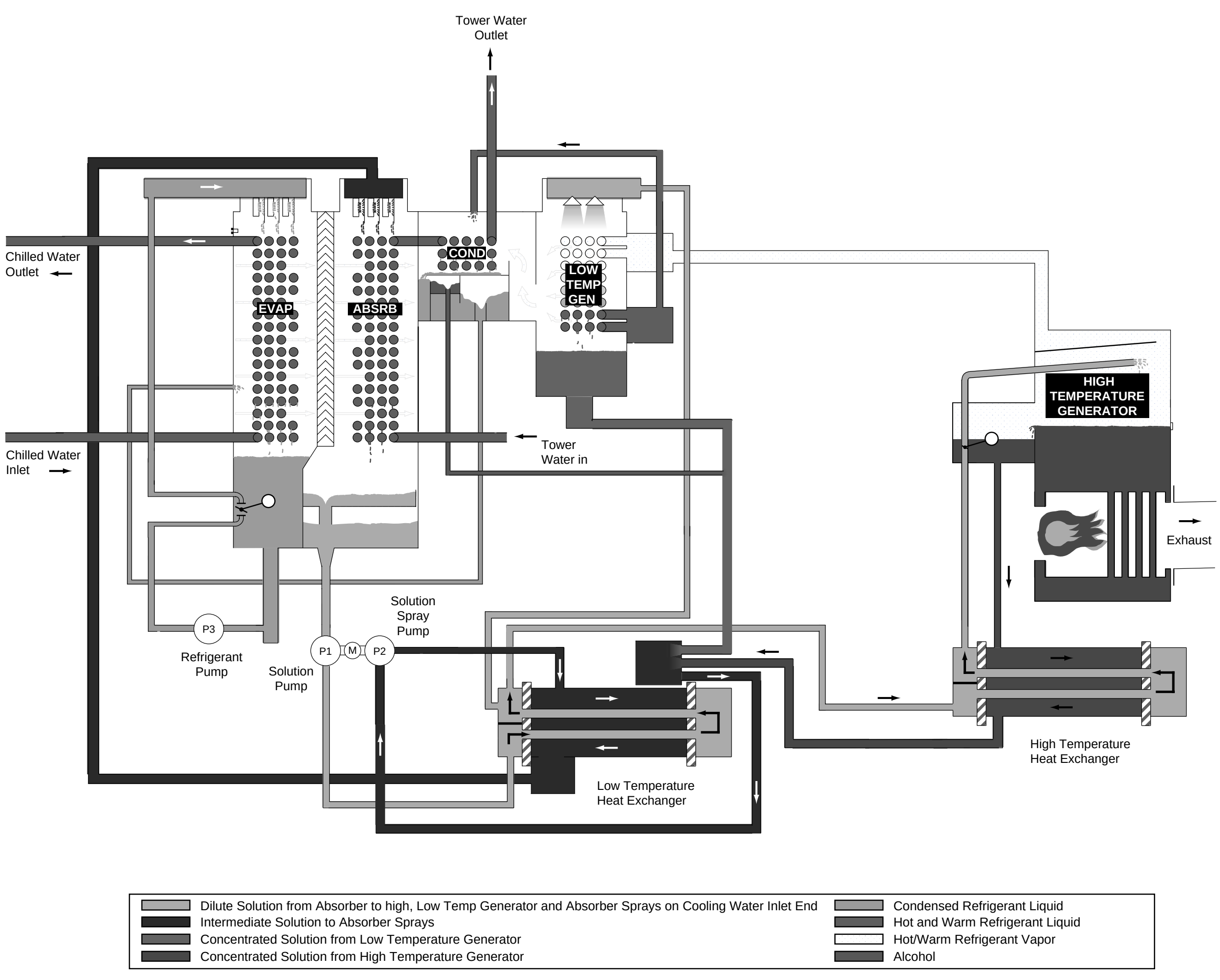

FIG. 4 – TYPICAL TWO-STAGE ABSORPTION CYCLE

by the Low-Temperature Generator enters the condenser. The refrigerant vapor is first condensed into liquid, and the two refrigerant liquids are then combined and cooled by the condenser water. This refrigerant liquid then flows to the evaporator.

5. **Evaporator**

Refrigerant liquid flows down to the refrigerant pump, where it is pumped up to the top of the evaporator. Here the liquid is sprayed out as a fine mist over the evaporator tubes. Due to the relatively high vacuum (6mmHg) in the evaporator, some of the refrigerant liquid vaporizes, creating the refrigeration effect.

This refrigeration effect cools the chilled water flowing through the evaporator tubes. The refrigerant liquid/vapor picks up the heat of the returning chilled water and cools it, typically down to 44ºF. The chilled water is then supplied back to the system.

6. **Absorber**

The concentrated solution coming back from the two generators is pumped to a solution spray header where it is sprayed over the tubes in the absorber. Refrigerant vapor is absorbed into the solution and the solution is thus diluted. This diluted solution is collected at the bottom of the absorber where it is again pumped to the two generators, starting the cycle over.

The dissolving of the lithium bromide in water gives off heat (heat of dilution). This heat is removed by the cooling water flowing through the absorber tubes. If this heat were not removed, it would not be possible for absorption to take place.

Absorption is essentially a diffusion process that takes place due to a vapor pressure difference between the refrigerant vapor (from the evaporator) and the solution. The absorption process will cease if this pressure differential is not maintained.

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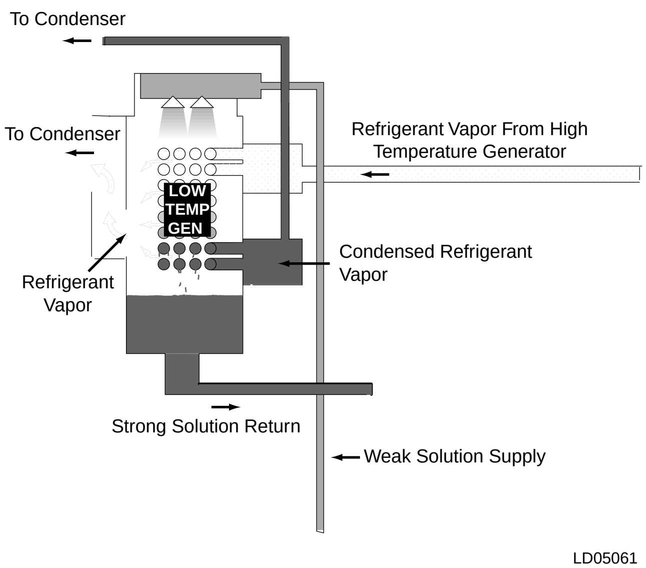

FIG. 5 – LOW TEMPERATURE GENERATOR

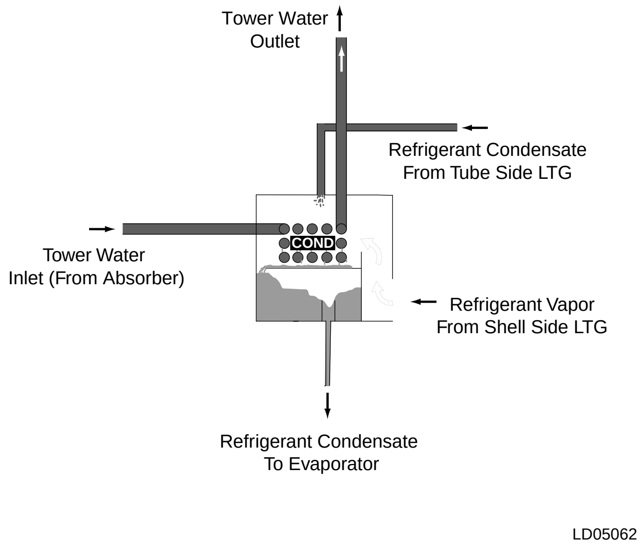

FIG. 6 – CONDENSER

It should be noted that the vapor pressure of the solution is governed by a pressure/ temperature/ solution concentration relationship. These relationships are graphically expressed on the PTX Diagram (Appendix E, page 169) for aqueous solutions of Lithium Bromide.

HEATING CYCLE (WITHOUT OPTIONAL HOT WATER HEAT EXCHANGER- STANDARD HEATING)

S-Model Direct-Fired units equipped with this option are capable of supplying low temperature hot water (maximum 140ºF). This option is not available on Steam-Fired or G-Model units.

Heating of the system water is performed in the evaporator, thus a two-pipe system configuration is required.

1. **High-Temperature Generator**

   The direct-fired energy source heats the intermediate concentrated lithium bromide solution in the high-temperature generator. This produces hot refrigerant vapor which travels directly to the evaporator/ heater.

   Concentrated solution flows back through the high temperature heat exchanger.

2. **Evaporator**

   The heat from the hot refrigerant vapor is transferred to the hot water flowing though the tubes. The refrigerant vapor condenses in the process and the liquid falls into the evaporator sump.

   The refrigerant is then pumped to the solution return line of the low-temperature generator, where it mixes with the solution en route to the absorber.

3. **Absorber**

   The dilute solution mixture from the low-temperature generator mixes with the concentrated solution from the high-temperature generator and is sent to the absorber sprays.

   This intermediate concentrated solution drops into the absorber sump.

   It is then pumped to the heat exchangers en route to the high and low-temperature generators.

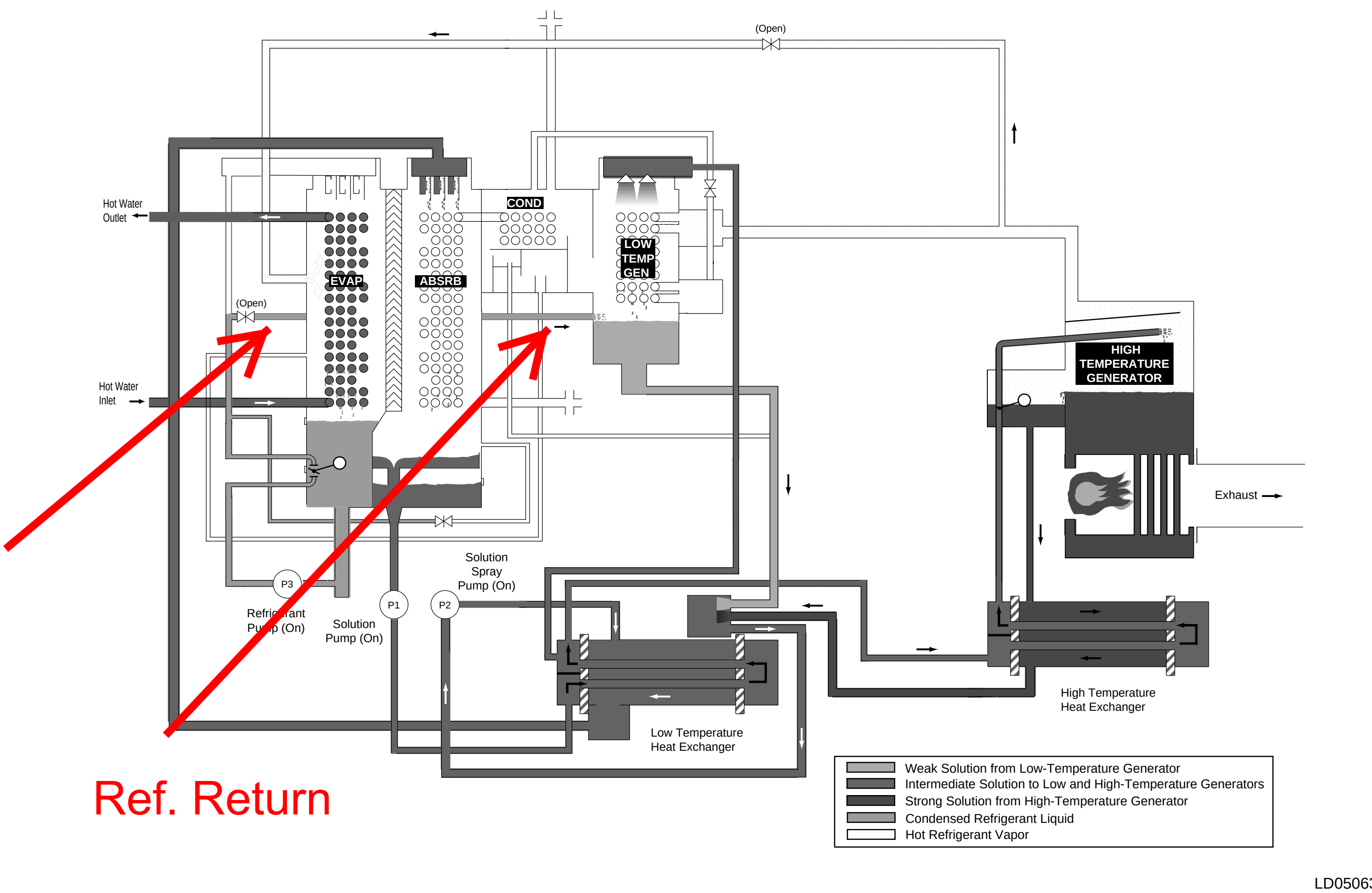

FIG. 7 – STANDARD HEATING CYCLE

The solution and refrigerant pumps ***run*** *during this cycle.*

HEATING CYCLE (WITH OPTIONAL HOT WATER HEAT EXCHANGER - HIGH TEMPERATURE HEATING)

Units equipped with this option are capable of supplying high temperature hot water (Maximum 175ºF). This option is available on Direct-Fired Models only.

1. **High-Temperature Generator**

   Dilute lithium bromide solution is heated by the burner in the high-temperature generator. This produces hot refrigerant vapor which travels to the hot water heat exchanger.

2. **Hot Water Heat Exchanger**

   In the hot water heat exchanger heat is transferred from the hot refrigerant vapor to the cooler system hot water and changes state from a vapor to a liquid. This condensed refrigerant liquid returns to the High-Temperature Generator and the cycle begins again.

The solution and refrigerant pumps ***do not run*** *during this cycle.*

SIMULTANEOUS HEATING AND COOLING OPERATION

YORK ParaFlow Chiller/Heaters equipped with a hot water heat exchanger can provide both chilled and hot water simultaneously. An understanding of the simultaneous operation feature and its limitations is required to assure proper application.

Operation during simultaneous cooling and heating is designed to maintain the chilled water temperature at the setpoint conditions. Hot water heating is provided; however, the chiller cannot simultaneously maintain chilled and hot water temperatures at their design setpoints.

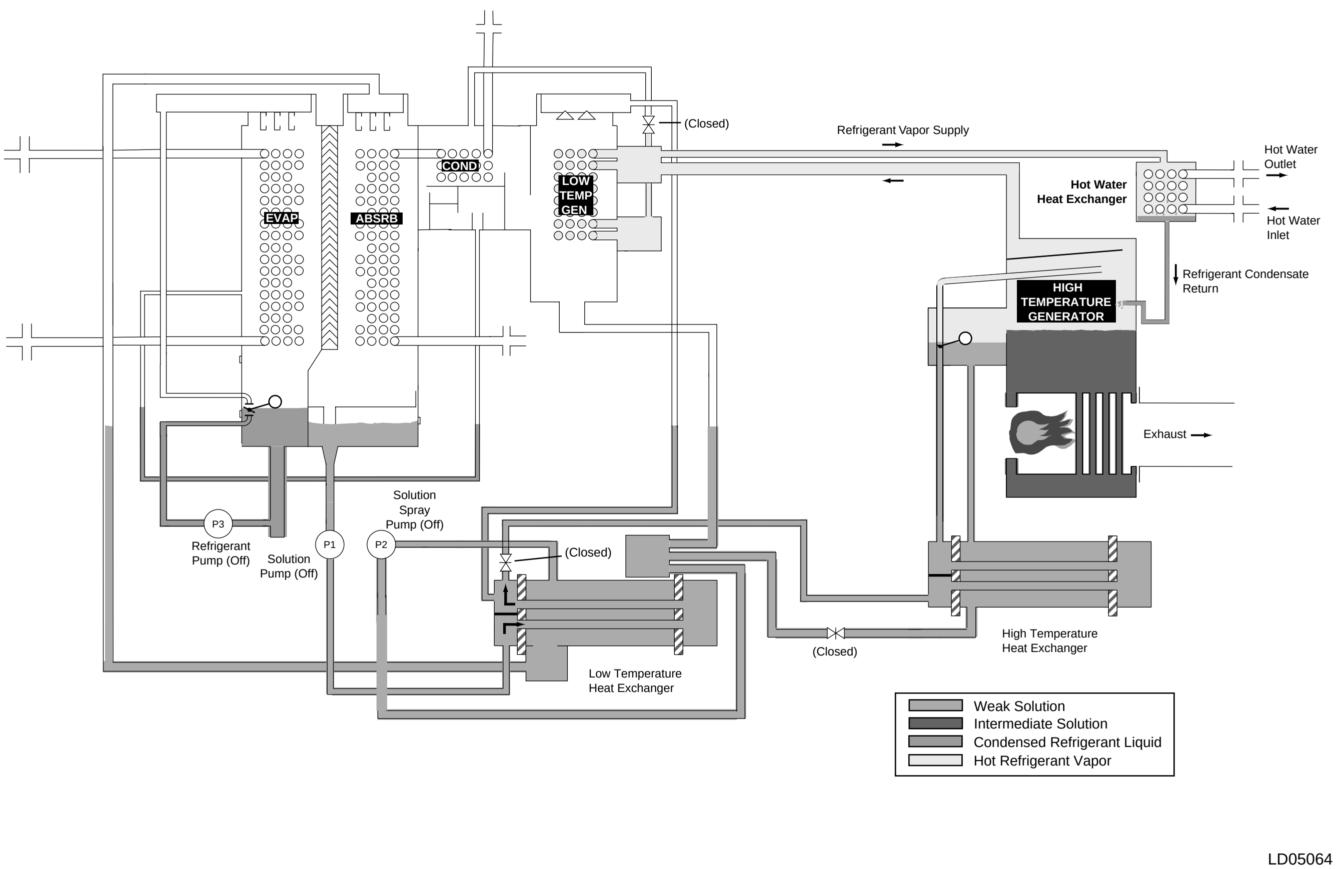

FIG. 8 – HIGH TEMPERATURE HEATING CYCLE

WARNING

When the YORK ParaFlow Chiller/Heater is in the heating only mode, the mixing valve must be in the open position to allow full flow through the hot water heat exchanger. The hot water controller will then modulate the burner to meet load variations and the unit will operate in the normal manner.

During simultaneous operation, the hot water heater extracts a portion of the refrigerant vapor from the generator for use in hot water heating. There are two factors that will determine the amount of heating that can be produced. One factor is the available heat input into the generator. This heat input is set by the burner/generator sizing. The total heat input required for cooling plus heating cannot exceed the available burner capability. The graph in Figure 9 shows the relationship between chilling and heating capacity at varying energy input rates. The energy input rate is governed by the chilled water demand.

For example, at 100% energy input rate (100% cooling load), the machine will produce 100% chilling and no heating; or, 80% chilling and 10% heating; or, 50% chilling and 32% heating, etc. At 70% energy input rate, the machine will produce 70% of the rated chilling capacity and no heating; or, 50% chilling and approximately 13% heating, etc.

The second factor is the available hot water temperature. The generator refrigerant vapor temperature determines the available hot water temperature. The generator refrigerant vapor temperature is determined by the cooling cycle operating conditions. It reaches a maximum value when cooling capacity is at its maximum and water temperatures are at their design conditions. As the cooling load decreases or the cooling tower water temperature decreases, the refrigerant vapor temperature will decrease. Thus, the maximum leaving hot water temperature will be less at off-design conditions.

To control the hot water temperature, a motorized mixing valve and two temperature controllers must be supplied and installed in the hot water circuit by the installation contractor as shown in Fig. 9. One controller senses the leaving hot water temperature and positions the mixing valve to maintain that temperature. The other controller acts as a limit switch and will abort simultaneous operation by placing the mixing valve in the full bypass position and stopping the hot water circulating pump if the leaving chilled water temperature rises to a pre-set level (usually 50ºF), indicating that too much energy is being used to make hot water and the chiller cannot meet the chilling demand.

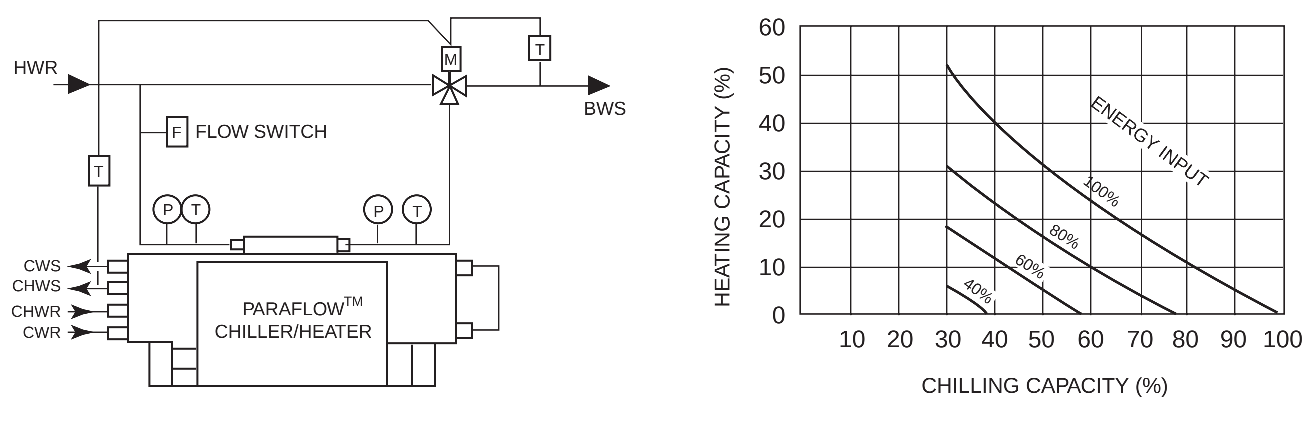

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FIG. 9 – SUGGESTED PIPING SCHEMATIC FOR SIMULTANEOUS OPERATION (ALL PIPING AND CONTROLS BY OTHERS)

DESCRIPTION OF MAJOR COMPONENTS AND SUBSYSTEMS

The YORK ParaFlow™ Absorption Chiller consists of the following major components and sub-systems. Refer to Appendixes B & C for component locations.

High-Temperature Generator - The high-temperature generator consists of a shell and tube bundle. It is located on the side of the main shell on G-model units and opposite evaporator side on S-model units. The purpose of the generator is to concentrate the weak lithium bromide solution coming from the absorber by heating it up and boiling off refrigerant vapor.

The supply of the weak solution is controlled through the use of a float valve/box configuration. This box is attached directly to the generator.

Two sources of heat can be used to drive the cycle.

1. **Direct-Fired -** In direct fired units, a burner flame is fired directly into a combustion heat exchanger. This heat exchanger consists of a combustion chamber and a vertical steel heat exchanger bundle. The lithium bromide solution surrounds the outside of the combustion chamber and flows by convective currents through the inside of a vertical tube bundle located at the far end of the combustion chamber from the burner. The outer rows of tubes are externally finned to provide for a more uniform heat transfer over the entire bundle.

   Refrigerant vapor flows through a series of baffle plates on its way to the low-temperature generator.

   On G-model units, the generator is shaped in a teardrop configuration, while on S-model units, the generator is rectangular in shape.

2. **Steam -** In steam units, the high-temperature generator consists of a shell and a cupro-nickel U-tube bundle. The shell is filled with solution and covers the U-tube bundle. Steam is supplied to the generator from an external source through the tube side of the U-tube bundle.

   Refrigerant vapor flows through a series of baffle plates on its way to the low-temperature generator.

   On G-model units, the generator has a long sloped appearance, while on S-model units, the generator is rectangular in shape.

Low-Temperature Generator - This component is located in the upper shell of the unit and is integral with the condenser on all models. It consists of a shell and tube bundle.

The heat source for the low-temperature generator is the refrigerant vapor exiting the high-temperature generator. The vapor enters the tubes and transfers its heat to the solution surrounding the outside of the tubes. By the time the vapor reaches the opposite end of the tubes, it is basically all condensed back into a liquid.

The tube bundle is flooded on G-model units; while on S-model units, the solution flows through a header and is sprayed over the tubes through a series of spray nozzles.

Refrigerant vapor boiling out of the solution produced in the low-temperature generator flows to the condenser through an eliminator assembly. The purpose of the eliminator is to prevent solution from carrying over to the condenser thus contaminating the refrigerant.

Condenser - The condenser consists of a shell and tube bundle. Its purpose is to condense refrigerant vapor coming from both the high-temperature and low-temperature generators.

Cooling water flows through the tube side of the bundle and removes the latent heat of condensation from the refrigerant. The condensed refrigerant vapor flows to the alcohol separator enroute to the evaporator.

Evaporator/Absorber Main Shell Assembly - This is the lower shell assembly on G-model units; on S-model units, it is the two tube bundles opposite the high-temperature generator. It contains two sections, the evaporator and the absorber.

The evaporator consists of a single- or multi-pass tube bundle, a refrigerant pan, eliminators, and a refrigerant spray header assembly. The liquid to be chilled (usually water) flows through the tubes to be cooled by vaporization of the liquid refrigerant. The liquid refrigerant is pumped through the sprays and flows down over the outside surface of the evaporator tubes.

The refrigerant vapor then migrates to the absorber through the eliminator assembly. The eliminator assembly ensures that only refrigerant vapor, and not liquid, enters the absorber section.

The absorber consists of a single- or multi-pass tube bundle, the absorber spray header assembly, and the lower part of the shell, which serves as a solution storage area. Condensing water is circulated through the absorber tubes to cool the sprayed lithium bromide solution as an aid in absorbing the water vapor coming from the evaporator.

Solution Pumps - The solution pumps on absorption units serve two functions. The first is to pump dilute lithium bromide solution from the absorber, through the solution heat exchangers, and finally to the high-temperature and low-temperature generators. This pump is referred to as the main solution pump.

A second solution pump (strong solution spray pump) transfers strong solution from the two generators to the absorber sprays. On larger G-Model units, a weak solution spray pump is also used to send weak solution from the absorber's belly directly to the weak solution spray header.

On the smaller S-Model units, a double-ended pump (two pumps using the same motor) is used for both the main and solution spray pumps.

Refrigerant Tank and Pump - The refrigerant tank on S-model units is integral with the evaporator, located at the bottom. On G-model units, it is separate from the evaporator and located under the absorber-evaporator main shell. On both models, the refrigerant pump is adjacent to the refrigerant tank.

Condensed refrigerant flows from the condenser, through the alcohol separator, into a U-tube pipe, which spills the refrigerant into the evaporator section to fill the evaporator pan, located under the evaporator tube bundle. From the evaporator pan, the condensed refrigerant flows into the refrigerant tank. The refrigerant pump transfers the condensed refrigerant to the evaporator spray nozzles on G-models, or drippers on S-model units.

Solution Heat Exchangers - The solution heat exchangers are added to increase the overall efficiency of the cycle. The heat exchangers are used to preheat the dilute lithium bromide solution flowing to the generators. At the same time, the strong solution flowing back from the generators is cooled. This means that less heat will be needed to drive the cycle in the generators and less heat will have to be removed from the solution in the absorber.

Purge System - YORK's absorption units are designed and manufactured for extreme leak tightness to ensure against infiltration of non-condensables into the high-vacuum system. Leakage of air into the system will lead to performance problems and an increase in internal corrosion rates.

The purge system provides a means for ridding the unit of any such accumulation of non-condensables. The system is designed to automatically and continuously purge the unit of non-condensables and store them in an isolated purge chamber. The chamber can then be periodically purged either manually or automatically if it is equipped with a Smart-Purge™ system.

Controls and Wiring

An electronic control system is provided with each absorption unit to permit automatic or manual control of the system. Provisions are made for the following:

1. Automatic capacity control involving electronic controls that modulate either a steam valve or burner.
2. Safety controls involving flow switches, low refrigerant temperature cut-out, motor overloads and various other protective devices.
3. Special control features to aid in the prevention of crystallization.
4. Smart-Purge™ system which will automatically purge non-condensables from the purge tank and monitor the frequency of purging over time.

CONTROL DESCRIPTIONS

Components in the Control Center

Refer to the Millennium Control Center Operations Form (155.17-O2).

Components in Power Panel (see Fig. 10)

1SW - This is a non-fused, service disconnect switch. The incoming power lines from the customer supplied fused disconnect switch or circuit breaker should be connected to terminals L1, L2, and L3 of this switch.

1T - This is a step-down control transformer that reduces the unit's incoming power (primary) down to a control voltage of 120/115-1-50/60 (secondary).

1FU, 2FU, 3FU - Control fuses. 1FU and 2FU protect the primary side of the 1T transformer. The amperage rating of these fuses depend on the unit voltage. 3FU is always a 10-amp fuse and is on one leg of the secondary side of the 1T transformer.

1M - Main solution pump contactor.

2M - Refrigerant pump contactor.

3M - Purge pump contactor.

4M - Weak solution spray pump contactor, used only on 16SL thru 19S and 19GL thru 22GL units.

5M - Strong solution spray pump contactor, used only on 19GL thru 22GL model units.

1OL thru 5OL - Each contactor is accompanied by a heater element overload with resetting capability. The designation number of the overload matches the designation number of the contactor.

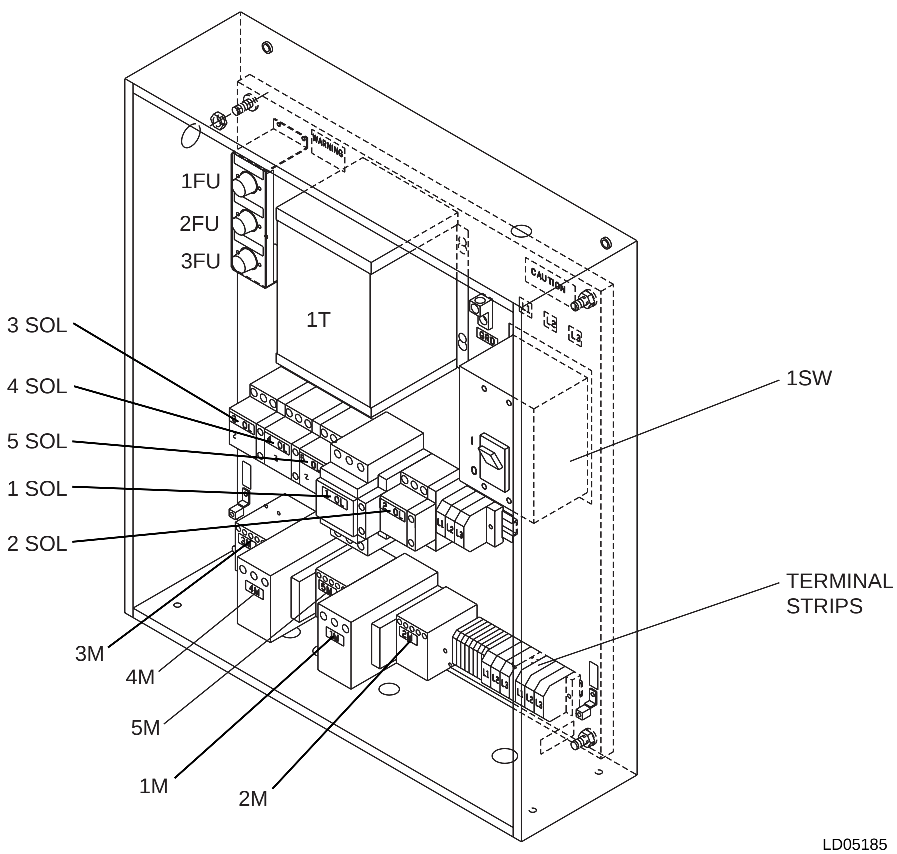


FIG. 10 – POWER PANEL – 3 SOLUTION PUMPS

SECTION 2 – CRYSTALLIZATION

DILUTION CYCLE AND CRYSTALLIZATION

All absorption chillers that use lithium bromide and water as the solution/refrigerant pair are subject to the perils of crystallization. This is due to the fact that some areas of the unit operate with solution liquid concentration levels that are only possible at higher than the normal ambient temperature surrounding the unit. For example, the solution concentration in the high-temperature generator (HTG) of a double effect absorption unit is typically 64.5% lithium bromide by weight. Referring to Figure 11, 64.5% solution will begin to crystallize at 112°F (44.4°C). Since the solution temperature in the HTG normally is slightly above 300°F (148.9°C) at full load, no crystallization will take place, as long as the higher solution temperatures are maintained.

Special measures have to be taken before the unit is shut down so that the solution is sufficiently diluted in all areas of the unit to prevent crystallization during the off cycle, since the solution temperature will eventually equal the surrounding ambient temperature. All units employ some sort of dilution cycle which fulfills this requirement. As long as the unit is allowed to dilute itself during an orderly shutdown sequence, the unit should be able to sit idle at fairly low plant room ambient temperatures for extended periods of time without any threat of crystallization. Typically, after a dilution cycle, the average solution concentration within the chiller will be below 50% lithium bromide by weight. Although the crystallization line on the chart of Figure 11 does not extend that far, it can be seen that the solution at 50% concentration will have no tendency to crystallize at normal ambient temperatures.

Keeping the previous paragraph in mind, why then do we have problems with absorption units crystallizing?

Crystallization Due to a Power Failure

Probably the most predominant reason for crystallization is due to fairly long duration power failures. If a chiller is running at full load and power is interrupted for a sufficient length of time, the concentrated solution in the high side of the unit will eventually cool down. Since no dilution cycle was performed, the solution concentration in some areas of the unit may still be relatively high. If the temperature of this concentrated solution is allowed to fall low enough, the solution will reach its crystallization point. Plant room temperature, insulation quality and the solution concentration all play a part in the determination of how long it will take before the unit will crystallize.

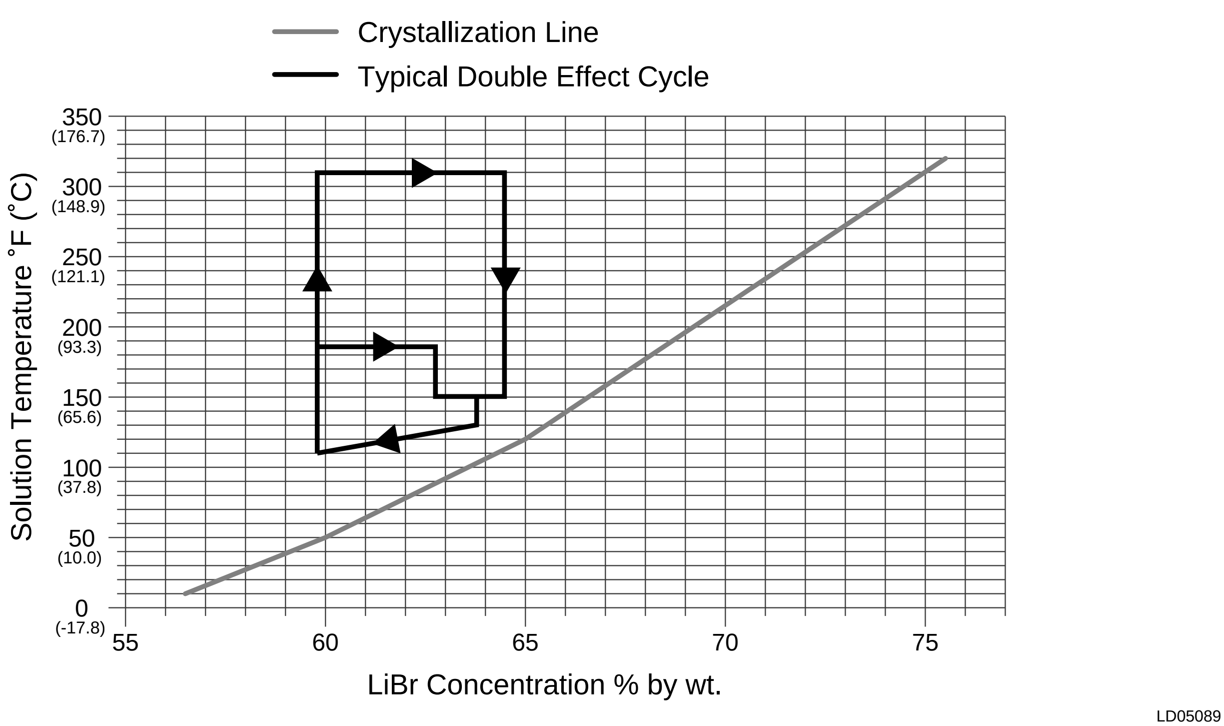


FIG. 11 – CRYSTALLIZATION

Power failures result in the unit pumps stopping completely. Without the pumps inducing flow through the various sections of the unit, concentrated solution becomes trapped in the generator section and solution-to-solution heat exchangers. If this concentrated solution is allowed to cool down to a low enough temperature, it may turn to a slushy liquid and eventually to a solid substance.

The potential for a York ParaFlow™ Chiller to crystallize during a power interruption is directly related to the following:

1. The concentration of the solution in the solution heat exchangers is very important. The higher the concentrations at the time of the power failure, the more likely the unit is to crystallize.
   a. The higher the load, the higher the concentration.
   b. A unit with dirty tubes or non-condensables will be more susceptible due to higher concentrations in the solution heat exchangers.
   c. Overfiring the unit will tend to over concentrate the strong solution and make it more susceptible to crystallization. Over-firing will also lead to higher corrosion rates and shortened unit life. Machines must not be over fired.
2. The ambient temperature of the machine room and the amount of thermal insulation on the solution to solution heat exchangers will also determine the likelihood of crystallization. Improper or inadequate thermal insulation on the hot sections of the unit will allow heat loss to progress rapidly and therefore shorten the amount of time before the concentrated solution cools down to its crystallization temperature. Outside air dampers that remain open during a power failure may allow the plant room to cool down quickly which will hasten crystallization.

   Refer to the Installation Manual (155.17-N1) for details on insulating ParaFlow™ absorption units.
3. The duration of the power interruption is very important. Although it is very difficult to quantify the acceptable time before crystallization occurs, it is doubtful that harmful crystallization will occur if the power interruption is less than fifteen minutes. Thirty minute or longer power interruptions have been experienced during full load operation of some machines with no problems.

Crystallization During Operation

2

Although a more rare occurrence, units can also crystallize during operation. Two of the chief causes of crystallization during operation are non-condensables in the absorber and rapidly fluctuating tower water temperature.

Non-condensables in the absorber result in less refrigerant being absorbed by the solution. The solution never gets as diluted as it should. It leaves the absorber and is heated in the HTG . If the unit's heat input is at or near full load, the leaving solution concentration may exceed the level at which it can remain liquid when passing through the solution to solution heat exchanger. For example, the normal concentration of solution leaving the absorber at full load is between 58% and 59%. If there are non-condensables present in the absorber, the solution concentration may exceed 61%. Since the unit is attempting to operate at full load, the firing rate will be sufficient to raise the solution concentration in the HTG by at least the same amount as when the absorber solution was normal, which was approximately 5%. Raising the solution concentration by 5% would result in 66% solution leaving the HTG. Referring to Figure 11, it can be seen that the crystallization temperature for 66% solution is about 140°F (60.0°C). Since the HTG temperature is higher than 140°F (60.0°C), the solution will be okay while it is still in the HTG. The problem occurs when this concentrated solution passes through the solution-to-solution heat exchangers on its way back to the absorber sprays. Since this solution concentration remains constant as it passes through the high-temperature solution-to-solution heat exchanger, if it is cooled below 140°F (60.0°C) at any point in the route, crystallization will begin. The cool solution leaving the absorber eventually ends up being the heat exchange medium (after passing through the low-temperature solution-to-solution heat exchanger) that cools the concentrated solution leaving the HTG as it passes through the high-temperature solution-to-solution Heat Exchanger. This relatively cool solution's temperature is the determining factor of whether crystallization occurs.

Tower water inlet temperature will greatly affect the leaving solution temperature of the absorber. If the tower water temperature is lower than design or is allowed to fluctuate in a downward trend fairly rapidly, the potential exists to overcool the concentrated solution in the high-temperature solution-to-solution heat exchanger. Crystallization will then result. To further compound this type of situation, if the absorber is not performing well due to the presence of non-condensables, the amount of solution flowing to the HTG will be less than normal since there is less refrigerant in it. Since the unit is attempting to make design capacity, the firing rate will be sufficient to raise the solution concentration higher than the design 5%. This will result in even higher solution concentrations leaving the HTG. The temperature of the solution leaving the absorber will also be lower than normal due to the amount of subcooling that will be present as a result of the lack of mass transfer taking place. This will result in a greater potential for overcooling the concentrated solution in the high-temperature solution-to-solution heat exchanger.

Fluctuating Tower Water Temperature

Rapidly fluctuating tower water temperature can also cause crystallization. The reasons are essentially the same as described in the previous example. Rapidly falling tower water temperature will cause the leaving solution temperature from the absorber to drop quickly. This cool solution may overcool the concentrated solution leaving the HTG as it passes through the high-temperature solution-to-solution heat exchanger. This can happen at normal HTG solution concentrations, although of course, the problem would be compounded if there were already abnormally high solution concentrations in the HTG. The tower water temperature should not be allowed to change more than 0.5°F (0.28°C) per minute.

YORK *ParaFlow*™ chillers have several features that will help prevent crystallization from occurring. The refrigerant charge is adjusted at full load, with no non-condensables present so that refrigerant is just ready to spill over from the evaporator pan to the absorber. Therefore, if the absorber ever begins to malfunction due to the presence of non-condensables or dirty tubes, as the solution concentration increases the refrigerant quantity resident in the evaporator pan also increases and begins to spill over into the absorber solution resulting in a concentration reduction. This self-correcting mechanism is built into every *ParaFlow*™ unit. The Micro-Panel software (EPROM version .09 or higher) constantly calculates the HTG solution concentration [if the HTG temperature is at least 250°F (121.1°C)]. If the calculated concentration exceeds 66%, the firing rate of the unit is reduced to minimum until the solution concentration falls below 65% again. If the HTG solution concentration continues to rise, the unit is shut down on a safety shutdown and put through a dilution cycle.

Measures to Prevent Crystallization

Good practices to help prevent crystallization should be employed. These include:

1. Solution-to-Solution Heat Exchangers, the HTG Float Box and all interconnecting piping should be well insulated. Do not insulate the unit prior to commissioning and never use weld pins to secure insulation.
2. Tower water (absorber cooling water) must be controlled to prevent rapid fluctuations in temperature. The maximum rate of tower water temperature change should not exceed 0.5°F (0.28°C) per minute. Tower water temperature should not exceed the design absorber inlet temperature [normally 85°F (29.4°C)] nor should it be lower than 68°F (20.0°C).
3. Keep absorber, condenser and evaporator tubes clean.
4. Do not allow non-condensables to accumulate in the unit. Proper purging techniques and solution chemistry control will greatly reduce the likelihood of crystallization.
5. Be sure that the refrigerant charge is adjusted so that refrigerant spill will occur if solution concentrations exceed the norm. Refrigerant may need to be adjusted after several years of operation due to the amount of refrigerant vapor removed during purging.

How to Determine if a Unit is Crystallized

The classic sign of a crystallized *ParaFlow*™ unit is that the solution level in the absorber tank disappears and the solution level in the HTG is above the sight glass level.

If this condition is noticed, it may be necessary to have a qualified YORK Service technician decrystallize the machine.

SECTION 3 – PURGING AND NON-CONDENSABLES

NON-CONDENSABLES

It is necessary to purge absorption chillers due to the potential for the systems to collect non-condensable gases. Non-condensables, if allowed to accumulate, will reduce the absorption unit's performance and may cause corrosion within the unit.

It could be speculated that over ninety percent of all capacity related complaints on ParaFlow™ units involve the presence of non-condensables.

A *non-condensable* is defined as a gaseous substance that cannot be liquefied or condensed at the pressure and temperature surrounding it.

Non-condensables appear in two forms in absorption units.

1. Internally generated non-condensables are formed as a by-product of corrosion.
2. Air may be drawn into a unit via leaks.

Non-condensables that collect in the absorber section of the unit blanket the heat transfer tubes and reduce the absorber's ability to capture the refrigerant vapor.

Non-condensables that collect in the high side of the unit end up in the condenser where they blanket the condenser tubes, reducing the condenser's capacity. Full load capacity will be prevented by high condensing pressure.

NON-CONDENSABLE QUANTITIES

An absorption unit's general health can be determined by both the quantity and quality of non-condensables it produces. A properly maintained *ParaFlow™* unit will produce very few non-condensables—the fewer the better. A small amount of internally generated gases will always be present and should be considered normal. Air leaks, no matter how small, will almost always cause noticeable increases in the amount of non-condensables a unit produces.

Since it is important to correct any air leaks as soon as possible, it is essential to develop a disciplined method of purging a unit so that any abnormalities can be discovered quickly. On *SmartPurge™* equipped units, the purge tank is automatically evacuated only when necessary and the frequency of evacuation is continuously monitored.

Smart-Purge™ is standard on all new ParaFlow™ units.

CONTINUOUS INTERNAL PURGING WHILE UNIT IS OPERATING

The purge system on a *ParaFlow™* unit is designed to automatically and continuously remove non-condensables from the absorber and condenser section of a unit and store them in an area called a purge tank, where they can be manually or automatically evacuated by the unit purge pump. The transport of the non-condensables to the purge tank is a continuous process accomplished without the use of any moving parts.

The purge tank must be evacuated by the unit purge pump. This can be done either manually or automatically, depending if the unit is equipped with *SmartPurge™* or not.

SmartPurge™ monitors the purge tank pressure and evacuates the purge tank when the tank pressure reaches 60 mm Hg absolute. The automatic purge system stops evacuating the purge tank when its pressure is reduced to 30 mm Hg.

PURGE COMPONENTS

Several devices combine to provide the functional purge system. Many of the components can be found on the *purge tree*. The purge tree (Figure 12) is a series of piping and valves connected together and located on the opposite-generator side of the unit. The valves are manifolded together for convenience so that nearly all purge operations can be performed from one location.

On the *G-Model* unit the purge tree also consists of other purge system devices such as the gas separator and the purge eductor. On most *S-Model* units, the purge tree (Figure 16) consists of only the purge valve manifold. The other purge devices are located further away.

PURGE PUMP

Each unit is equipped with a purge pump which is essentially a vacuum pump specially modified to work well in lithium bromide service. *G-Model* units have a 5.6 cfm vacuum pump. *S-Model* units have a 0.9 cfm pump. Both are belt driven, two-stage, rotary vane-type pumps.

WARNING

Do not operate the purge pump without the belt guard in place!

CAUTION

On units with SmartPurge™, be aware that the purge pump starts and stops automatically.

Purge pumps are mounted differently on different model units. The purge pump is factory mounted on an underslung sliding bracket system on the *S-Model* units. On 22G and 22GL models, a shelf-type base is provided for field mounting of the pump. On all other *G-Model* units, the pump must be mounted on a customer supplied base near the unit.

The purge pump is used to:

1. Remove stored non-condensables from the purge tank
2. Manually purge the absorber
3. Manually purge the hot water heat exchanger if so equipped.

The purge pump should be warmed up for at least 10 minutes prior to purging. This will help keep the oil free of refrigerant.

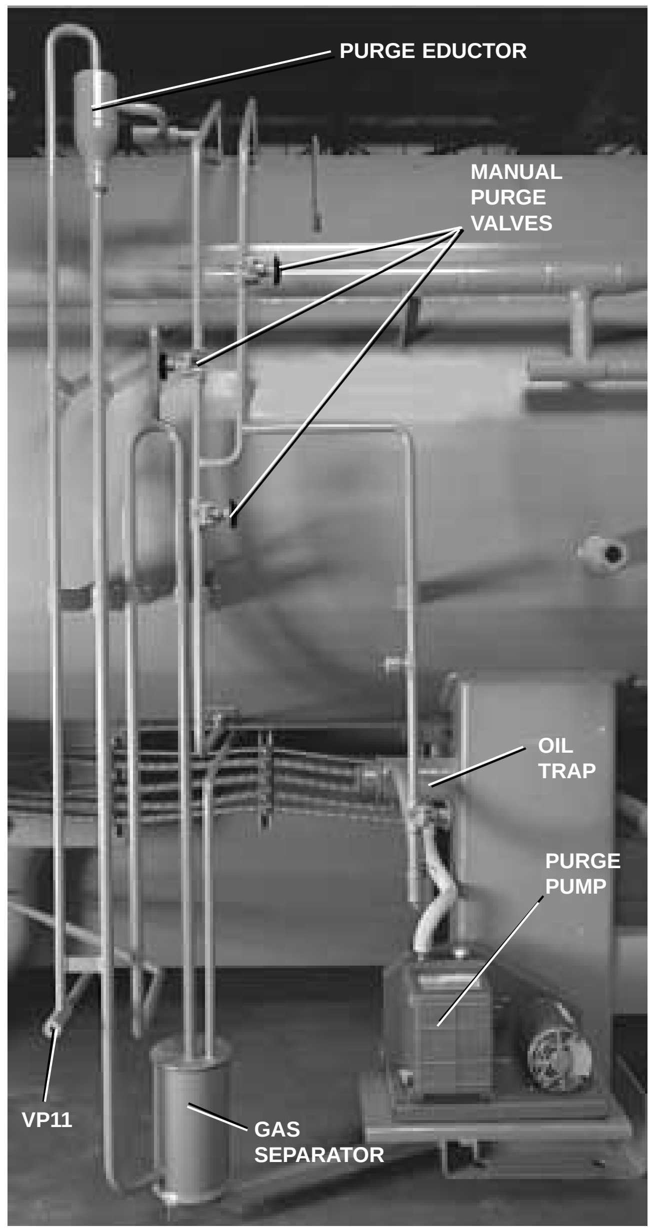
The purge pump exhausts the unit non-condensables.

Although occasionally some of the non-condensable gases produced are unpleasant in odor, the normal quantities are very small. If venting the purge exhaust is required, it can be done by running the purge piping outdoors or into a scrubbing unit of some type. Common sense should prevail in the piping design if venting the purge pump out doors. Total pressure drop of vent piping must not exceed 5 psig.

WARNING

Explosion Warning: Never install an isolation valve on the discharge of the pump or in the vent line. Closing this valve while the pump is operating could result in an explosion.

The purge pump should be operated with the gas ballast open to prevent refrigerant vapor from condensing in the oil. Close the purge pump gas ballast when performing a bubble leak test procedure.



00264VIP

FIG. 12 – PURGE TREE G-MODEL UNITS

Leave the gas ballast valve in the open position, except when performing a leak test.

See the Pumps section of this manual for further purge pump maintenance information.

PURGE TANK

The purge tank is essentially a storage container where non-condensables are kept until they can be pumped out of the unit by the purge pump. The stored non-condensables are pumped into the purge tank by the purge eductor system.

The purge tank is a long round tank located above the high-temperature generator on an *S-Model* unit. It is part of the alcohol separator assembly (although both alcohol separator and purge tank are individual vessels welded together) on most of the *G-Model* units. On the 22G and 22GL the purge tank is a separate rectangular tank located on the opposite-generator side of the unit.

Non-condensables stored in the purge tank do not affect the unit performance. The purge tank is kept separate from the rest of the unit by a liquid U-trap seal. Due to the liquid seal height, the purge tank can safely hold at least 100 mm Hg absolute of pressure without fear of the non-condensables venting into the absorber.

G-MODEL 00265VIP

S-MODEL 00266VIP

FIG. 13 – PURGE EDUCTOR G-MODEL AND S-MODEL UNITS

PURGE EDUCTOR

The purge eductor (Figure 13) is a liquid powered jet pump (ejector). Jet pumps have no moving parts and use a high pressure stream of liquid (solution from the solution pump discharge line) passing through a nozzle to cause a portion of a low pressure stream (condenser refrigerant vapor and non-condensables) coming into the side of the pump to combine with the nozzle stream. This causes a reduction in pressure at the low pressure inlet and induces the rest of the low pressure inlet substance to flow into the body of the pump. In the diffuser section of the pump some of the velocity of the combined liquid flow is converted back to pressure. The eductor outlet will be at a pressure between the high pressure inlet and the low pressure inlet (see Figure 14).

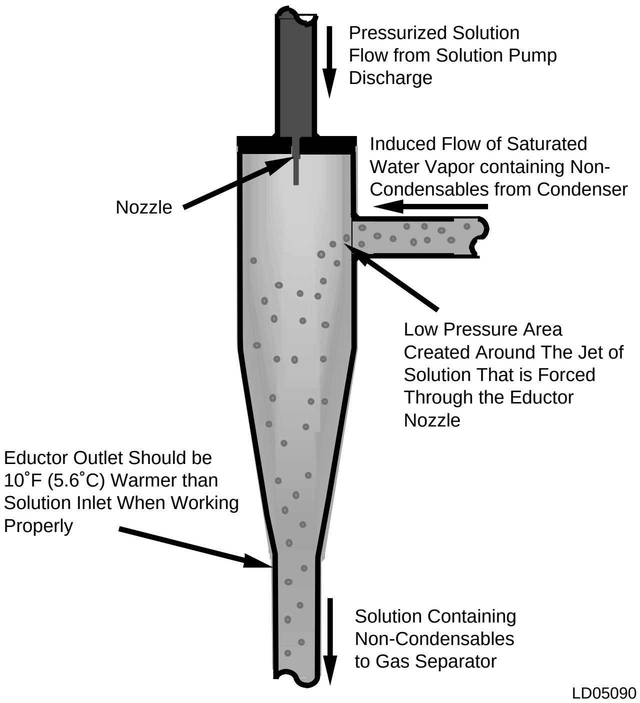


FIG. 14 – PURGE EDUCTOR

The *G-Model* unit purge eductor is larger than the *S-Model* eductor; however, they both function in the same way. (See Figure 13.)

The outlet of the eductor will be approximately 10°F (5.5°C) hotter than the solution inlet to the eductor nozzle when the eductor is performing properly. This is due to the water vapor from the condenser being absorbed into the solution coming through the nozzle.

GAS SEPARATOR

The gas separator is where the non-condensables are removed from the solution flowing out of the purge eductor (Figure 15).

GAS SEPARATOR

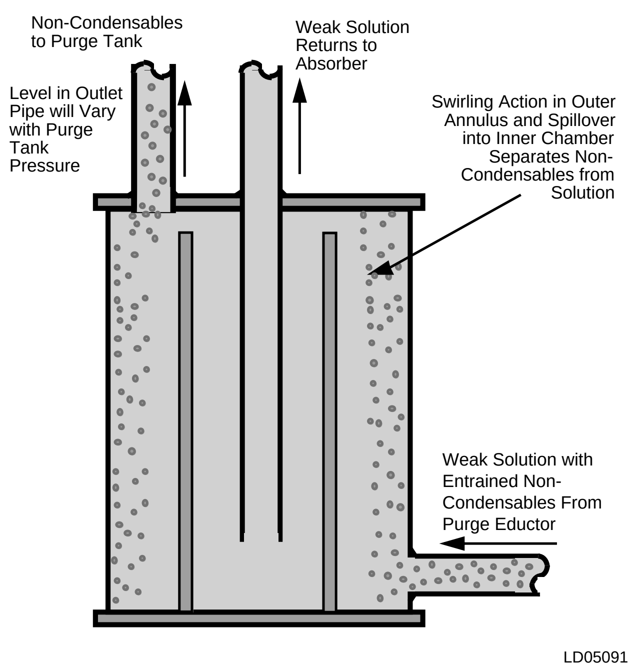


FIG. 15 – GAS SEPARATOR

Solution mixed with non-condensable gases flows into the side of the separator where it enters an annulus between the inner chamber and the outer wall of the separator. The swirling and overflowing action induced by the inner chamber causes the non-condensables to rise up and accumulate near the top of the separator. The solution outlet pipe extends down into the inner chamber where solution with no non-condensables is present. The non-condensables accumulating near the top of the gas separator pass upward through the non-condensable outlet pipe into the purge tank.

VALVES

Many valves are used on the purge system. All of the valves are designed to be reliable and leak-free.

Most of the manual valves are diaphragm-type.

A few flow control valves are used which are the spindle-type. Spindle-type valves require a seal cap to be removed before any adjustments can be made. The seal cap of the spindle valve and the adjustment spindle require an allen wrench. The spindle valve requires four counter-clockwise turns to fully open the valve. **Do not open the spindle valve past 4 turns open or a leak may occur.**

There are several special purpose valves used, such as the check valve and the automatic purge valves, as well as several angle-type globe valves.

The following is a description of each individual valve and its functional purpose. Note that an individual model unit may not have all of the valves listed.

VP1: Spindle Valve. Controls flow of refrigerant vapor/non-condensable mixture from the condenser into the purge eductor. Normally this valve is set for full open (4 turns open) during operation.

VP2: Diaphragm Valve. Used to remove non-condensables from the purge tank (with VP5 open, if applicable) or to read the purge tank pressure.

This valve should be kept open when operating in the SmartPurge™ mode.

VP3: Diaphragm Valve on *G-Model* units and smaller *S-Model*. Spindle valve on larger *S-Model* units. Used to purge from the condenser before the unit has been commissioned or after pressurizing unit. **Under no circumstances should this valve be opened while the machine is operating.** Typically, a lock is installed on this valve to avoid accidental opening.

VP4: Diaphragm Valve. Used to manually purge the absorber. This pipe is connected to the internal absorber purge header system. Used in conjunction with VP5, the purge pump will pull non-condensables from the absorber. This valve will be used to manually purge the absorber when switching the unit from heating to cooling operation. On *G-Model* units, be sure the absorber level is visible in the middle shell sight glass before purging from the absorber. Failure to do so may result in solution flowing out of the unit.

VP5: Diaphragm Valve. Used as an isolation valve between the purge pump and the other purge valves. On units with *SmartPurge*™, this valve is not present. VP5 must be open when using the purge pump to purge from any section of the unit.

VP6: Diaphragm Valve. Used to purge the hot water heat exchanger on direct-fired units equipped with the auxiliary hot water heat exchanger. This valve should only be opened for a maximum of 3 minutes/month during the heating operation if non-condensables are causing a high-pressure situation. By opening this valve, non-condensables in the hot water heat exchanger will be vented to the purge tank on *G-Model* units and to the condenser on *S-Model* units. If VP6 is left open too long, enough refrigerant vapor will leave the high side of the unit to cause abnormally high solution concentration in the high-temperature generator. The unit will typically trip out on the high temperature cutout when this occurs.

VP8: Check Valve. This valve is in the purge line between the purge pump and the rest of the purge piping. It is a flapper-type check valve which must be installed horizontally with the "hinge marking" up. Its purpose is to provide added protection from air ingress if the purge valves were open during an unattended power failure situation.

VP9: Diaphragm Valve. Used to purge the second hot water heat exchanger on the 20G direct-fired unit. The same rules apply as VP6.

VP11: Spindle Valve. This valve controls the supply of solution to the nozzle of the purge eductor. This valve is typically set to 4 turns open. This valve is not present on all models.

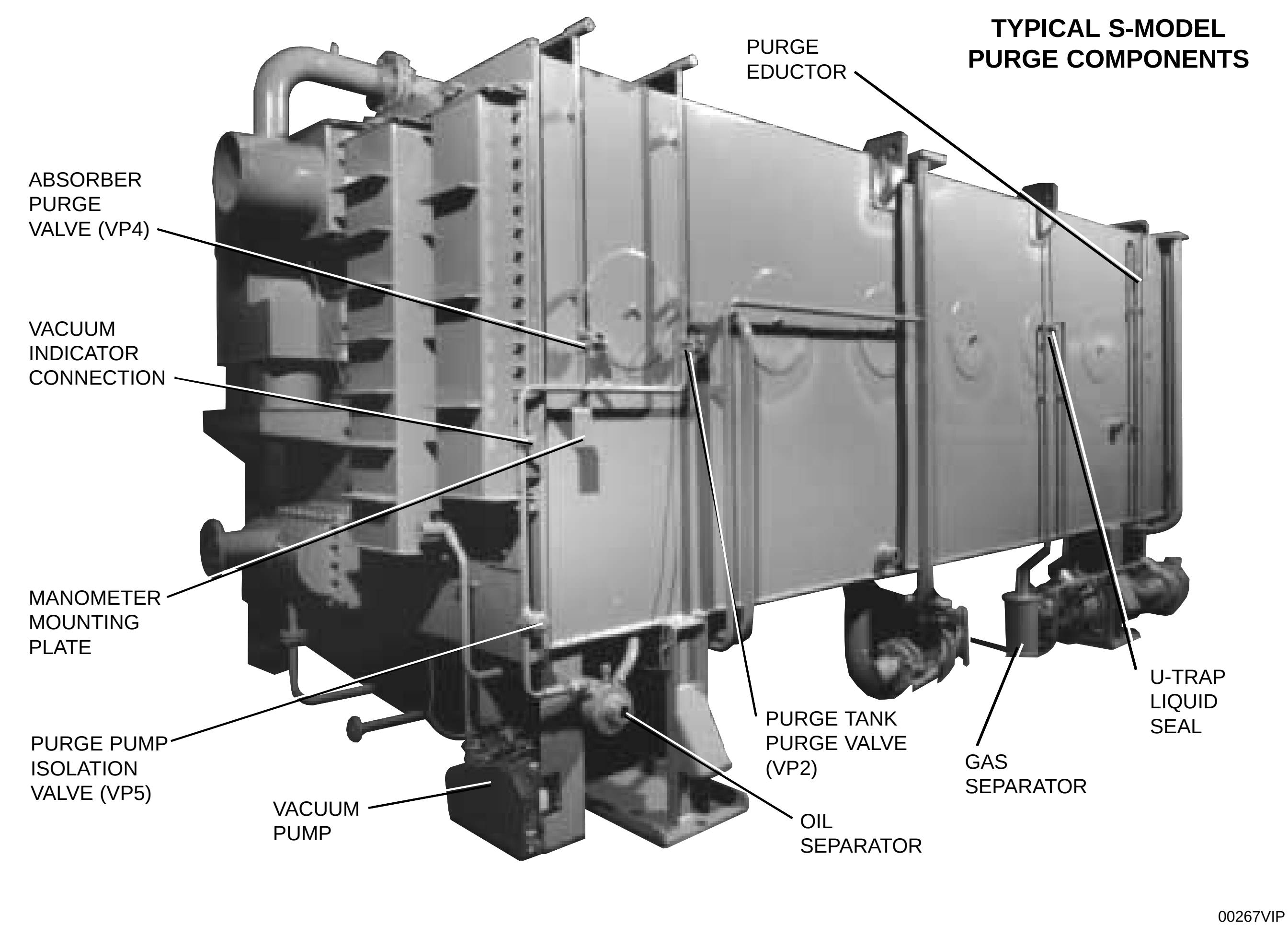


FIG. 16 – TYPICAL S-MODEL PURGE COMPONENTS

VP19 (2 SOL): Motorized Ball Valve. Used on units equipped with *SmartPurge*™. This valve is controlled by the MicroPanel and automatically opens when purging is required. VP19 opens first in the purge sequence after the purge pump starts. Pressure transducer PT-3 then monitors the pressure in the line. When the pressure is reduced to 15 mm Hg, VP20 is permitted to open, which allows non-condensables to be removed from the purge tank.

VP20(1 SOL): Solenoid Valve. Used on units equipped with *SmartPurge*™. This valve is controlled by the Micro-Panel and automatically opens during the purging sequence. VP20 opens after the purge pump operation is proven by pressure transducer PT-3.

VP21: Spindle Valve. Used on larger *S-Model* units. This valve is in series with VP4. It should be left full open when the unit is in the cooling mode and closed in the heating mode.

VP22: Spindle Valve. Used on larger *S-Model* units. This valve is in series with VP2. It should be left full open when the unit is in the cooling mode and closed in the heating mode.

OIL SEPARATOR

The oil separator is located in the suction line of the purge pump. It is constructed so that oil from the vacuum pump cannot get drawn into the unit should a power failure occur during purging. The separator is sized to hold twice the volume of the purge pump oil charge.

The oil separator also serves as a trap in the unlikely event that solution gets drawn into the purge piping and helps prevent contamination of the purge pump.

ABSOLUTE PRESSURE GAUGE

The gauge is very important for reading the extra low system pressures throughout the unit. It can be used to read absorber pressure, purge tank pressure, purge pump pressure and, on *S-Model* units, condenser pressure.

The standard absolute pressure gauge is a mercury manometer. An optional dial-type absolute pressure gauge may be provided where mercury is prohibited. In either case, the gauge will read in mm Hg absolute. *Hg* is the chemical symbol for mercury and *mm* is the abbreviation for millimeter. If exposed to the atmosphere, the gauge will be at the top of its range.

Care should be taken to prevent lithium bromide solution from contaminating the gauge. It will cause inaccuracies in the pressure reading on the mercury manometer and it will damage the dial-type gauges.

To read the mercury manometer, allow the pressure to stabilize and then read the *difference* between the two columns of mercury. The columns will be at an equal height only in a perfect vacuum. If one column is 1 mm below the zero point and the other column is 1 mm above the zero point, the pressure is 2 mm Hg absolute.

PURGING FREQUENCY

The purge tank evacuation frequency will be dependent on several factors such as unit size, operational parameters, running time, solution chemistry, and of course, leak tightness of the unit. Some units may only need to have their purge tank evacuated a few times per year. Others may require more frequent evacuation. Although very frequent purge tank evacuation is a matter of concern, a change in the frequency is also an indicator of a unit problem. For instance, a unit may routinely accumulate 60 mm Hg of pressure in the purge tank over 200 hours of operation (approximately one month). If, all of the sudden, the purge tank accumulates 60 mm Hg pressure in 100 hours of operation (approximately two weeks), there is a strong indication that either a leak is developing, or there is a problem with the solution chemistry, or both. Therefore, if a unit is manually purged, it is important to keep track of the purging history. If the unit is equipped with *SmartPurge*™, the micro processor keeps track of the purging frequency and alerts you if it has become excessive.

WHEN TO PURGE THE PURGE TANK

The old philosophy of purging an absorption unit was to have the plant room operator manually purge the unit once per day, whether it was needed or not. In addition to purging from the purge tank, most operators preferred to purge from the absorber with the purge pump for a given period of time. Although some users may still prefer this method, it should not be necessary, providing the unit is in good health.

Since the *ParaFlow*™ unit's internal purge system is automatically and continuously (while the unit is operational) moving any non-condensables from critical areas of the unit such as the absorber or condenser to the purge tank, it is only necessary to monitor the purge tank pressure and evacuate it periodically. It should not be necessary to purge the absorber with the purge pump on a properly operating unit.

Although the purge tank can adequately maintain 100 mm Hg pressure, *SmartPurge*™ will evacuate the tank if the pressure exceeds 60 mm Hg. The purge tank will be evacuated until the tank pressure is reduced to 30 mm Hg. It is recommended that units without *SmartPurge*™ be purged the same way.

Open the purge tank to the vacuum indicator and check the purge tank pressure. If it is above 60 mm Hg, use the purge pump to evacuate the tank until the vacuum indicator shows that the tank pressure is 30 mm Hg. **Do not evacuate the purge tank to a pressure lower than 30 mm Hg.** There is nothing to be gained by lowering the pressure of the tank below 30 mm Hg; plus solution may be pulled into the tank and purge pump if the absorber pressure is high enough. Operations personnel should be shown how to keep a history log of when the purge tank was evacuated, and what it's "before purging" and "after purging" pressures were. Logs and log instructions are available through your local YORK Service Office.

WHEN TO PURGE THE ABSORBER

On G-Model units, do not purge from the absorber if the absorber solution level is in the top sight glass of the absorber shell, or solution may be drawn into the vacuum pump.

Although non-condensables are automatically removed from the absorber by the solution vortex, under certain circumstances the absorber must be manually purged with the purge pump. This is normally only necessary under the following conditions:

- Just after changing the unit from the heating to the cooling mode. This is especially true on S-Model units with Low Temperature Heating (using evaporator for heating).
- Unit being evacuated after performing a maintenance procedure.

WHEN TO PURGE THE HOT WATER HEATER

Direct-Fired units with the optional hot water heat exchanger have a purge connection which allows the user to vent non-condensables should they build up during the heating cycle. The non-condensables will then be vented to the purge tank on the *G-Model* units,or to the condenser on the *S-Model* units.

It is necessary to vent non-condensables from the hot water heat exchanger only when the high-temperature generator pressure is excessive.

Only open the purge valve (VP6 or VP9) for a maximum of three minutes during heating operation in a given one month period.

SMARTPURGE™

SmartPurge™ consists of hardware and software that monitors the purge tank pressure, purges it when needed and records the event. *SmartPurge*™ will also alert the user if purging is excessive.

By utilizing two pressure transducers, *SmartPurge*™ continuously watches the purge pump performance and stops the purging process if a problem occurs.

If *SmartPurge*™ is installed, it will be necessary to make it active by removing the I/O Expansion board jumper *JP-1*. It will also be necessary to enable *SmartPurge*™ by selecting it using the Micro-Panel keypad

SmartPurge™ must be turned off to perform manual purge procedures.

For more specific information on *SmartPurge*™, see the Control-Center Operation's Manual (155.17-O2).

G-MODEL UNIT PURGE SYSTEM (without Smart Purge™)

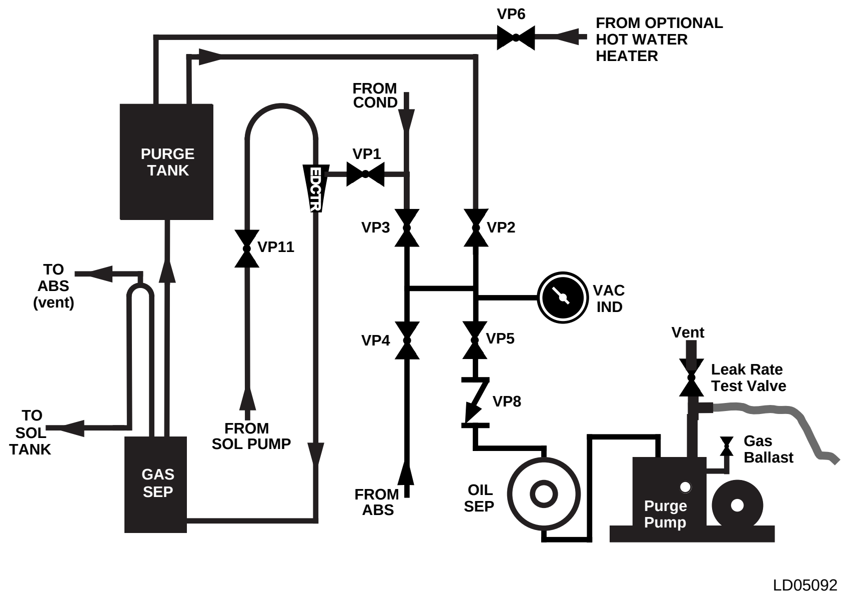


FIG. 17 – G-MODEL UNIT PURGE SYSTEM (WITHOUT SMARTPURGE™)

G-MODEL UNIT PURGE SYSTEM with SmartPurge™

Note: VP5 may not be installed on all machines.

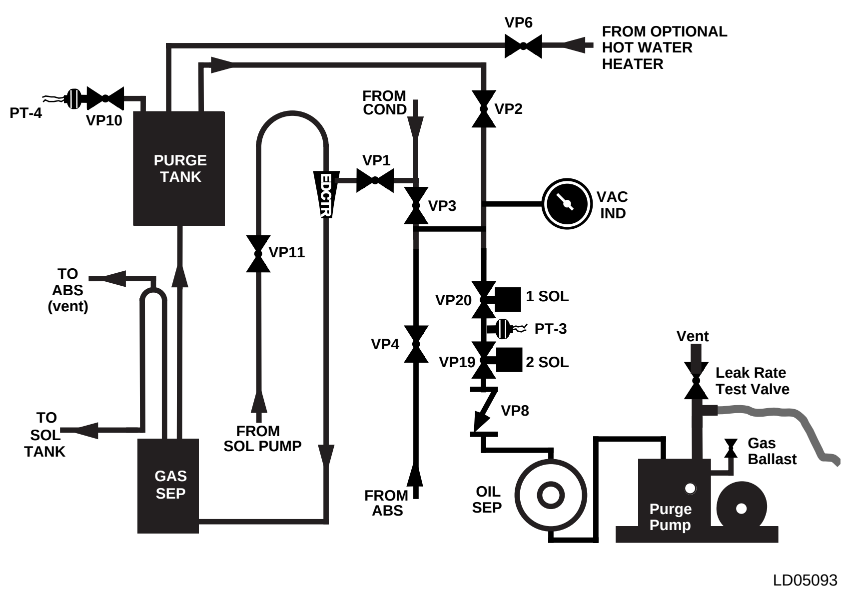


FIG. 18 – G-MODEL UNIT PURGE SYSTEM (WITH SMARTPURGE™)

S-MODEL UNIT PURGE SYSTEM (without SmartPurge™)

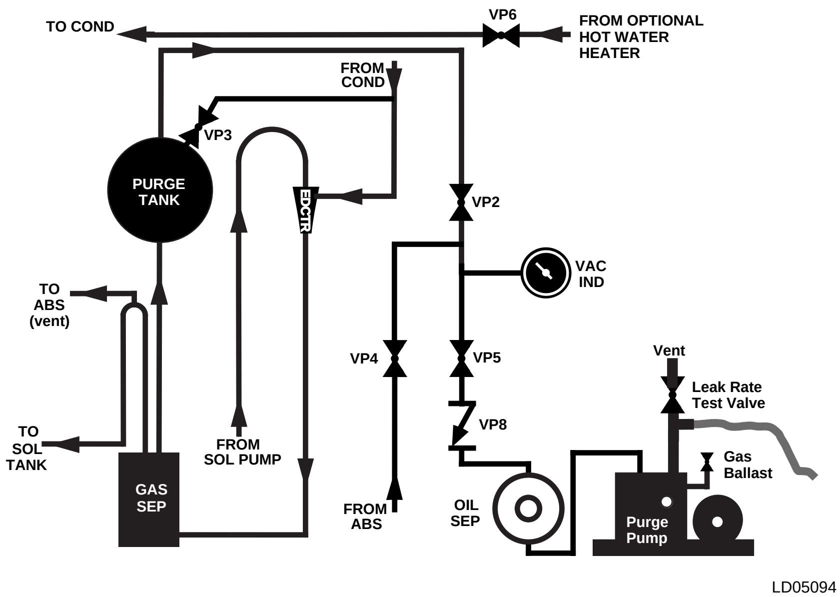


FIG. 19 – S-MODEL UNIT PURGE SYSTEM (WITHOUT SMARTPURGE™)

S-MODEL UNIT PURGE SYSTEM (with SmartPurge™)

Note: VP5 may not be installed on all machines.

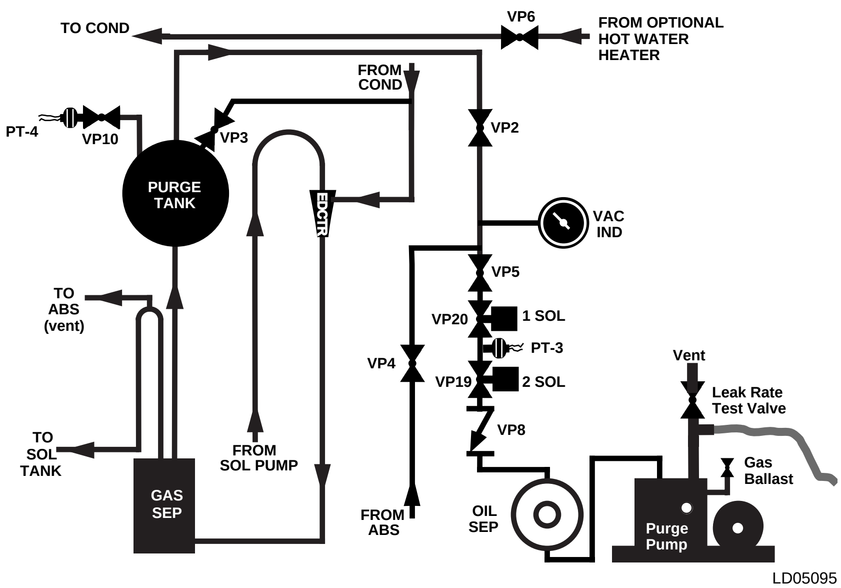


FIG. 20 – S-MODEL UNIT PURGE SYSTEM (WITH SMARTPURGE™)

G-MODEL CONTINUOUS PURGE CYCLE

Solution from the solution pump discharge flows through valve VP11 to the nozzle of the purge eductor which induces non-condensable laden refrigerant vapor to flow from the condenser through VP1.

The combined flow of solution and non-condensables leaves the purge eductor and flows to the gas separator where the non-condensables separate and flow to the purge tank where they are stored.

The solution flows back to the absorber through a liquid U-trap seal.

When the solution eductor is working properly, the eductor outlet is at a higher temperature than the solution inlet to the eductor.

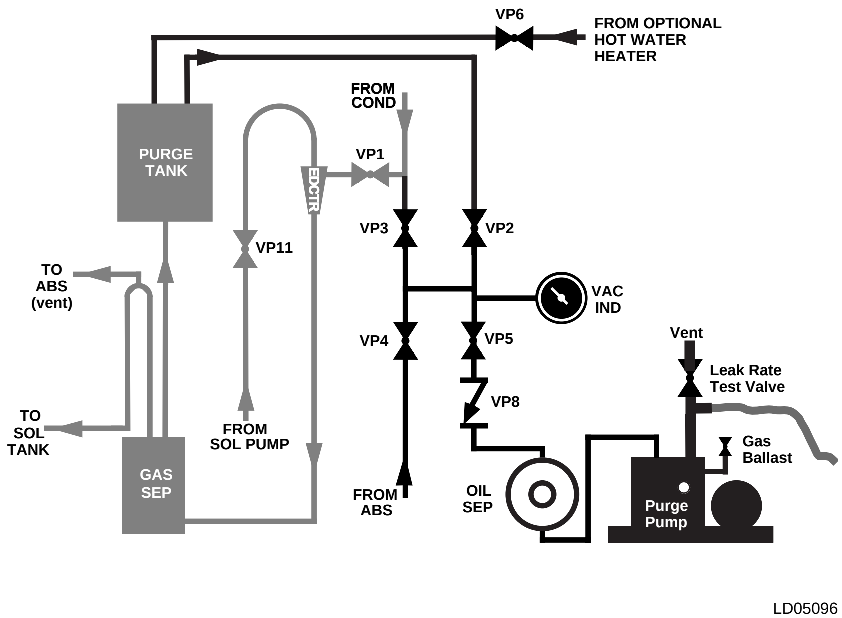


FIG. 21 – G-MODEL CONTINUOUS PURGE CYCLE

S-MODEL CONTINUOUS PURGE CYCLE

Solution from the solution pump discharge flows to the nozzle of the purge eductor which induces non-condensable laden refrigerant vapor to flow from the condenser.

The combined flow of solution and non-condensables leave the purge eductor and flow to the gas separator where the non-condensables separate and flow to the purge tank where they are stored.

The solution flows back to the absorber through a liquid U-trap seal.

When the solution eductor is working properly, the eductor outlet is at a higher temperature than the solution inlet to the eductor.

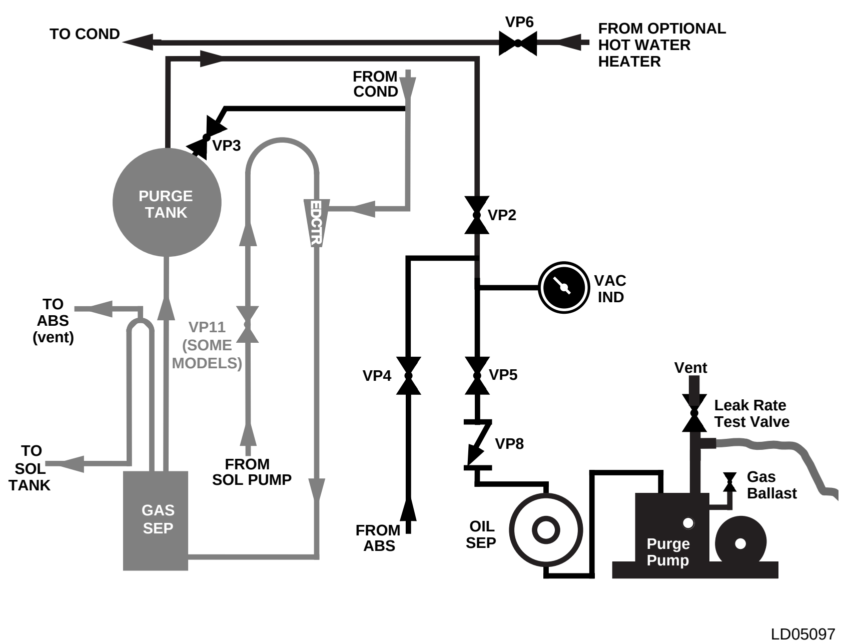


FIG. 22 – S-MODEL CONTINUOUS PURGE CYCLE

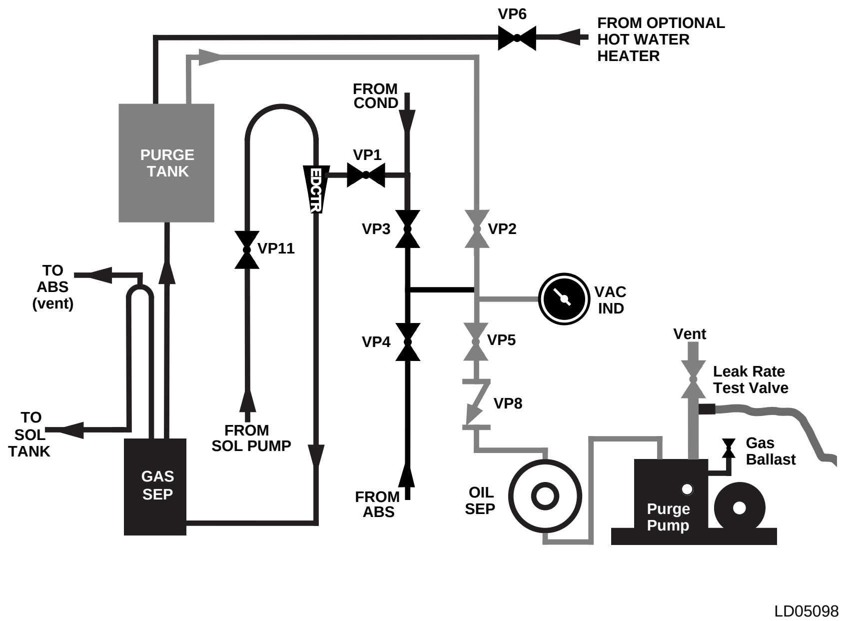


FIG. 23 – MANUALLY PURGING THE PURGE TANK ON G-MODEL UNIT

MANUALLY PURGING THE PURGE TANK ON G-MODEL UNIT

1. The Micro-panel should be set to operate in the manual purge mode (Refer to Form 155.17-O2 for details)
2. Operate purge pump for 10 minutes to warm up oil with gas ballast open, leak rate valve open and all purge system valves closed. Check that the purge pump is capable of pulling down to at least 3 mm Hg by opening VP5 briefly and reading the purge pump pressure on the vacuum indicator gauge. Close VP5.
3. Slowly open valve VP2 to read the purge tank pressure on the vacuum indicator gauge. If the pressure exceeds 30 mm Hg absolute, the purge tank may be purged although it is not necessary unless the tank pressure is equal to or exceeds 60 mm Hg absolute.
4. Slowly open valve VP5. Watch the purge tank pressure. When it is lowered to 30 mm Hg absolute, close VP5 and VP2.
5. Run purge pump for 10 minutes more to clean up oil.

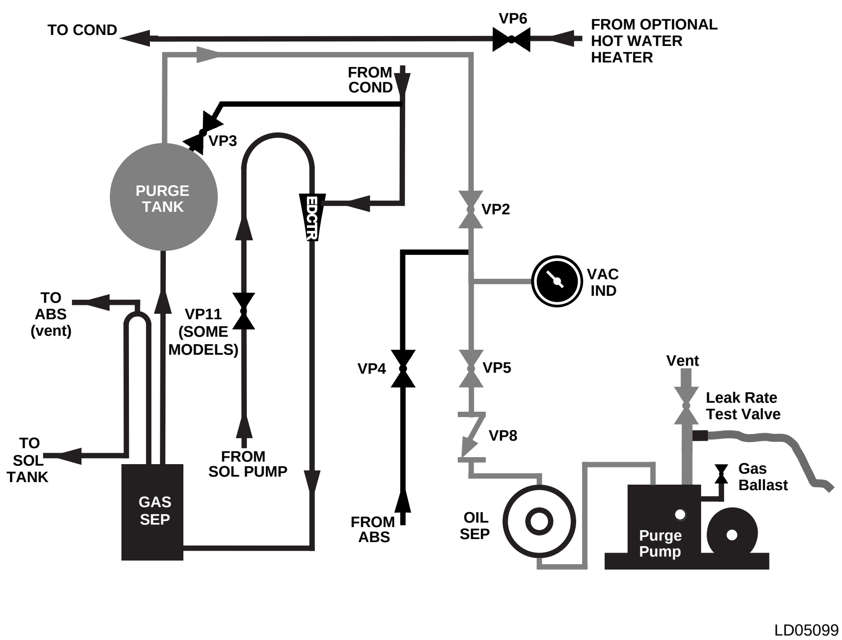


FIG. 24 – MANUALLY PURGING THE PURGE TANK ON S-MODEL UNIT

MANUALLY PURGING THE PURGE TANK ON S-MODEL UNIT

1. The Micro-panel should be set to operate in the manual purge mode (Refer to Form 155.17-O2 for details)
2. Operate purge pump for 10 minutes to warm up oil with gas ballast open, leak rate valve open and all purge system valves closed. Check that the purge pump is capable of pulling down to at least 3 mm Hg by opening VP5 briefly and reading the purge pump pressure on the vacuum indicator gauge. Close VP5.
3. Slowly open valve VP2 to read the purge tank pressure on the vacuum indicator gauge. If the pressure exceeds 30 mm Hg absolute, the purge tank may be purged although it is not necessary unless the tank pressure is equal to or exceeds 60 mm Hg absolute.
4. Slowly open valve VP5. Watch the purge tank pressure. When it is lowered to 30 mm Hg absolute, close VP5 and VP2.
5. Run purge pump for 10 minutes more to clean up oil.

MANUALLY PURGING THE ABSORBER ON G-MODEL UNIT

Should it be necessary to purge the absorber, first assure that the solution level is no higher than the center absorber main shell sight glass.

1. The Micro-panel should be set to operate in the manual purge mode. (Refer to Form 155.17-O2 for details.)
2. Operate purge pump for 10 minutes to warm up oil with gas ballast open, leak rate valve open and all purge system valves closed. Check that the purge pump is capable of pulling down to at least 3 mm Hg by opening VP5 briefly and reading the purge pump pressure on the vacuum indicator gauge. Close VP5.
3. Open VP4 and then VP5.
4. Purge as necessary with the purge gas ballast fully open and the leak rate test valve open, except when checking bubble rate.
5. After purging is complete, close VP4 and VP5.
6. Run purge pump for 10 minutes more to clean up oil.

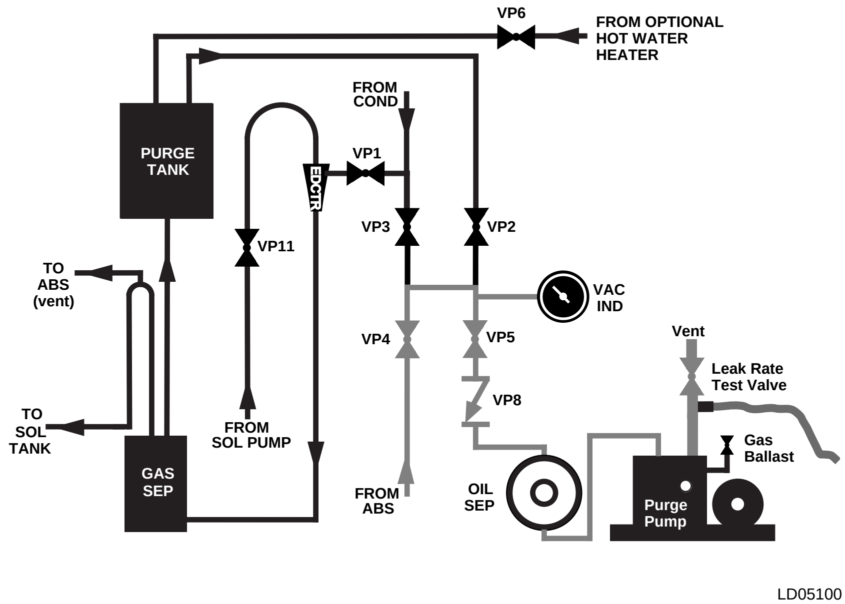


FIG. 25 – MANUALLY PURGING THE ABSORBER ON G-MODEL UNIT

MANUALLY PURGING THE ABSORBER ON S-MODEL UNIT

1. The Micro-panel should be set to operate in the manual purge mode. (Refer to Form 155.17-O2 for details.)
2. Operate purge pump for 10 minutes to warm up oil with gas ballast open, leak rate valve open and all purge system valves closed. Check that the purge pump is capable of pulling down to at least 3 mm Hg by opening VP5 briefly and reading the purge pump pressure on the vacuum indicator gauge. Close VP5.
3. Open VP4 and then VP5.
4. Purge as necessary with the purge gas ballast fully open and the leak rate test valve open, except when checking bubble rate.
5. After purging is complete, close VP4 and VP5.
6. Run purge pump for an additional 10 minutes to clean up the oil.

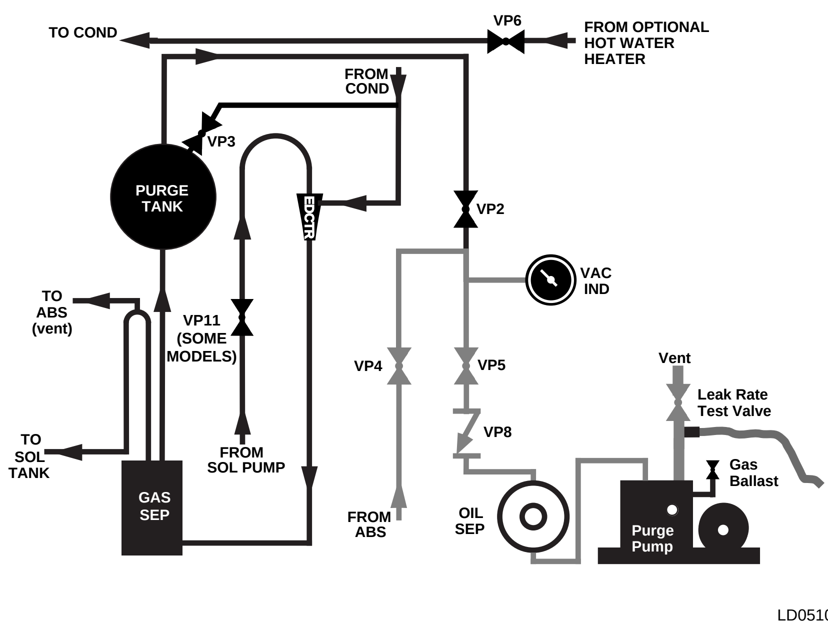


FIG. 26 – MANUALLY PURGING THE ABSORBER ON S-MODEL UNIT

MANUALLY PURGING THE HOT WATER HEAT EXCHANGER ON G-MODEL UNIT

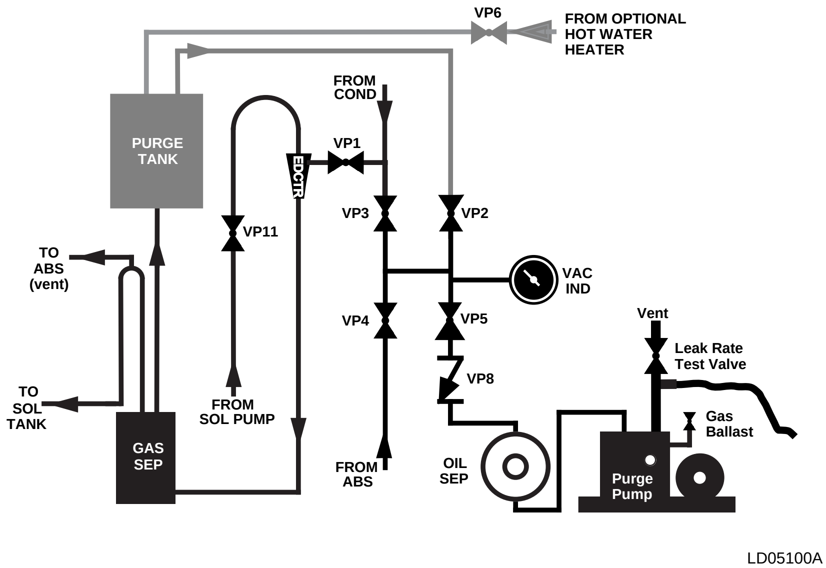


FIG. 27 – MANUALLY PURGING THE HOT WATER HEAT EXCHANGER ON G-MODEL UNIT

NOTE

The hot water heat exchanger should only be purged when the high-temperature generator pressure is excessive.

1. During operation, open VP6 and VP9 (20G model only) for no more than 3 minutes.
2. Close VP6 and VP9 (where applicable).

CAUTION

The hot water heat exchanger should be purged no more than once per month.

MANUALLY PURGING THE HOT WATER HEAT EXCHANGER ON S-MODEL UNIT

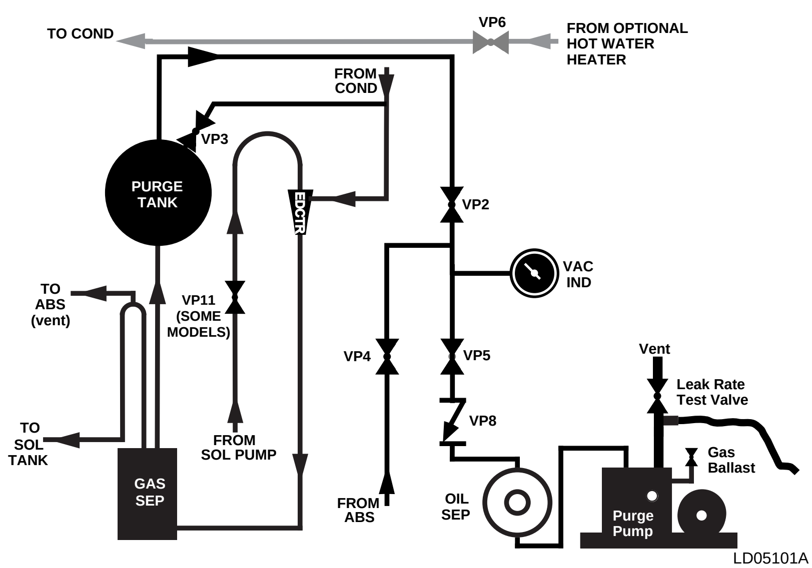


FIG. 28 – MANUALLY PURGING THE HOT WATER HEAT EXCHANGER ON S-MODEL UNIT

NOTE

The hot water heat exchanger should only be purged when the high-temperature generator pressure is excessive.

1. During operation, open VP6 for no more than 3 minutes.
2. Close VP6.

CAUTION

The hot water heat exchanger should be purged no more than once per month.

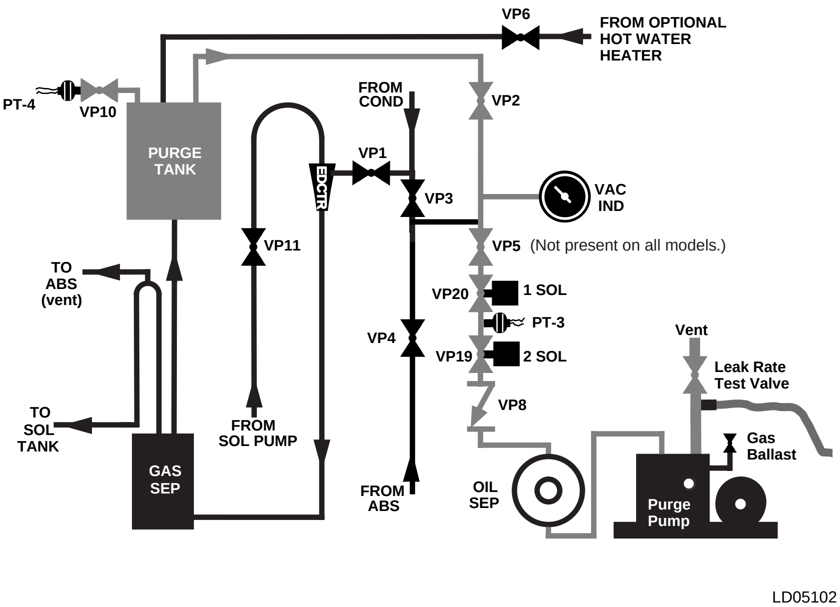


FIG. 29 – AUTOMATIC PURGING OF THE PURGE TANK ON G-MODEL UNITS EQUIPPED WITH SMARTPURGE™

AUTOMATIC PURGING OF THE PURGE TANK ON G-MODEL UNITS EQUIPPED WITH SMARTPURGE™

(SmartPurge™ must be enabled by removing I/O Expansion Board Jumper JP1 and then selecting it on the Micro-Panel see 155.17-O2 for further instructions.)

When the purge tank pressure transducer PT-4 senses a purge tank pressure equal to or greater than 60 mm Hg absolute, the purge pump and 2 SOL are energized.

When PT-3 senses a pressure equal to or less than 15 mm Hg absolute, 1SOL is energized.

The purge tank is then evacuated until PT-4 senses a pressure equal to or less than 30 mm Hg absolute.

1SOL and 2SOL are de-energized and the purge pump runs for 15 minutes before being de-energized.

The auto purge cycle counters are incremented.

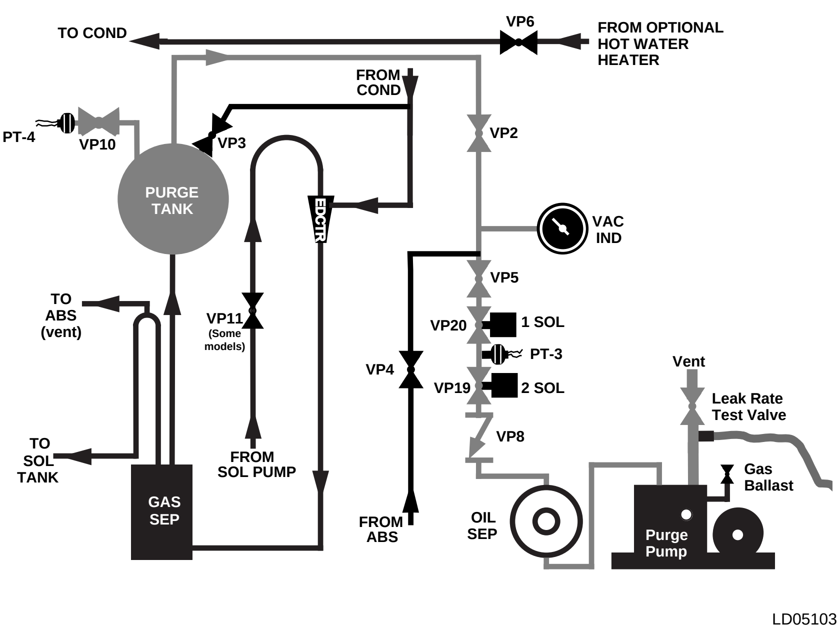


FIG. 30 – AUTOMATIC PURGING OF THE PURGE TANK ON S-MODEL UNITS EQUIPPED WITH SMARTPURGE™

AUTOMATIC PURGING OF THE PURGE TANK ON S-MODEL UNITS EQUIPPED WITH SMARTPURGE™

(SmartPurge™ must be enabled by removing I/O Expansion Board Jumper JP1 and then selecting it on the Micro-Panel see 155.17-O2 for further instructions)

When the purge tank pressure transducer PT-4 senses a purge tank pressure equal to or greater than 60 mm Hg absolute, the purge pump and 2 SOL are energized.

When PT-3 senses a pressure equal to or less than 15 mm Hg absolute, 1SOL is energized.

The purge tank is then evacuated until PT-4 senses a pressure equal to or less than 30 mm Hg absolute.

1SOL and 2SOL are de-energized and the purge pump runs for 15 minutes before being de-energized.

The Auto-Purge cycle counters are incremented.

SECTION 4 – PUMPS

PURGE PUMP OPERATION

As previously discussed, each machine is equipped with a vacuum pump (refer to Figs. 33 and 34 for pump specifications) which is designed to remove non-condensables from various areas of the machine. The following issues should be kept in mind whenever operating a YORK Vacuum Pump.

Cleanliness

Take every precaution to prevent foreign particles from entering the pump. A fine mesh screen is provided for this purpose in the intake passage of all YORK Vacuum Pumps.

Types of Lubricants

All YORK mechanical vacuum pumps are tested with DUOSEAL® oil and shipped with a full charge to prevent unnecessary contamination. DUOSEAL® oil has been especially prepared and is ideally suited for use in mechanical vacuum pumps because of its desirable viscosity, low vapor pressure and chemical stability.

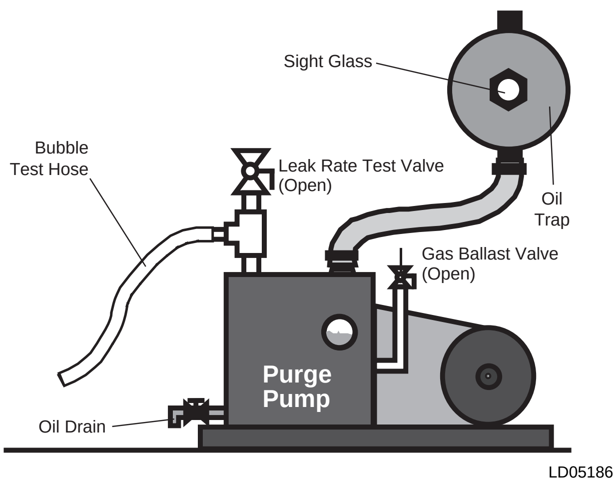


FIG. 31 – PURGE PUMP PIPING AND VALVES - NORMAL OPERATION

The vacuum guarantee on all YORK vacuum pumps applies only when DUOSEAL® oil is used.

Purge Pump Piping and Operating Valves

The purge pump piping and valves, illustrated in Figure 31, is installed at start-up and can be used for several functions. During normal operation, both the gas ballast and the leak rate test valve must be open at all times.

The Principle of Gas Ballast

a) **The Effects of Unwanted Vapor** - Systems which contain undesirable vapors cause difficulty from both the standpoint of attaining desirable ultimate pressures as well as contamination of the lubricating medium. A vapor is defined as the gaseous form of any substance which is usually a liquid or a solid. Refrigerant (water) and alcohol vapors are two of the most common vapors encountered in absorption chillers. When such vapors exist in a system, the vapors or mixtures of gas and vapor are subject to condensation within the pump. This precipitated liquid may dissolve or become emulsified with the oil. This emulsion is recirculated to the chambers of the pump where it is again volatized, causing increased pressure within the system.

b) **The Presence and Removal of Condensate** - Condensation takes place particularly in the compression stroke of the second stage of a two-stage pump. The compression stroke is that portion of the cycle during which the gas drawn from the intake port is compressed to the pressure necessary to expel it past the exhaust valve. Condensation takes place when the ratio between the initial pressure and the end pressure of the compression is high; that is, when the mixture of vapor and gas drawn from the intake port is compressed from a low pressure to a high pressure. By adding air through the gas ballast valve to the mixture of vapor and gas being compressed, the pressure required for delivery past the exhaust valve is reached with a considerably smaller reduction of volume of the mixture; thus, depending upon the amount of air added, condensation of the vapor is either entirely avoided or substantially reduced.

Oil Level Determination

The amount of oil suitable for efficient and satisfactory performance should be determined after the pump has reached its operating temperature. Initially, however, the pump should be filled with fresh oil while the pump is idle. Fill the pump until the oil level falls half way up the oil level window. If, after a short period of operation, the level should fall, it is likely the result of oil entering some of the interior pockets of the pump.

4

If the oil level rises, this signifies oil had drained into the pump cavity while idle. Shut off pump, then drain oil down to proper level.

If a gurgling sound occurs, additional oil may need to be added. Mechanical pumps will gurgle in varying degrees under four conditions of performance: (1) when operating at high pressure as in the beginning cycles of evacuation of the purge tank; (2) when the oil level in the pump reservoir is lower than required; (3) when a large leak is present in the system; and (4) when the gas ballast is open. Best performance of a mechanical pump is generally obtained after sufficient time has been allowed for the pump to come to operating temperature.

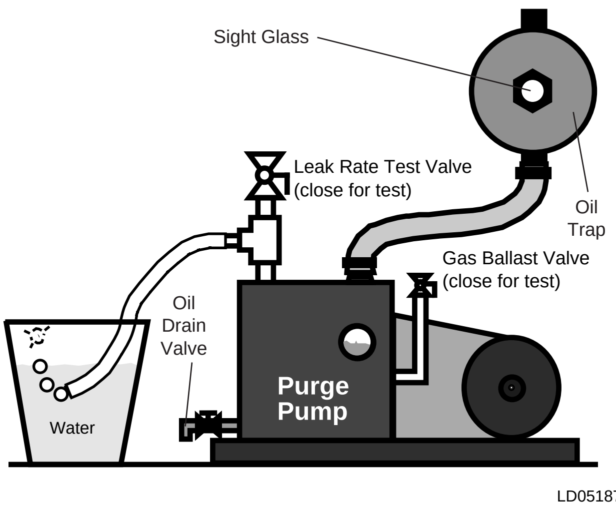


FIG. 32 – BUBBLE TESTING FOR LEAKS

Bubble Test Procedure

A bubble test can be performed to determine if a leak and/or non-condensables are present in the vacuum pump, adjoining piping or machine.

The test is performed by closing both the gas ballast and leak rate test valves and inserting the flexible 1/4 inch plastic hose in a cup or bucket of water. Hold the hose so that it is about 1/2 inch below the surface of the water. An initial surge of bubbles will be seen, followed by a constant decrease. If no leaks or non-condensables are present in the area being tested, few if any bubbles will be noticed after the initial surge.

PURGE PUMP MAINTENANCE

Vacuum Problems

Pressure Determinations - A simple criterion for the condition of a mechanical pump is a determination of its ultimate pressure capability. This can be accomplished by attaching a gauge directly to the pump. The gauge may be any suitable type, provided consideration is given to the limitations of the gauge being used. The pump must be capable of pulling a vacuum of at least 3 mmHg. If the pressure is unusually high, the pump may be badly contaminated, low on oil or malfunctioning. On the other hand, if the pressure is only slightly higher than the guaranteed pressure of the pump, an oil change may be all that is required.

Oil Contamination - The most common cause of a loss in efficiency in a mechanical pump is contamination of oil. It is caused by condensation of refrigerant and alcohol vapors, and by foreign particles. The undesirable condensate emulsifies with the oil which is recirculated and subjected to re-evaporation during the normal cycle of pump activity, thus reducing the ultimate vacuum attainable. Some foreign particles and vapors may form sludges with the oil, impair sealing and lubrication and cause eventual seizure. Although the gas ballast valve is helpful in removing vapors, it is not equally effective on all foreign substances; therefore, periodic oil changes are necessary to maintain efficient operation. The required frequency of changes will vary with the particular system.

The oil should be changed when it looks dirty, cloudy or the pump is not capable of pulling below 3mmHg.

Oil Changes and Oil Level

Draining the Pump - An oil change is most easily accomplished when the pump is warm and the oil is less viscous. Use a container large enough for the oil in the particular pump. Stop the pump, and open the drain valve. A thorough job may be accomplished by tipping the pump slightly, if this is possible. The small residue remaining in the pump may be forced out by hand-rotating the pump pulley with the exhaust port partially closed and the intake port open. Closing the exhaust port completely under these conditions will create excessive pressure at the drain valve, which may cause the oil being drained to splatter.

Flushing the Pump - This procedure should be performed whenever the performance of the pump is poor and simply changing the oil didn't correct this shortcoming.

1. Check the oil level.
   a. If the oil level is well above the fill mark, this can indicate the pump has ingested lithium bromide solution. Go to step 2.
   b. If the oil level is even with the fill mark and you do NOT suspect lithium bromide solution has been ingested accidentally by the pump, run the pump for 15 minutes and allow the pump oil to warm up for 15 minutes.
2. Turn off the motor for the vacuum pump. Drain the oil into a clear plastic container. Look for water settling to the bottom of the container. In some cases, an emulsion of oil and water can be seen between the oil and the water. If water is noticed, perform steps 3 through 5 several times until the oil comes out clear.

NOTE

The oil drained from the pump came from the oil case only. There may be water or other contaminants in the pumping mechanism. To be sure all contaminants have been removed, the pump mechanism needs to be flushed.

3. Make sure the belt guard is installed before proceeding further. Attach a short hose to the drain valve which runs into a clear plastic container. Secure the hose end in the container so that it does not blow around during the next step.
4. Flushing the pump is carried out by adding a cup of new DUOSEAL® oil through the intake (IN) port while the pump is turned on for 15-20 seconds. While adding the pump oil, the exhaust (OUT) port is blocked by the palm of your hand. Look for water coming out of the drain hose. Turn off the pump.
5. Repeat step 4 until only clean oil comes out of the drain hose.
6. Fill the pump (through the exhaust port) with 2.25 quarts of DUOSEAL™ vacuum pump oil on Welsh Model 1402 pumps, and 0.625 quarts on Welsh Model 1400 pumps.
7. Plug the intake (IN) port with a rubber stopper. Turn the pump on and run the pump for 10 minutes. Close the gas ballast valve.
8. Check the vacuum reading of the pump by connecting a thermocouple, manometer or pirani gauge tube to the pump's intake. The total pressure reading should be at least 3 mmHg.

   A simple way to connect the gauge tube to the pump is to run the threaded tip of the tube through a hole in the rubber stopper. Use pump oil as a lubricant for inserting the tube. The stopper chosen should be bigger than the outer diameter of the intake fitting.

Refilling the Pump - Refill the pump by pouring new DUOSEAL® oil into the exhaust port. Fill to the indicated level and start the pump with the intake closed. A gurgling noise is characteristic when high pressure air is drawn through the pump. It should disappear quickly as the pressure within the pump is reduced. If gurgling continues (with gas ballast closed), add sufficient additional oil through the exhaust port until gurgling ceases.

Shaft Seal Replacement

To replace the shaft seal of a pump, drain the oil and remove the pump pulley and key. Remove the screws securing the old seal and pry it loose with a screwdriver or similar wedge, being careful not to mar the surface of the pump body against which the seal fits. Discard the seal and its gasket, inspect all surfaces and repair any damages with a fine abrasive stone. Wipe all sealing areas clean and place a film of DUOSEAL® oil on both the shaft and the inside bore of the new shaft seal. Using a new gasket, carefully slide the new seal into position and center it on the shaft. It is not necessary to apply any sealant to the gasket. Tighten the mounting screws uniformly and refill the pump with DUOSEAL® oil. Follow instructions included in repair kit.

Repairing Oil Leaks

Location, Cause and Effect - Oil leaks may develop wherever two mating faces are sealed with a gasket. Such seams may fail as the result of deterioration of the gasket material, loosening of the screws caused by temperature variations, or improper care as the result of previous reassembly. Typical gasketed seams in a mechanical pump are located at the oil level window, the shaft seal, the oil drain and the mating faces of such mechanical surfaces as the intake chamber cover. The importance of a gasketed seam is determined principally by its function. If it is a vacuum seal, the ultimate performance of the pump is dependent upon it. If it is an oil seal, the pump may be operated satisfactorily for some time without loss of function. Eventually, of course, a great loss of oil may cause harmful damage.

Repairing Technique - An oil seam may be sealed by any of several methods. When an O-ring is employed, the surfaces of the O-ring and its groove should be wiped clean. If the O-ring is not badly deformed or scratched, it may be reused by sealing with a slight film of vacuum oil or vacuum grease. Thin composition gaskets are generally used for large irregularly shaped areas. A replacement joint of this type should be thoroughly cleaned of all previous gasket material and the mating surfaces cleaned of any nicks.

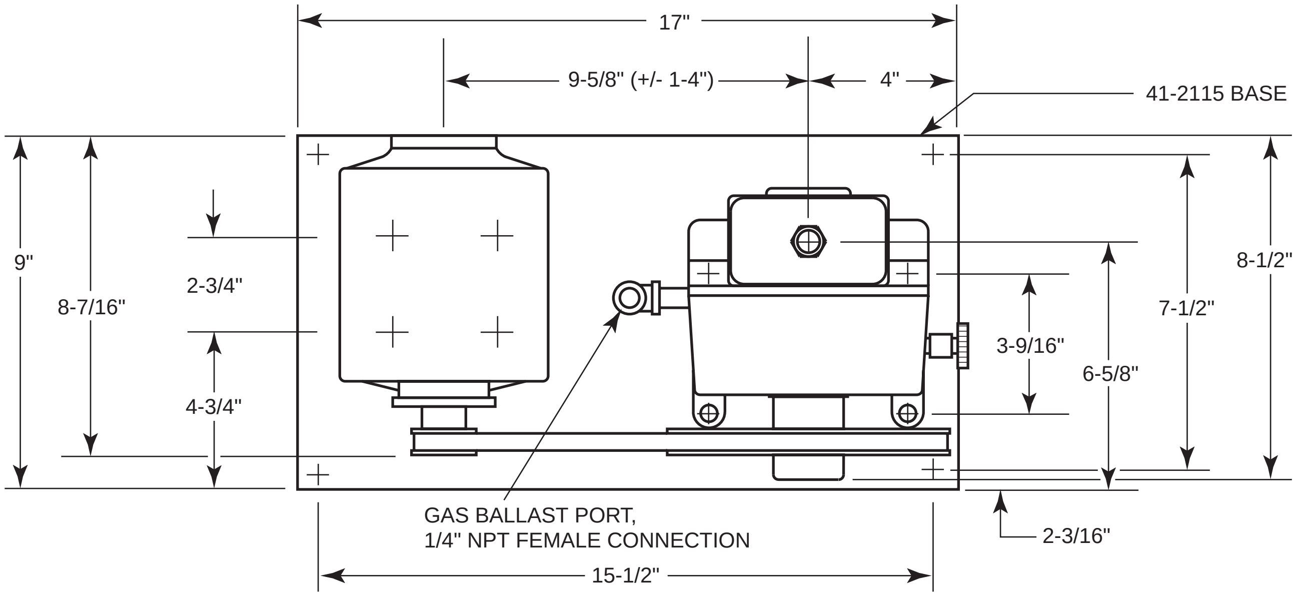
Drive Problems

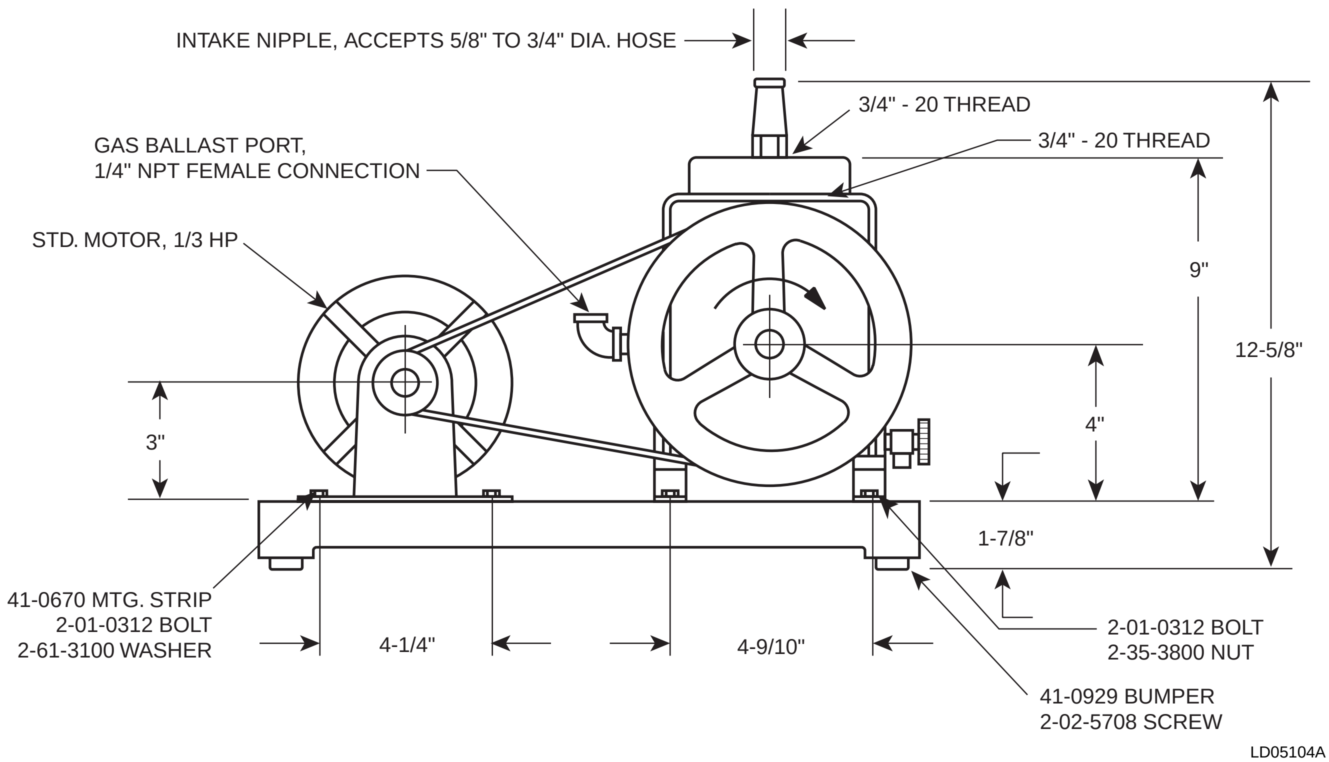
WARNING

When troubleshooting drive problems or checking belt tension, always shut-off and lock out power at the main disconnect switch. If Smart-Purge mode is selected, the pump will start automatically.

If for any reason the pump will not operate, turn off and lock out the power at the main circuit breaker or disconnect. Check the overload assembly and electrical connections. Remove the guard cover followed by the belt. Re-establish power to the pump. If the motor operates properly, try hand-rotating the pump in the proper direction with the pump intake port open. If both turn freely, then replace the belt and check the belt tension. The tension should be sufficient to drive the pump without visible slippage. Any greater tension will cause noise and possible damage to the bearings of both the motor and pump. Make certain that both pulley grooves are clean and free from oil. The pulleys must be fastened securely on their respective shafts, and in parallel alignment. Re-install the belt guard and check for proper operation and amperage.

Replace or re-build any defective components.

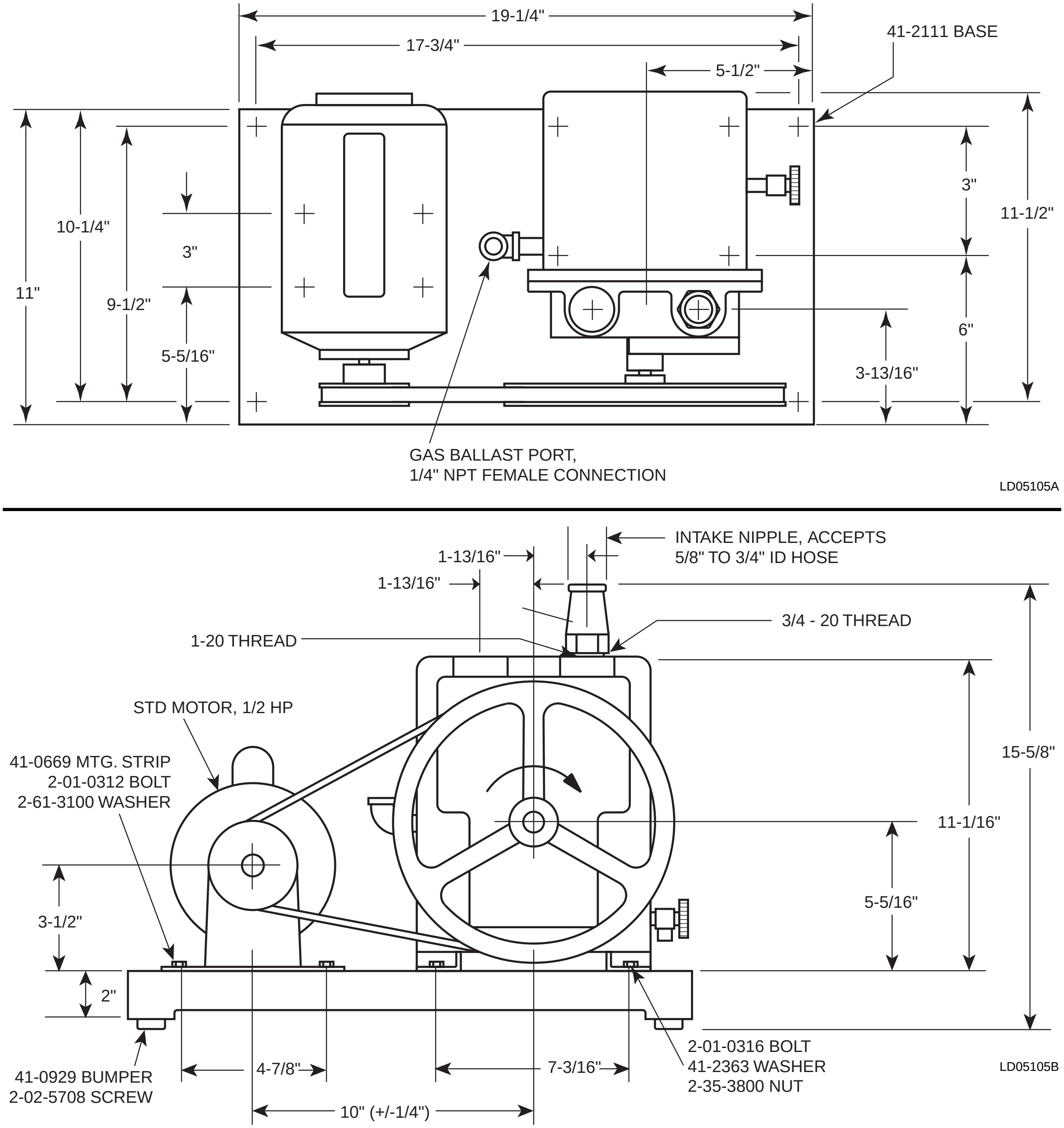




SPECIFICATIONS:

Free- Air Displacement, L/M 25
CFM 0.9
Guaranteed Partial Pressure
Blankoff, millitorr 0.1
Pump Rotational Speed, RPM 580
Number of Stages 2
Oil Capacity, qts 5/8
Net Weight, Pump Only, lbs 33
Net Weight, Mounted Pump, lbs 58
Shipping Weight, Mounted Pump, lbs 66

FIG. 33 – MODEL 1400 VACUUM PUMP FOR YORK - USED ON S MODEL UNITS



SPECIFICATIONS:

Free- Air Displacement, L/M 160
CFM 5.6
Guaranteed Partial Pressure
Blankoff, millitorr 0.1
Pump Rotational Speed, RPM 525
Number of Stages 2
Oil Capacity, qts 2 1/4
Net Weight, Pump Only, lbs 82
Net Weight, Mounted Pump, lbs 112
Shipping Weight, Mounted Pump, lbs 125

FIG. 34 – MODEL 1402 VACUUM PUMP FOR YORK - USED ON G MODEL UNITS

BUFFALO PUMPS

Introduction

The Buffalo pumps used on *ParaFlow*™ chillers are single suction, single-stage, hermetically sealed centrifugal pumps designed for zero leakage. The pumps employ a unique spring-loaded conical bearing design that allows for long life between overhauls. The pump bearings are cooled and lubricated by the pumping fluid (refrigerant water or lithium bromide solution). The pumping liquid also carries away heat generated by the motor.

CAUTION

Do not run the pump dry. Even momentary operation without the pump and motor casing filled with liquid will damage pump bearings.

The majority of the pumps used are single-ended; however, some of the smaller S-model units use a double-ended pump for both the main and solution spray pumps. This simply means that the same motor is used to drive both pumps.

Figures 35 and 36 show cutaway views of both style pumps. The arrows indicates the cooling circuit through the pumps.

Troubleshooting

Pump Tripping on Overloads - Check voltage supply on all three phases to be sure it is correct for the pump motor in question. Check overload for proper amperage setting (Pump Motor FLA), loose wires or poor connections that generate heat and trip the overload. If no problems are found, shut off all power to the unit, lock out and tag all disconnects. Check the motor connections to be sure the pump is wired correctly. Using a megohm meter, check the pump motor windings for shorts or grounds. If motor problems are found, motor replacement will be necessary (Contact your local YORK Factory Service office for details). If no problems are found during this procedure, reconnect the motor. Apply power to the unit and run the pump, while watching the operating amps. If high amps are encountered, the problem may be mechanical, such as bearing seizure. Pump inspection will be necessary. If the overload continues to trip, but the motor amperage is within the allowable range, the overload is defective.

Pump Tripping on Thermal Protection - If the winding temperature thermostat is tripping the pump, allow the thermostat to reset. Exercise caution, the motor housing skin temperature should be in excess of 300°F (148.9°C) when the winding temperature thermostat trips. Although rare, if the thermostat will not reset in a reasonable period of time, it may be defective. If this is the case, temporarily bypass the thermostat and run the pump. Check the motor housing temperature with an infrared thermometer. The average outside skin temperature of a solution pump motor housing is 190°F (87.8°C) at stable operating conditions [100°F (37.8°C) Suction Temperature]. Refrigerant pumps run cooler than this. Check to be sure that the pump is not running dry periodically or that either the suction/discharge isolation valves are closed. Check to see that the pump is not pumping abnormally high-temperature liquid for some reason. If no problems related to flow through the pump are found, the internal coolant passages may be blocked. Pump disassembly will be required (Contact your local YORK Factory Service office for details).

Unusual Noise/Vibration - Pumps will make some noise during normal operation. Abnormal sounds and vibration may be due to foreign material trapped in the coolant circuit and rubbing between the stator and rotor. Noise may also be a result of extreme bearing wear. Pump disassembly is required.

Pump Overhaul

The expected time span between Buffalo Pump overhauls on a properly maintained *ParaFlow*™ unit should be between 50,000 and 60,000 hours. Pumps installed on units running with high amounts of suspended solids or high amounts of dissolved copper in the solution will suffer shorter lives. It is therefore recommended to install a solution filtration kit on the unit to remove the suspended solids and/or perform a copper removal procedure as indicated on the solution chemistry report. Contact your local YORK Factory Service office for details.

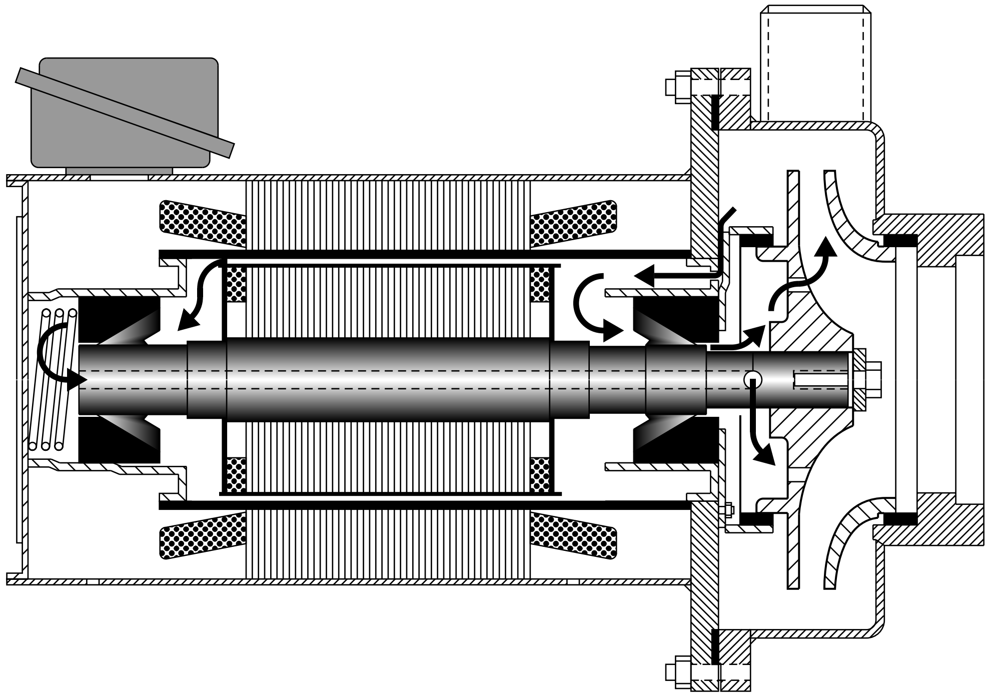


FIG. 35 – FLOW OF REFRIGERANT WATER OR LITHIUM BROMIDE THROUGH SINGLE-END PUMP

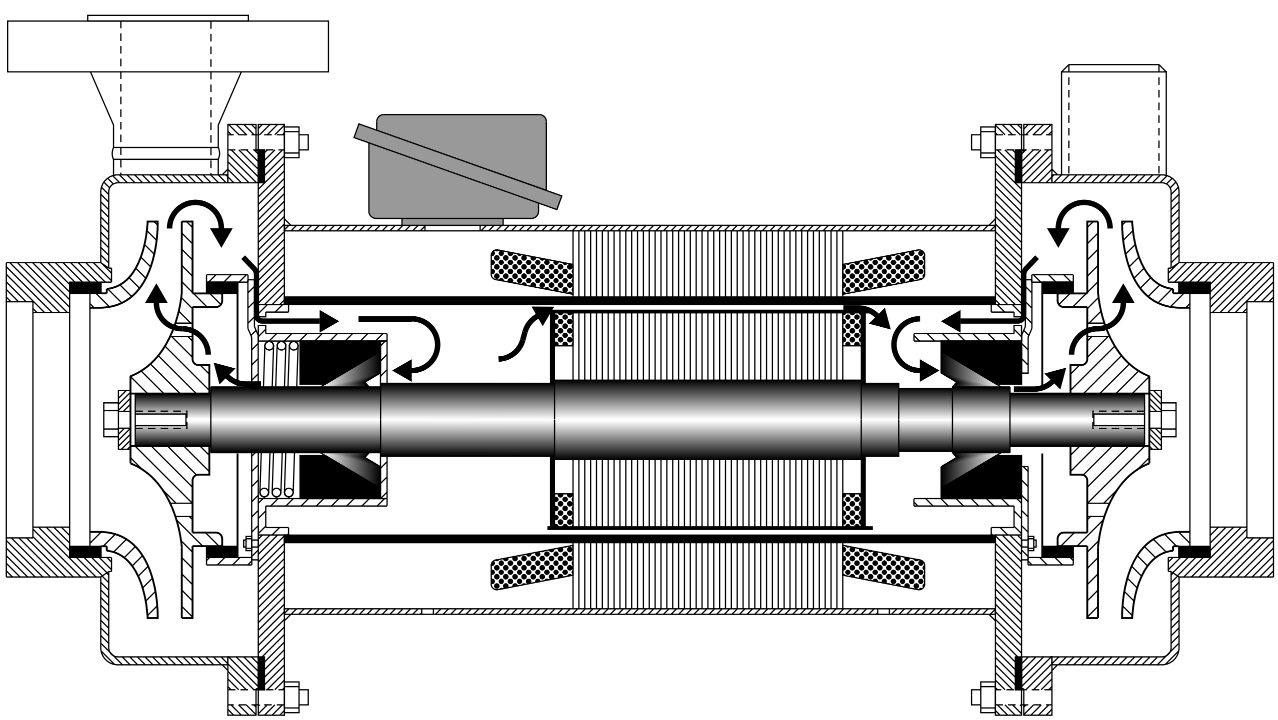


FIG. 36 – FLOW OF LITHIUM BROMIDE THROUGH DOUBLE-END PUMP

SECTION 5 – BURNERS

MODEL IDENTIFICATION

The numerical suffix after the letter “C” denotes the burner frame size. The letter “R” inserted immediately after the letter “C” denotes an inverted blower configuration. All new *ParaFlow*™ units have this inverted configuration.

The alphabetical designation immediately following the frame size indicates the fuels to be used: “G” is for gas only; and “GO” is for combination gas/oil.

The two numbers following the fuel designation denotes the standard gas train size. (Selected components may be of different pipe sizes than the nominal train size coded). Refer to Figure 37 below.

20 - 2” Gas Train
25 - 2-1/2” Gas Train
30 - 3” Gas Train

The model number listed in the example below is depicted throughout this section of the manual. Other burners will vary in physical size but will have the same configuration.

Type → **Frame Size** → **Fuel (gas/oil)**

CR4 - GO - 25

Standard Gas Train Size (2-1/2”)

FIG. 37 – MODEL IDENTIFICATION

GAS TRAINS

Gas trains consist of components as shown in Figure 38 below. The required components are job specific and will depend upon local, state and federal codes.

Refer to As-Built Burner Piping Diagrams supplied with burner for specific gas train details.

BURNERS

The two types of burners presently used on *ParaFlow*™ units are Power Flame and Weishaupt.

The burners range in inputs from 2553 MBH for the smaller S-models, to 10418 MBH for the larger sizes.

The main burner can either be fired using gas (natural or propane) or #2 fuel oil.

A gas pilot burner is used for both gas and oil operation.

For information on Weishaupt Burners, refer to IOM manual supplied with burner.

A typical burner is illustrated in Figures 39 through 42 on the following two pages. The basic components for a gas/oil combination burner are illustrated.

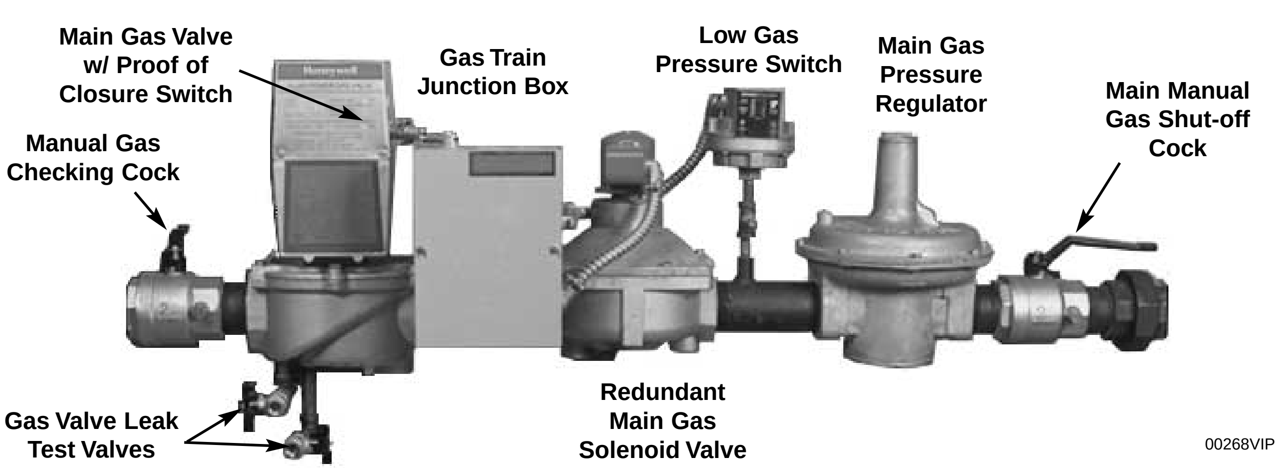


FIG. 38 – 2-1/2” UL LISTED GAS TRAIN

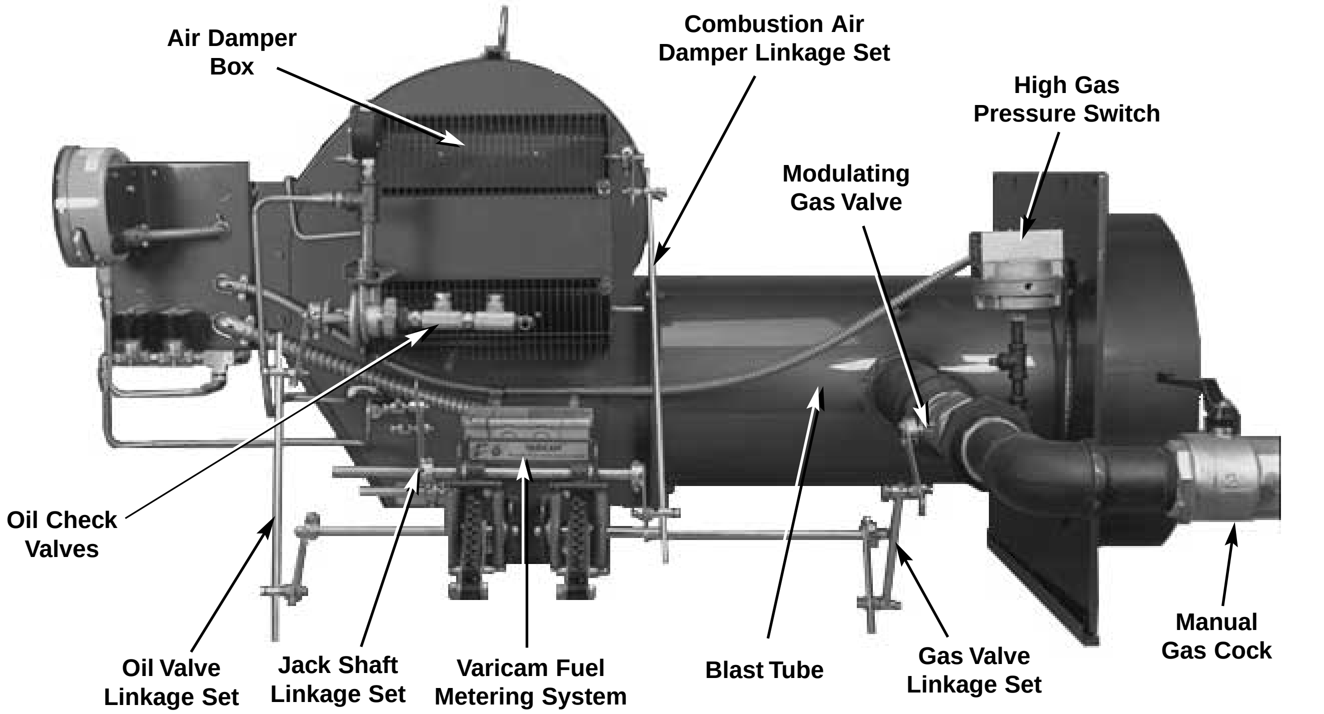


FIG. 39 – TYPICAL BURNER COMPONENTS – RIGHT SIDE VIEW

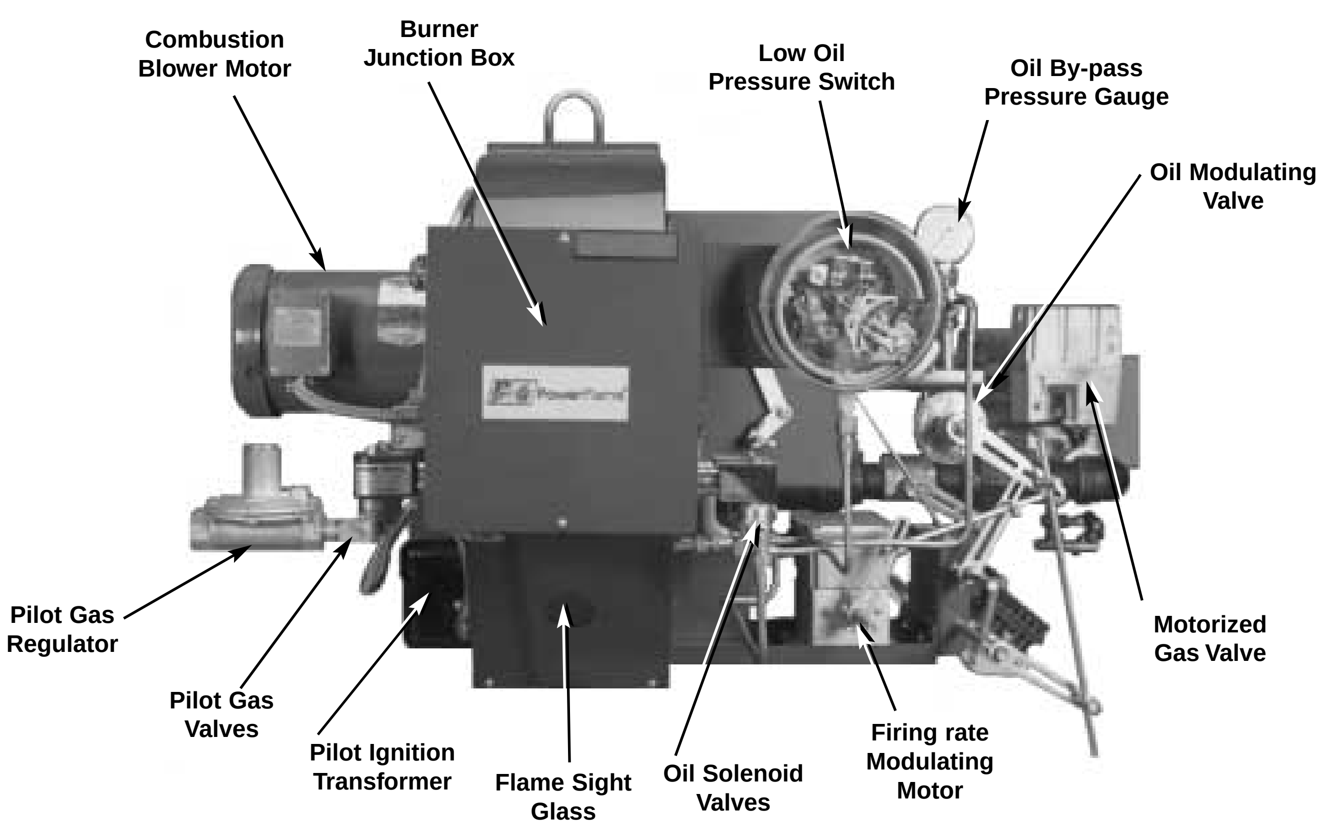


FIG. 40 – TYPICAL BURNER COMPONENTS – BACK END VIEW

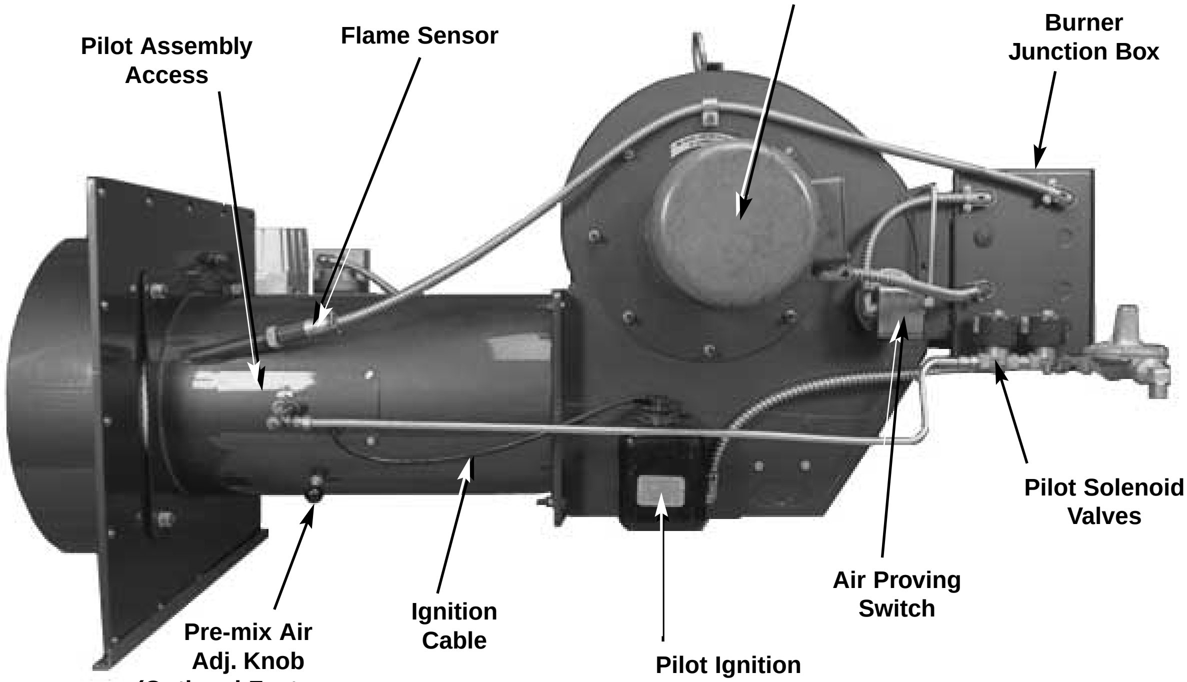
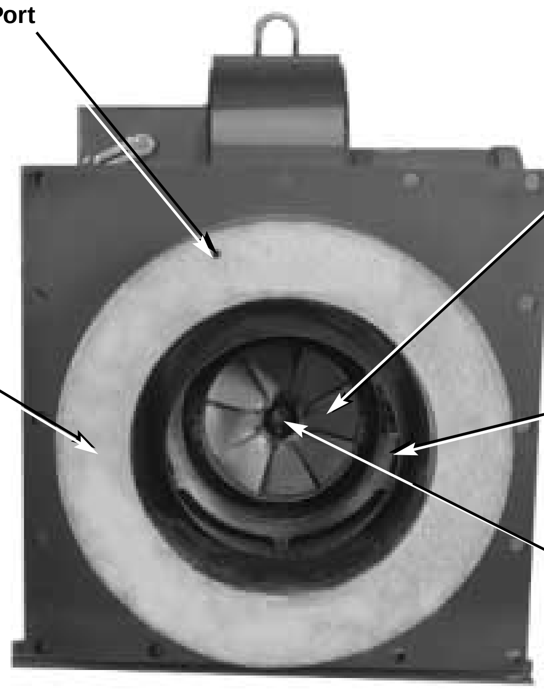


FIG. 41 – TYPICAL BURNER COMPONENTS – LEFT SIDE VIEW



The components and arrangements shown in this section are typical for a model CR4-GO-25 burner. Gas only units will have similar components; however, all oil components shown will not be present. For specifics on your system, refer to the technical information supplied with the burner.

FIG. 42 – TYPICAL BURNER COMPONENTS – FRONT VIEW

5

BURNER WITH FULL MODULATION FUEL /AIR CONTROL (GAS OPERATION)

The gas full modulating system (Figure 43) uses a **Motorized Gas Valve (1)** to ensure opening and positive closure of the gas source to the **Firing Head (2)**.

A **Modulating Motor (3)** controls the positioning of a **Butterfly Gas Proportioning Valve (4)** and movable **Air Dampers (5)** through **Mechanical Linkage**.

The gas flow control rate is accomplished through adjustment of the **Main Gas Pressure Regulator (7)** and the **Butterfly Gas Proportioning Valve**.

A proven spark-ignited gas pilot provides ignition of the main flame. When the gas pilot has been proven by a flame detector, the **Motorized Gas Valve(s)** open and allows gas to flow to the burner head for main flame low fire light off. The rate of gas flow is controlled by the **Butterfly Gas Proportioning Valve**.

After a short period of time at the low-fire position, the burner will modulate between low and high fire, depending on the signal that it is receiving from the *ParaFlow*™ ISN Control Center (signal varies with leaving chilled water temperature).

When the leaving chilled water temperature drops to around 3°F (1.6°C) below its set-point, the **Diaphragm Gas Valve** closes (normally the burner will be at its low fire position at this time) and the **Air Dampers** will go to the low fire light off position in preparation for the next firing cycle.

NOTE

Component operational sequencing will vary with Specific Flame SafeGuard Control being used. Refer to the Flame SafeGuard Control section of this manual for details.

Refer to submittal package supplied with burner for further detailspertaining to burner operation.

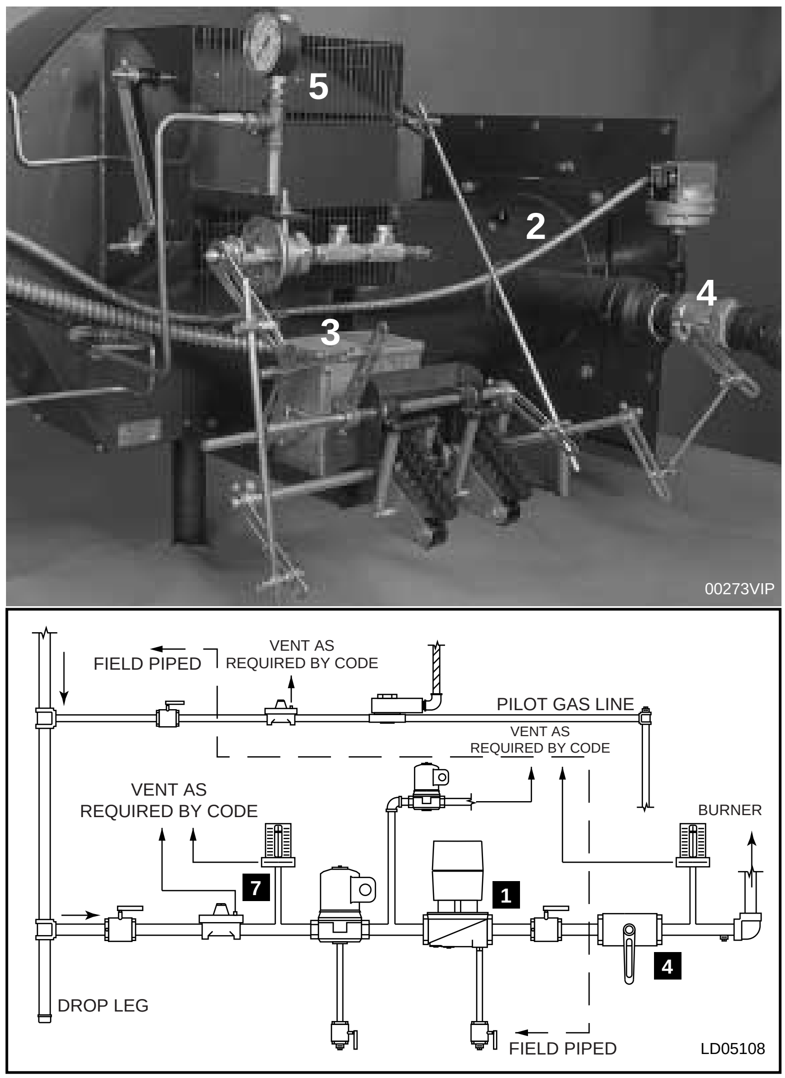


FIG. 43 – BURNER WITH FULL MODULATION FUEL/AIR CONTROL (GAS OPERATION)

BURNER WITH FULL MODULATION FUEL / AIR CONTROL (OIL OPERATION)

The oil full modulation system (Figure 44) uses a **Two Stage Oil Pump (2)** with an internal bypass type **Oil Nozzle**. A **Modulating Motor (3)** controls the positioning of the **Air Dampers (4)** and the **Modulating Oil Valve (5)** in the nozzle return line through mechanical linkage.

A spark ignited gas pilot is used to light off the main flame.

At main flame light off the normally closed **Oil Valve(s) (1)** is energized allowing flow to the nozzle (codes require either one or two oil solenoid valves).

The **Modulating Oil Valve (5)** is adjusted to allow a controlled amount of oil to bypass the **Nozzle**. This reduces the pressure to the **Nozzle** for low fire light off.

Nozzle oil supply pressure is set by adjusting the oil pump pressure regulating 1/8” allen wrench fitting (7).

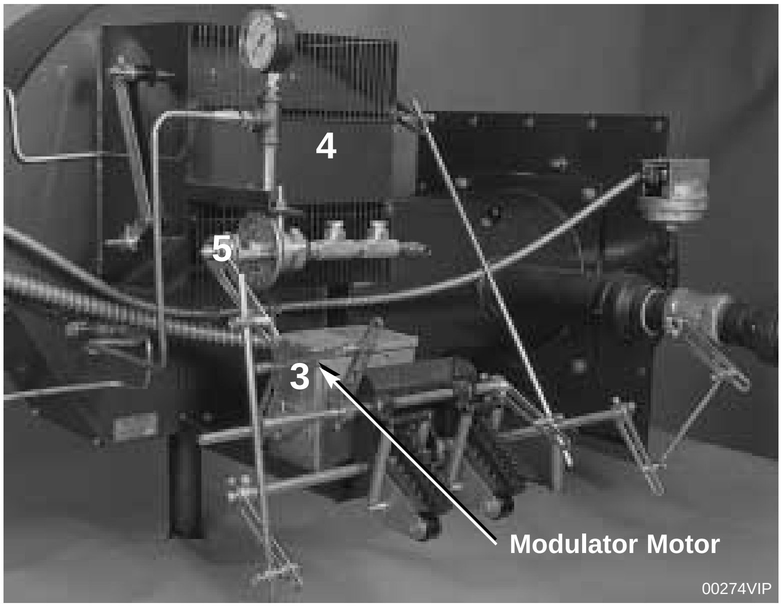
The low fire nozzle pressures should be taken at the plugged **Oil Pump Gauge Port (8)** and should be approximately 300 PSI (but could be as low as 240 PSI on certain inputs of the C4 and C5 models) with pressure at the **Nozzle Bypass Gauge (9)** from 60-100 PSI. These pressures will vary with nozzle size and job conditions.

A typical low fire oil flow setting on the Modulating Oil Valve would be number 7 on the dial, but will vary with job conditions.

After a brief period of time, to allow for the low fire flame to stabilize and stack to heat up, the burner will modulate from between low and high fire depending on the milli-amp signal that it is receiving from the *ParaFlow*™ ISN Control Center (signal varies with leaving chilled water temperature).

When the leaving chilled water temperature drops to approx. 3°F (1.6°C) below its set-point, the normally closed **Oil Valve(s)** will be de-energized and the **Modulating Motor** will position the **Air Dampers** and **Modulating Oil Valve** back to its low fire position light off position. It will remain in this position until the next start-up sequence.

Refer to submittal package supplied with burner for further detailspertaining to burner operation.



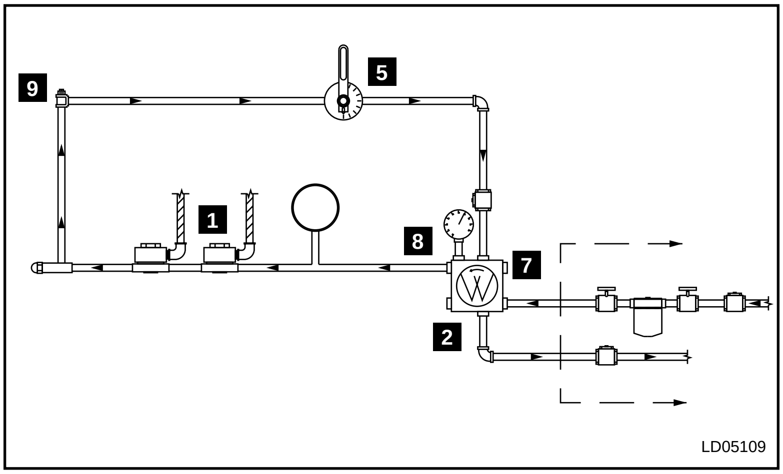
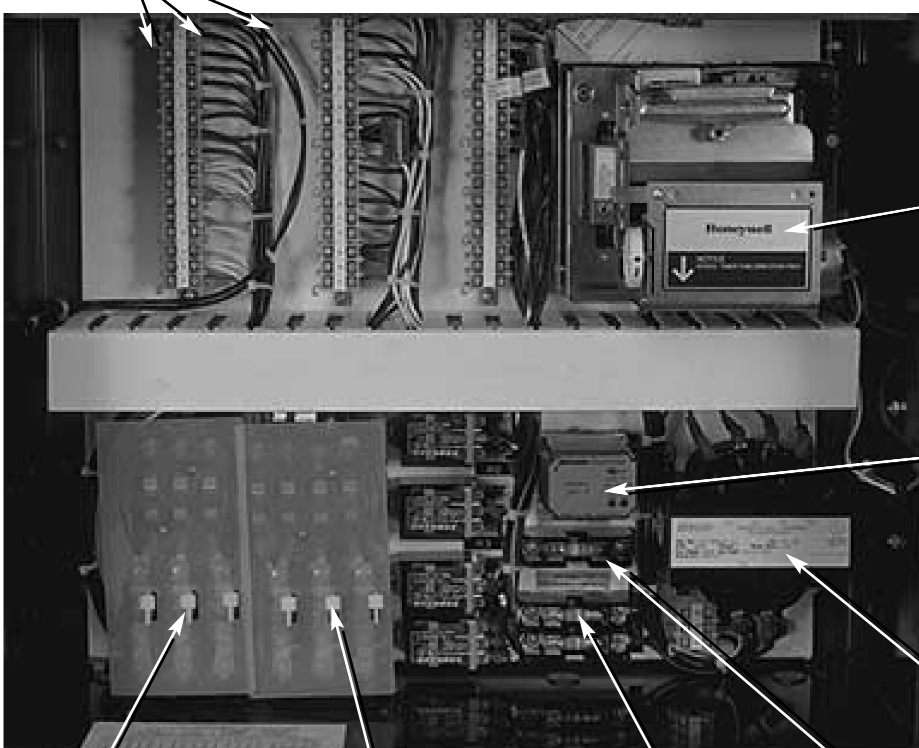


FIG. 44 – BURNER WITH FULL MODULATION FUEL/AIR CONTROL (OIL OPERATION)

00276VIP

00275VIP

Warning and Status Lamps:
1 - Call For Operation 2 - Ignition On
3 - Main Fuel 4 - Flame Failure



00277VIP

FIG. 45 – BURNER CONTROL PANEL

FLAME SAFEGUARD CONTROLS

• R4140L

1. On a call for heating or cooling (no faults present), 120VAC will be sent from the Micro Computer Control Center to terminal 5 of the burner panel.
2. The "Call for Operation Lamp", located on the burner panel, illuminates and power is sent to terminal 4 of the R4140L Flame Safeguard Control.

Pre-Purge Period (60 seconds)

3. Power is applied to terminal 8 (R4140L), starting the combustion air blower motor and the 60 second pre-purge period. The common terminals of the purge interlock (2LS) and the low fire start interlock (3LS) switches located in the Honeywell Modutrol Motor will also receive power. The 3LS switch closed on start-up will allow power to flow to terminal 13 of the R4140L. The 3LS switch must be closed for the burner sequence to start. This is a safety designed so the burner will not start firing if the gas valve is not in its fully closed position. If the valve doesn't fully close, it will allow gas to flow and build in the combustion chamber (during the off cycle) causing an unsafe condition when ignition occurs.
4. At 4 seconds into the cycle, the modulating motor will drive to its high fire (open) position (relay 46CR energized), opening the combustion air dampers and the gas and oil (where applicable) modulating valves. Fuel will not flow to the burner until the automatic gas or oil (where applicable) valves are energized. By opening the combustion air dampers, fresh air is allowed to flow through the combustion chamber and out the stack, thus allowing the chamber to be purged of any raw fuel before ignition occurs. 3LS opens.

NOTE

If a flame is sensed at any point before or during this pre-purge period, safety shutdown will occur.

5. The timer will stop at 10 seconds and will not continue until the purge interlock (2LS) switch closes.
6. At 45 seconds, the modulating motor will drive towards its low fire (closed) position (relay 46CR de-energized).
7. At 51 seconds, the timer will stop until the low fire start interlock switch (3LS) closes. Once the 3LS switch closes, the timer starts, allowing ignition trials to begin at 60 seconds.

Ignition Trials (Pilot and Ignition terminate at same time)

8. At 60 seconds, power is applied to terminal 5 (R4140L), energizing the ignition transformer and pilot gas valve(s). The "Ignition On" lamp on the burner panel will illuminate.
9. Pilot and ignition trials will end at 70 seconds. A pilot flame must be established between 60 and 70 seconds or the burner will cycle off on flame failure, requiring manual reset of the flame safeguard control.
10. The main gas valve(s) or oil valve(s) will be energized, allowing main fuel flow to the burner at 70 seconds. A ten second interrupted pilot/ignition begins.
11. At 80 seconds, the 10-second interrupted pilot/ignition is de-energized and the main flame signal should be steady. The "Ignition On" lamp on the burner panel will shut off. Relay 47CR is energized allowing full modulation of the burner system.

Ignition Trials (Early Spark Termination - 5 seconds)

8. At 60 seconds, power is applied to terminals 5 (R4140L) and 18, energizing the ignition transformer and pilot gas valve(s). The "Ignition On" lamp on the burner panel will illuminate.
9. The ignition spark will be shut off when terminal 18 is de-energized at 65 seconds. Terminal 5 (pilot gas valve[s]) will be de-energized at 70 seconds. A pilot flame must be established between 60 and 70 seconds, or the burner will cycle off on flame failure, requiring manual reset of the flame safeguard control.
10. The main gas valve(s) or oil valve(s) will be energized, allowing main fuel flow to the burner at 70 seconds. A ten second interrupted pilot/ignition begins. The "Main Fuel" lamp on the burner panel will illuminate.

11. At 80 seconds, the 10 second interrupted pilot/ignition is de-energized and the main flame signal should be steady. The “Ignition On” lamp on the burner panel will shut off. Relay 47CR is energized allowing full modulation of the burner system.

Run Period

Burner is firing and will modulate between low and high fire depending on the leaving chilled water temperature.

Post Purge Period and Shutdown

On a cycling shutdown, the main fuel valve terminal 7 is de-energized shutting off the burner flame. The “Main Fuel” lamp on the burner panel will shut off. The modulating motor will stroke to its low fire (light off) position if not already there and the unit will enter a dilution cycle.

• RM7840L

Initiate Cycle (10 seconds)

The RM7840L enters the initiate sequence when the relay module is powered. The initiate sequence lasts for ten seconds unless certain voltage or frequency tolerances are not met in which case the control will be locked out. Once this 10-second check is completed, the RM7840L will enter the standby mode.

Standby

The RM7840L is ready to start an operating sequence when the operating control input determines a call for either cooling or heating is present.

1. On a call for heating or cooling (no faults present), 120VAC will be sent from the Micro Computer Control Center to terminal 5 of the burner panel.
2. The “Call for Operation” lamp, located on the burner panel, illuminates and power is sent to terminal 6 of the RM7840L Flame Safeguard Control.

Pre-Purge Period (60 seconds)

3. Power is applied to terminal 5 (RM7840L), starting the combustion air blower motor (and oil pump motor, where applicable). The common terminals of the purge interlock (2LS) and the low fire start interlock (3LS) switches located in the Honeywell Modutrol Motor will also receive power. The 3LS switch, closed on start-up, will allow power to flow to terminal 18 of the RM7840L. The 3LS switch must be closed for the burner sequence to start. This is a safety feature designed so the burner will not start firing if the gas valve is not in its fully closed position. If the valve doesn’t fully close, it will allow gas to flow and build in the combustion chamber (during the off cycle), causing an unsafe condition when ignition occurs.
4. The modulating motor will drive to its high fire (open) position (Relay 59CR Energized), opening the combustion air dampers and the gas and oil (where applicable) modulating valves. Fuel will not flow to the burner until the automatic gas or oil (where applicable) valves are energized. By opening the combustion air dampers, fresh air is allowed to flow through the combustion chamber and out the stack, thus allowing the chamber to be purged of any raw fuel before ignition occurs. 3LS opens. The pre-purge timing doesn’t start until the High Fire Purge Interlock (2LS) switch closes, sending power to terminal 19 of the RM7840L.

NOTE

If a flame is sensed at any point before or during this pre-purge period, safety shutdown will occur.

5. After the completion of the 60 second pre-purge cycle, the modulating motor will be driven back to its low fire light off position (relay 59CR de-energized). 3LS closes allowing the ignition trials to take place.

Ignition Trials (Pilot and Ignition terminate at same time)

6. At 60 seconds, power is applied to terminals 8 and 10 (RM7840L) energizing the ignition transformer and pilot gas valve(s). The “Ignition On” lamp on the burner panel will illuminate.
7. Pilot and ignition trials will end at 70 seconds. A pilot flame must be established between 60 and 70 seconds, or the burner will cycle off on flame failure, requiring manual reset of the flame safeguard control. With flame proven, power to terminal 10 is removed shutting off ignition transformer. (Early spark termination).
8. The main gas valve(s) or oil valve(s) (terminal 9) will be energized, allowing main fuel flow to the burner at 70 seconds. A ten second interrupted pilot/ignition begins. “Main Fuel” lamp on the burner panel will illuminate.
9. At 80 seconds, the 10 second interrupted pilot/ignition is de-energized, and the main flame signal should be steady.

Run Period

A ten second stabilization period occurs at the beginning of the run period. Relay 60CR, which allows motor modulation, will not be energized until after this period has expired.

Burner is firing and will modulate between low and high fire depending on the leaving chilled water temperature.

Post Purge Period and Shutdown (15 seconds)

On a cycling shutdown, the main fuel valve terminal 9 is de-energized, shutting off the burner flame. The “Main Fuel” lamp on the burner panel will shut off. The modulating motor will stroke to its low fire (light off) position (if not already there) and the unit will enter a dilution cycle. The RM7840L will enter its standby mode.

SECTION 6 – STEAM CONTROL VALVES

The steam control valve is sized for each job based upon the available steam pressure, required steam pressure at the unit (typically 115PSIG) and the steam flow required at full load conditions. The valve and actuator will be supplied with the unit.

There are three types of steam valves presently used on YORK *ParaFlow*™ Units; Honeywell, Leslie and Sampson.

All valves are cage or stem guided construction. The bodies are manufactured using either carbon steel or cast iron. The cage, plug and seat is made of 400 series stainless steel, while the seat is made of teflon.

VALVE PERFORMANCE

The minimum Cv for the various valves are as follows:

VALVE SIZE	MINIMUM Cv	
	HONEYWELL, LESLIE	SAMPSON
2”	53	37
2-1/2”	90	64
3”	120	87
4”	188	175

VALVE FLOW CHARACTERISTICS

The above control valves use an equal percentage flow characteristic. The flow characteristic is the relationship between the steam flow rate through the valve and the valve stem travel as it is varied from 0 to 100%. Two flow characteristics are shown in Fig. 46.

Equal Percentage

Equal increments in valve stem travel will produce equal percentage changes in existing flow. **The change in flow rate is always proportional to the flow rate just before the change in position is made for a valve plug.**

For example: When the valve plug is near its seat and the flow is small, the change in flow rate will be small. If the flow rate is large to begin with, its change in flow rate will be large.

The equal percentage curve in Fig. 46 illustrates this behavior. The table in Fig. 46 lists values for valve stem positions in 10% increments starting at 10%. Notice that for each 10% increase in valve stem travel a 50% increase in percent of maximum flow is observed (from its previous point).

Linear

The linear flow characteristic curve shows that the flow rate is directly proportional to the valve stem travel.

A 10% valve stem travel corresponds to 10% of maximum flow. A 60% stem travel corresponds to 60%, etc.

INITIAL VALVE STEM POSITION (%)	FINAL VALVE STEM POSITION (%)	INITIAL % OF MAX. FLOW	FINAL % OF MAX. FLOW	% CHANGE IN FLOW
10	20	2.6	3.9	50
20	30	3.9	5.85	50
30	40	5.85	8.78	50
40	50	8.78	13.17	50
50	60	13.17	19.75	50
60	70	19.75	29.63	50
70	80	29.63	44.44	50
80	90	44.44	66.66	50
90	100	66.66	100	50

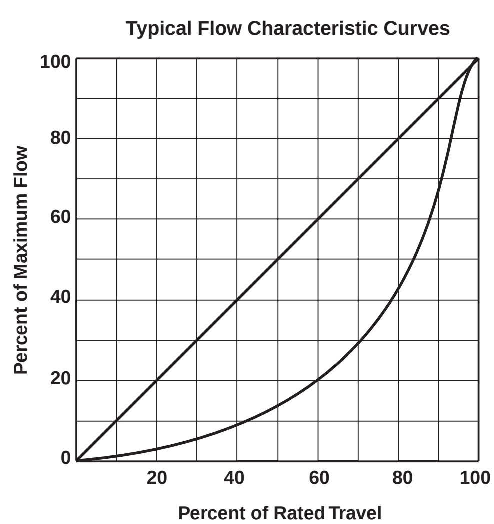


FIG. 46 – TYPICAL FLOW CHARACTERISTIC CURVES

LD05326

VALVE ACTUATION

Electric

Electric actuators operate on either a 120V pulse or a 4-20mA signal. Because this actuator doesn't drive the valve closed during a power failure, it is necessary to install an automatic shut-off valve (customer supplied) upstream of the YORK supplied modulating valve (refer to Fig. 47) to assure that the steam flow will be shut off in the event of a power failure. Failure to install this valve may result in crystallization and possible machine damage in the event of a power failure.

Pneumatic

This optional configuration comes with a pneumatic actuator and I to P positioner to provide continuous control. A 4-20mA signal is supplied to the positioner through the micro-panel. This actuator is designed to fail closed, therefore no additional shut-off valve is required.

Steam System Operation

The steam valve modulates to maintain the desired leaving chilled water temperature. For information pertaining to the control logic, refer to form 155.17-O2 (Control-Center Operations Manual).

The unit is set up (needle and back pressure valve adjustments) to provide design steam flow at full load conditions. The nominal saturated steam conditions are typically 115PSIG @ 347ºF. The temperature to the generator must never exceed 363ºF or else damage to the tubes and/or steam system components may occur.

CAUTION

Overfiring the machine (i.e. elevated inlet pressures and temperatures) will lead to increased corrosion rates and pre-mature failure of the unit. Under no circumstances should a unit be overfired.

An inlet steam strainer should be installed as illustrated in the piping schematic shown in Fig. 47 to prevent debris from entering the generator bundle.

At design steam flow, the condensate back pressure valve (manual globe valve) is adjusted to maintain 15 PSIG upstream of this valve. This back pressure will be lower at reduced load conditions.

A 150 PSIG pressure relief valve must be installed as shown in Figure 47 to protect the generator.

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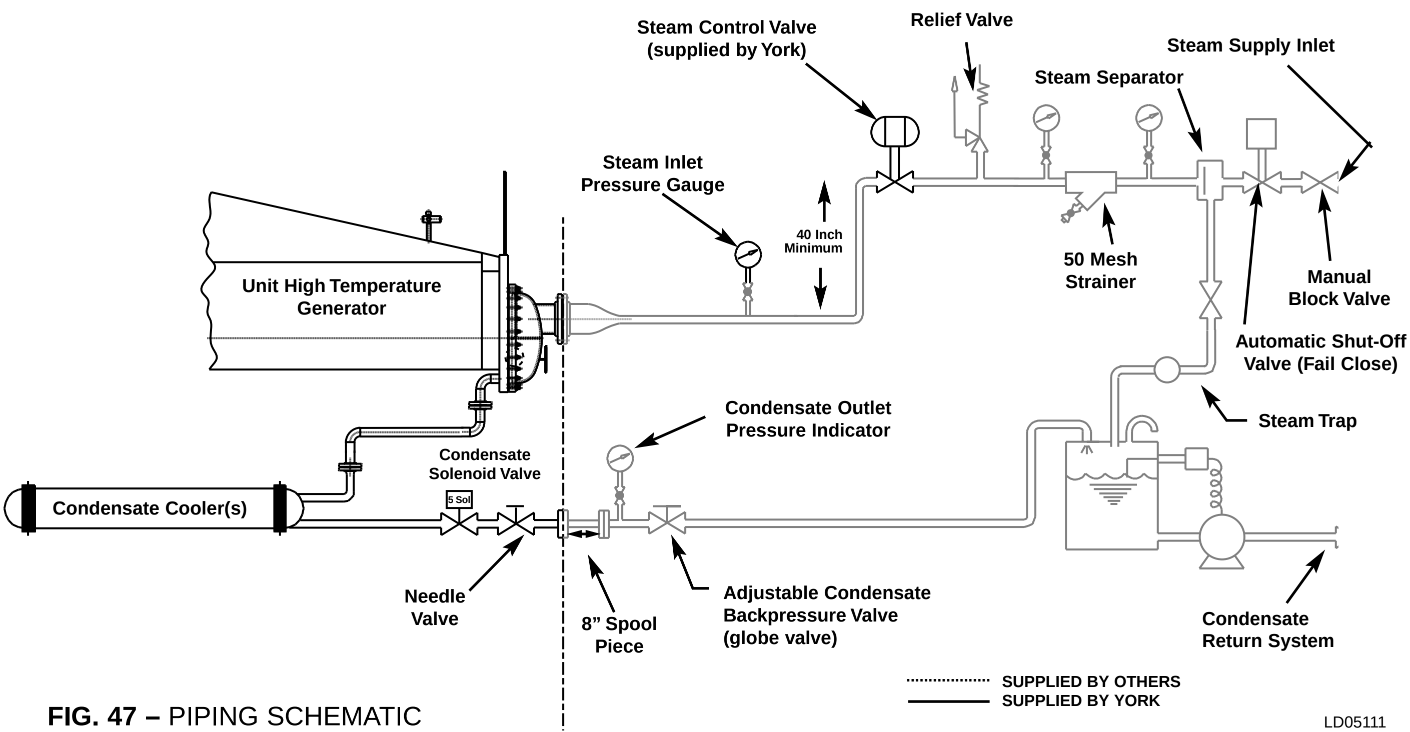

FIG. 47 – PIPING SCHEMATIC

SECTION 7 – STEAM HEAD GASKET REPLACEMENT

The steam gasket must be replaced after head removal or if it is leaking.

REPLACEMENT PROCEDURE

1. Completely remove all traces of the old gasket material from both the head and tube sheet. Clean all studs with a wire brush so that they are free of any residue and that the nuts can be run all the way on the stud by hand.
2. Remove the paper backing on the joint sealant and attach the joint sealant to the steam generator tube sheet near the 12 o'clock position just inside the bolt circle. Continue attaching the joint compound to the surface, working completely around until you are back at the starting point. Overlap the ends of the sealant by at least 1/2 inch.
3. Attach a strip of joint sealant across the pass baffle partition mating area, overlapping both of the ends across the joint sealant applied previously by 1/4 inch minimum.
4. Tap the overlapped areas down flush before attaching the head to the generator.
5. Apply a thin coat of high temperature anti-seize compound to the studs (Fel-Pro® C5-A, York P/N 013-01690-000).
6. Re-attach the head to the generator, taking care not to disturb the placement of the gasket material. Slide the head gently up against the tube sheet and install all nuts finger tight.
7. Using four (4) incremental steps, torque the nuts using a star (crisscross) pattern. In other words, first torque the nuts to 20 ft/lb, then 40 ft/lb, then 60 ft/lb and finally 80 ft/lb (refer to Figure 48).
8. In a counter-clockwise direction (starting at the 12 o'clock position), recheck all studs/nuts and confirm they are at 80 ft.lbs. of torque.
9. After the unit has operated at design pressure and temperature, shut the unit down, reduce the pressure and re-torque all bolts to 80 ft/lb. The gasket should now be ready for normal use.

The type of **Gore-Tex® Joint Sealant** used in this application is one of many expanded PTFE compounds manufactured by W.L. Gore & Associates, Inc. DO NOT SUBSTITUTE.

The York part number for a 1/4 inch x 50 ft. roll of **Gore-Tex® Joint Sealant** is **028-12908-000**. One roll of joint sealant should be sufficient to do several generators. The actual length required per generator will depend on the size of the unit.

Bleed off any residual pressure and completely close and tag steam supply and condensate valves prior to attempting to remove steam head. Use proper lifting devices to secure and remove steam head to avoid personal injury and damage.

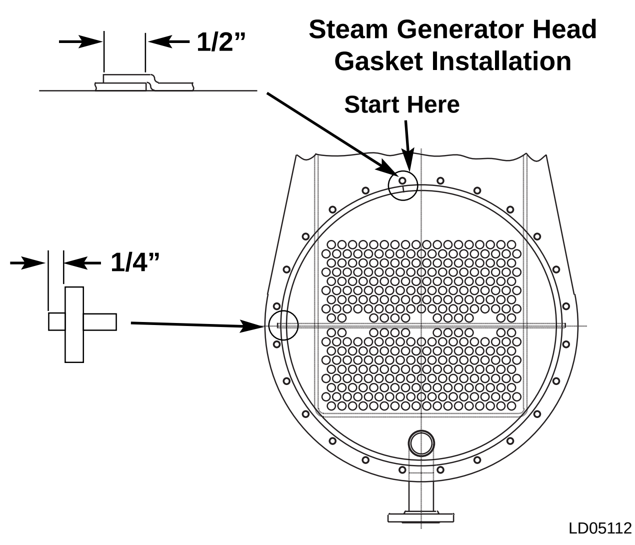

FIG. 48 – NUT TORQUING PATTERN

SECTION 8 – CHANGEOVER PROCEDURES

The following operational procedures are applicable to direct-fired machines only. The machine must be equipped for standard or high temperature heating.

Non-condensables will accumulate in the absorber section during heating operation. It will be necessary to manually purge these non-condensables from the absorber prior to starting the machine in the cooling mode. The purge time will depend on how long the machine was operating in the heating mode as well as the leak rate into the machine.

HEATING/COOLING CHANGEOVER PROCEDURE

Units Equipped With Standard Temperature Heating (Valves VD and VE Present) (S-Model Units Only)

1. Place the unit switch located on the micro-panel into the stop/reset position.
2. Close valves VD and VE after the dilution cycle is complete (assuming the machine is running in the heating mode).
3. Open valves VP21 and VP22 (where applicable).
4. Place all system valves into their appropriate positions for cooling only operation.
5. Fill the cooling tower and make sure that system water flows are to specifications.

NOTE

Tower water temperature must not be lower than 59ºF at start-up and must rise to at least 68ºF within 20 minutes of start-up. Also, the tower water temperature must not change more than 0.5 ºF / minute.

6. Following the instructions listed in Form 155.17-O2, change to the “cooling only” operating mode.

NOTE

Operating modes can only be changed with the unit switch in the stop/reset position.

7. Purge from the absorber (refer to purging section for details) until the bubble rate is less than 30 bubbles/minute.

NOTE

The manual purge mode will have to be selected if the unit is equipped with SmartPurge. Refer to Form 155.17-O2 for details.

8. Place the unit switch located on the micropanel into the start position. The switch will toggle back to the run position when released.
9. Continue to manually purge the absorber until the bubble rate is down to a minimum.

   If the machine is equipped with auto-purge, the micro-panel should be set to operate in the auto-purge mode at this time. (Refer to Form 155.17-O2 for details).
10. After a days operation, a solution sample should be taken (by a qualified technician) and sent to a YORK approved lab for analysis. Make inhibitor corrections as necessary. These corrections will prepare the machine for optimum performance and protection during the first half of the cooling season.

Units Equipped With High Temperature Heating (Optional Hot Water Heat Exchanger Installed)

1. Place the unit switch located on the micro-panel into the stop/reset position.
2. Open valves VA, VB and VC after the machine cycles off (assuming the machine is running in the heating mode).
3. Open valves VP21 and VP22 (where applicable).
4. Place all system valves into their appropriate positions for cooling only operation.
5. Fill the cooling tower and make sure that system water flows are to specifications.

NOTE

Tower water temperature must not be lower than 59ºF at start-up and must rise to at least 68ºF within 20 minutes of start-up.

6. Following the instructions listed in Form 155.17-O2, change the operating mode to “cooling only”.

Operating modes can only be changed with the unit switch in the stop/reset position.

7. Purge from the absorber (refer to purging section for details) until the bubble rate is less than 30 bubbles/minute.
8. Place the unit switch located on the micropanel into the start position. The switch will toggle back to the run position when released.
9. Continue to manually purge the absorber until the bubble rate is down to a minimum.

   If the machine is equipped with auto-purge, the micro-panel should be set to operate in the auto-purge mode (Refer to Form 155.17-O2 for details).
10. After a day's operation, a solution sample should be taken (by a qualified service technician) and sent to a YORK approved lab for analysis. Make inhibitor corrections as necessary. These corrections will prepare the machine for optimum performance and protection during the first half of the cooling season.

COOLING/HEATING CHANGEOVER PROCEDURES

The following operational procedures are applicable to direct-fired machines only. The machine must be equipped with the standard or high temperature heating option.

About two weeks prior to switching over to heating operation, take a solution sample and send to a YORK approved lab for analysis. Make inhibitor corrections as necessary with the machine operating in the cooling mode. (Solution samples should be taken by a qualified technician only)

Purging the absorber is not necessary when switching from cooling to heating as it is when switching from heating to cooling.

Units Equipped With Standard Temperature Heating (Valves VD and VE present) (S-model units only)

1. Place the unit switch located on the micro-panel into the stop/reset position.
2. Open valves VD and VE after the dilution cycle is complete (assuming the machine is running in the cooling mode).
3. Place all system valves into their appropriate positions for heating only operation.
4. Make sure that system hot water flows are to specifications.
5. Following the instructions listed in Form 155.17-O2 , change to the "heating only" operating mode.

Operating modes can only be changed with the unit switch in the stop/reset position.

6. Place the unit switch located on the micropanel into the start position. The switch will toggle back to the run position when released.

Units Equipped With High Temperature Heating (Optional Hot Water Heat Exchanger Installed)

1. Place the unit switch located on the micro-panel into the stop/reset position.
2. Close valves VA, VB and VC after the dilution cycle is complete (assuming the machine is running in the cooling mode).
3. Place all system valves into their appropriate positions for heating only operation.
4. Make sure that system hot water flows are to specifications.
5. Following the instructions listed in Form 155.17-O2, change the operating mode to "heating only".

Operating modes can only be changed with the unit switch in the stop/reset position.

6. Place the unit switch located on the micropanel into the start position. The switch will toggle back to the run position when released.

COOLING/SIMULTANEOUS HEATING AND COOLING OPERATION CHANGEOVER PROCEDURE.

Units Equipped With High Temperature Heating (Optional Hot Water Heat Exchanger Installed)

NOTE

All unit valves must be set to their typical cooling-only positions.

1. Place the unit switch located on the micro-panel into the stop/reset position.
2. Place all system valves into appropriate positions.
3. Make sure that system hot and chilled water flows are to specifications.
4. Following the instructions listed in Form 155.17-O2 change the operating mode to "simultaneous cooling/heating".

NOTE

The mode can only be changed with the unit switch in the stop/reset position.

5. Place the unit switch located on the micropanel into the start position. The switch will toggle back to the run position when released.

   The unit will be cycled to maintain the chilled water leaving temperature setpoint. A portion of the available heat in the generator may be used for heating as described in the operation section.

SECTION 9 – REFRIGERANT BLOWDOWN

REFRIGERANT BLOWDOWN

Over a period of time, the refrigerant water will become contaminated with solution. The rate at which this occurs is largely dependent on the manner in which the unit is operated. Many starts and stops, rapid load fluctuations and large tower water temperature changes are some of the things that may cause increased rates of contamination. Small amounts of solution in the refrigerant is normal; however, as the amount of solution in the refrigerant increases, a reduction in cooling capacity will occur.

On standard units, purification of the refrigerant is accomplished by manually opening the blowdown valve (VR8) for a period of time. The opening of the valve allows a portion of the refrigerant being pumped by the refrigerant pump to flow into the solution in the absorber shell. This operation is continued until the level of the refrigerant in the refrigerant tank is just above the refrigerant pump suction connection. Usually this level can be observed in the lower sight glass of the refrigerant tank. The valve is then closed and the blowdown process is complete.

The refrigerant will gradually return to the refrigerant tank as it is boiled out of the solution, but it should return in a more pure state. In other words, the refrigerant purification or blowdown is basically a distillation process.

The best time to blowdown a unit is just after start-up, when the refrigerant level is fairly low in the tank. Occasionally it may be necessary to blow the refrigerant down more than once at low load. To do this, close the blowdown valve, which will let the level rise back up again, then open the blowdown valve again until the level falls again. If you try to blowdown the refrigerant at full load, the rate at which the refrigerant is being replenished by the condenser may be greater than the blowdown rate, consequently, the level will never fall in the tank. This is not to say purification will not occur, only that it is difficult to know when to stop the process.

NOTE

There will be a noticeable reduction in unit cooling capacity while the blowdown valve is open.

The method used to measure the amount of solution contamination in the refrigerant requires special tools and procedures and is best left to the YORK Service Technician. At the time of start-up, YORK Service Technicians should train the operating personnel in the proper blowdown procedure. He will also measure the actual amount of refrigerant contamination in the unit after start-up and he will check the contamination level at each subsequent inspection visit during the first year of the unit's operation. He should let the operating personnel know if the blowdown frequency is sufficient.

REFRIGERANT BLOWDOWN PROCEDURE

1. Machine should be operating in cooling (preferably at low fire).
2. Open valve VR8 (Refrigerant Blow-Down Valve).
3. As soon as refrigerant level reaches the lower tank sight glass (G-Model units) or the evaporator sump sightglass (S-Model Units), close VR8.
4. Repeat as many times as necessary.

SECTION 10 – SOLUTION CHEMISTRY MAINTENANCE

Lithium Bromide solution has an uncanny ability to corrode steel in the presence of oxygen. The LiBr itself does not corrode steel. It is the reaction of the steel with the water in the solution that creates the corrosion; however, the presence of the LiBr salt increases the conductivity of the water to such a great degree that the normal corrosion seen between steel and water proceeds at a very rapid pace. With the addition of inhibitors and by keeping the pH high, we endeavor to slow down the process of corrosion in the unit to an acceptable rate.

The inhibitors used in ParaFlow™ absorption machines help to promote the formation of a protective oxide film on the inner steel surfaces of the vessel. This film is referred to as magnetite (Fe_3O_4). It is this oxide film that inhibits corrosion in the unit.

Under normal conditions, these inhibitors will deplete at a normal rate and must be replenished as required. If these inhibitors are not replenished in a timely manner, the magnetite film in the machine will break down and the corrosion rates will increase. It is therefore vital to always keep the inhibitor levels within their specified ranges to minimize internal corrosion in the unit.

A solution sample must be taken from the unit according to the schedule listed in the maintenance requirements checklist. This sample should be taken by a qualified service technician and sent to a YORK approved lab for analysis. A report will be sent back indicating the necessary corrections to the solution.

Besides checking for the inhibitor levels, the lab will also check the dissolved copper and ammonia level in the solution. An increase in either of these two parameters over time may indicate that an air leak is present in the machine.

High levels of dissolved copper can lead to copper plating in the unit, which can block system components and damage pump bearings. Although rare, high levels of ammonia can lead to corrosion stress cracking of the copper tubes in the vessel.

Suspended Solids: Suspended solids are comprised, for the most part, of iron oxide (magnetite) or rust. Another substance that could be present is copper sludge. Suspended solids are usually a result of corrosion, because of air leaks or exposure of the unit to air during a maintenance procedure. Suspended solids will settle out of the solution if allowed to sit for some time. Solution with suspended solids will be discolored. Any solution that is dark brown or black in color can be assumed to have too many suspended solids.

The effects of these solids in solution may clog absorber and evaporator spray nozzles, and the abrasive action of the solids while circulating may cause pump bearing damage, as well as tube erosion.

The cure for suspended solids is filtration. A visual observation of the solution sample is all that is necessary to determine if filtration is necessary. If the solution is dark brown or black, a clean-up filtration system must be installed on the unit.

For the most part, solution chemistry can be addressed solely on the basis of the above categories, however there are exceptions. Due to the complexity of the many interactions within a unit, there may be times when the chemistry does not seem to follow the rules. If this is the case, a more complex solution analysis may be necessary.

Alcohol

$C_8H_{18}O$ - 2-EthylHexanol Alcohol - This is an octyl alcohol sometimes referred to as 2-Ethyl-1-Hexanol. It is a colorless liquid having a molecular weight of 130.22. The specific gravity is 0.8344, so it is lighter than water. The boiling point is 184-185°C, and the flash point is 81°C. It dissolves about 2.5% its weight in water at 25°C.

The alcohol is used to provide better heat transfer in the absorber. It promotes a type of convection called *Marangoni Convection* in the solution film that collects on the outside surface of the absorber tubes. The alcohol may account for slightly more than fifteen percent of the unit total capacity.

All *ParaFlow*™ units have alcohol traps. The purpose of the alcohol trap is to separate the alcohol that gets carried over to the condenser from the refrigerant. Alcohol is returned from the trap to the solution where it needs to be. The proper amount of alcohol is a definite visible layer on top of the solution as observed in the sight glasses of the absorber during part load conditions. The layer may be as small as 1/8" in thickness.

A sufficient amount of alcohol is added to the unit at the factory. Over time, some of the alcohol will exit the unit via the purge gas. This amount is generally very small. Seldom is it necessary to add alcohol.

NOTE

Too much alcohol will have the opposite effect and reduce the capacity of the unit.

SECTION 11 – STEAM AND WATER QUALITY CONTROL

Water Quality

Absorber / Condenser and Evaporator water must be free of corrosive species or inhibited to prevent attack of the waterside tubing. Impurities and dissolved solids can cause scaling that reduces heat exchanger efficiency and causes corrosion of tubes. Corrosion, in turn, can result in more serious problems, such as metal wastage and contamination of the solution and refrigerant if through-wall pitting occurs.

YORK ParaFlow^{TM} Absorption Chiller/Heaters can only deliver design output and efficiency if they are properly operated and maintained. One of the most important elements of proper maintenance is the cleanliness of the tubes to prevent fouling, scaling and corrosion during daily operations and shutdowns.

It is the responsibility of the owner (operator) of this equipment to engage the services of an experienced and reputable water treatment specialist for both the initial charging of the system and its continuous monitoring and treatment. Improperly treated or maintained water will result in decreased efficiency, high operating costs and premature failure due to waterside corrosion.

For water treatment programs to be acceptable, they must protect all exposed metal (i.e., carbon steel, copper and brass) from corrosive attack. The use of corrosion inhibitors must be effective at low concentrations, must not cause deposits on the metal surfaces, and must remain effective under a broad range of pH, temperature, water quality and heat flux. Furthermore, the inhibitor package must prevent scale formation and disperse deposits while having a minimal environmental impact when discharged.

Water samples should be collected and analyzed on at least a monthly basis by the water treatment specialist. A quarterly review with the treatment supplier should address the conditions of the water systems and develop action plans based on these analyses. A third party water consulting company can help oversee the water treatment programs in order to properly protect the physical plant and avoid costly downtime.

It is equally important that the owner (operator) of the equipment performs tube cleaning and inspection of the absorber, condenser and evaporator waterside tubes at the frequencies recommended in the Tube Maintenance Section of the "Preventive Maintenance Schedule" located in this manual. In addition to periodic cleaning with tube brushes, tubes must be inspected for wear and corrosion. Tube failures usually occur due to corrosion, erosion, and fatigue due to thermal stress. Eddy current analysis and visual inspection by boroscope of all tubes are invaluable preventative maintenance methods. These provide a quick method of determining waterside tube condition at a reasonable cost.

Your local YORK Service Representative will be more than happy to supply any or all of these services.

Steam/Condensate Quality

Steam driven ParaFlow™ units use corrosion resistant CuNi tubes in the high temperature generator and condensate drain coolers.

As with the water side of the system, it is the responsibility of the owner (operator) of this equipment to engage the services of an experienced and reputable steam/condensate treatment specialist for both the initial charging of the system and its continuous monitoring and treatment. Improperly treated or maintained steam/condensate will result in decreased efficiency, high operating costs and premature failure due to steam/condensate side corrosion.

Steam/Condensate samples should be collected and analyzed on at least a monthly basis by the treatment specialist. A quarterly review with the treatment supplier should address the conditions of the steam systems and develop action plans based on these analyses. A third party consulting company can help oversee the treatment programs in order to properly protect the physical plant and avoid costly downtime.

It is equally important that the owner (operator) of the equipment performs an inspection of the generator tubes at the frequencies recommended in the Tube Maintenance Section of the "Preventive Maintenance Schedule" located in this manual. In addition to periodic cleaning with tube brushes, tubes must be inspected for wear and corrosion. Tube failures usually occur due to corrosion, erosion, and fatigue due to thermal stress. Eddy current analysis and visual inspection by boroscope of all tubes are invaluable preventative maintenance methods. These provide a quick method of determining steam generator tube condition at a reasonable cost.

Your local YORK Service Representative will be more than happy to supply any or all of these services.

Tube Cleaning

If during an inspection, scale is identified in any of the tube bundles, it will be necessary to remove this scale to prevent operational and/or corrosion problems.

A build-up of scale on the tubes can cause a wide range of problems including:

- Reduced Chilling Capacity
- High solution concentration and crystallization.
- Pitting and corrosion of tubes
- Reduced efficiency.

The first step in trying to clean scales from tubes is to brush clean them. Only soft nylon brushes should be used, as damage to the copper or CuNi tubes will result if harder brushes (such as steel) are used.

If the brush cleaning is unsuccessful in removing all the scale from the tubes, it will be necessary to chemical clean them. An experienced and reputable contractor should be consulted. If the chemical cleaning is not performed properly, extensive tube damage may result.

After chemical cleaning is performed, brush cleaning may again be required to remove the remainder of the scale.

SECTION 12 – OPERATIONAL AND MAINTENANCE RECOMMENDATIONS

The following sections list recommended maintenance schedules for a YORK ParaFlow Absorption Unit.

Items are listed according to the time required between inspections. Those items that should be addressed by the operator or maintenance staff at the facility where the machine is installed are marked as such. Those items that are marked (Service technician) should be performed by a qualified service technician. Contact your local YORK Factory Service office for details on maintenance contracts.

Regardless of who performs the work, it is vital that the recommendations contained in this section are followed. Failure to do so may result in unreliable operation, increased service requirements and shortened unit life.

DAILY OPERATION LOGS AND INSPECTIONS

All daily operation and maintenance checks are to be performed by operator of this equipment. These logs and observations can be used by the Service Technician to troubleshoot a problem, if it arises.

GENERAL

1. Check and record Operating Data on the Operations Log sheet located in Appendix D of this manual.
2. Perform an aural and visual inspection of the machine. Note any unusual noises or observations in the comments section of the log form. If the problem persists, contact your local YORK Factory Service office for recommendations.

Direct-Fired Machines (Gas Operation)

1. Record the following data on the Operations Log Form:
   a. Gas Firing Rate ft^3/hr. (From Gas Meter)
   b. Inlet Gas Pressure
   c. Exhaust Gas Temperature
2. Make sure the burner is firing properly. Unusual noises or smells may indicate abnormal firing. Turn burner on and off to make sure it starts and stops properly.
3. Check the fuel/air ratio linkages for tightness and freedom of travel (no binding should be present). Adjustments should be made by qualified personnel only.
4. Check for leakage in the gas supply piping line. Use a soap solution or a gas indicator.
   If gas is smelled around the unit, the machine should be shut off and isolated from the gas supply. Contact your gas supplier for details.
5. Verify proper operation of draft system.
   The two possibilities are either:
   a. Manual back draft with barometric damper control.
   b. Sequence overfire draft control (Modulating Damper).

Direct-Fired Machines (Oil Operation)

1. Record the following data on the Operations Log Form.
   a. Oil Consumption Rate (gal/min) (if flow meter is present).
   b. Oil Supply Pressure
   c. Oil Return Pressure
   d. Oil Pump Inlet Pressure
   e. Exhaust Gas Temperature
2. Make sure the burner is firing properly. Unusual noises or smells may indicate abnormal firing. Turn burner on and off to make sure it starts and stops properly.
3. Check the fuel/air ratio linkages for tightness and freedom of travel (No binding should be present). Adjustments should be made by qualified personnel only.
4. Check for leakage in the oil supply and return piping. This can be determined visually.
5. Check for smoke or soot in the exhaust gas or breeching/chimney system.
6. Verify proper operation of draft system.
   The two possibilities are either:
   a. Manual back drafts with barometric damper control.
   b. Sequence overfire draft control (Modulating Damper).

Steam-Fired Machines

1. Record condensate flow rate (GPM) and condensate back pressure.
2. Check for leakage in steam piping.

PREVENTIVE MAINTENANCE SCHEDULE

Component	Preventative Maintenance Operation	Maintenance Interval (Months unless otherwise indicated)									
		See Note Below	As Needed	Daily	Monthly	4	6	12	24	36	48
Unit	Solution Chemistry Analysis (Add inhibitors as needed)	(1), T									
	Record Operational Data (Data Form)			O							
	Refrigerant Blowdown	(2), O									
	Check For Refrigerant Contamination (Specific Gravity)						T				
	Leak Test Unit	(3)									
	Check Electrical Connections							T			
	Replace Sight Glasses or Glass Gaskets		T								
	Check For Proper Solution Levels adjust as required						T				
	Check For Proper Refrigerant Levels adjust as required						T				
	Check For proper Concentration of Octyl Alcohol		T								
	Check Unit Level							T			
	Rebuild Spindle Type Sample Valves		T								
Unit Safety Controls - Performance Test	LRT - Low Refrigerant Temperature Cutout Switch							T			
	CHFLS - Chilled Water Flow Switch.							T			
	CWFLS - Condenser Water Flow Switch							T			
	HWFLS - Hot Water Flow Switch (where applicable)							T			
	HP1 + HP2 (20G Direct Fired Units) - High Press. & Temp. Cutout Switches							T			
	HT1 - High Temperature Cutout Switch							T			
	LS - Low Solution Level Cutout Switch							T			
Instrumentation	Accuracy check of thermistors and transducers							T			
	Accuracy check of Condenser Pressure Gauge							T			
Solution and Refrigerant Pumps	Inspection (pump bearing and seal wear) Rebuild as required.	(4)									
	Inspection of pump contactors and overloads						T				
	Check operating amperage of pumps.						T				

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Component	Preventative Maintenance Operation	Maintenance Interval (Months unless otherwise indicated)									
		See Note Below	As Needed	Daily	Monthly	4	6	12	24	36	48
Solution and Refrigerant Pumps (continued)	Check electrical connections to pumps							T			
	Check performance of pumps (pressures, etc.)						T				
	Check average skin temperatures of pumps						T				
Purge Pump	Inspection of belt - replace or tighten as needed						O				
	Check operating amperage of pump						T				
	Check electrical connections to pump						T				
	Inspection of pump contactor and overload						T				
	Change oil		O								
	Determine ultimate vacuum of pump						T				
	Rebuild or replace pump		T								
Unit Continuous Purge System	Check for proper operation of purge eductor						T				
	Rebuild Purge Diaphragm Valves		T								
	Accuracy check of manometer or Vacuum Gauge						T				
Tube Bundle Maintenance	Inspect and brush clean absorber & condenser tubes							T			
	Inspect and brush clean evaporator tubes	(5)									
	Inspect and brush clean hot water heat exchanger tubes	(6)									
	Eddy current test high-temperature generator tubes (steam units only)	(6)									
	Eddy current and boroscope inspect absorber and condenser tubes (after brush cleaning)	(5)									
	Eddy current and boroscopic inspect evaporator tubes (after brush cleaning)	(6)									
	Eddy current and boroscope inspect hot water heat exchanger tubes (after brush cleaning)	(6)									

Component	Preventative Maintenance Operation	Maintenance Interval (Months unless otherwise indicated)									
		See Note Below	As Needed	Daily	Monthly	4	6	12	24	36	48
Steam (Steam-Fired Units only)	Inspection for wear of stem valve - Rebuild or replace as needed							T			
	Check for proper steam valve modulation							T			
	Inspect steam system piping and components for leaks			O							
	Inspect for design steam entering conditions			O							
	Check for wear and/or blocking of condensate needle valve(s) – Rebuild/clean or replace as needed.							T			
	Check for proper condensate back pressure			O							
Burner General (Direct-Fired Units Only)	Perform safety test - Spark Pick-Up							T			
	Perform safety test - Pilot Turn-Down							T			
	Performance test of burner fan air proving switch						T				
	Inspection of burner safety interlocks				O						
	Check for flame failure cutout (Main and Pilot)				O						
	Flame signal strength				O						
	Inspection of burner linkage			O							
	Inspection of draft control system				O		T				
	Combustion air - Check to make sure that all sources remain clear and open				O		T				
	Inspection for contamination of vertical heat exchanger tubes, flue and chimney						T				
	Inspection for leakage through pilot and main solenoid or motorized valve(s)						T				
	Inspection for wear of main and pilot gas pressure regulators						T				
	Combustion analysis (i.e., fuel/air ratios, combustion efficiency, etc.)						T				
	Inspection of gas pilot system - Remove pilot assembly and inspect							T			

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Component	Preventative Maintenance Operation	Maintenance Interval (Months unless otherwise indicated)									
		See Note Below	As Needed	Daily	Monthly	4	6	12	24	36	48
Burner (Direct-Fired Units Only) Gas Operation)	Inspection for cleanliness of main and pilot burner							T			
	Inspection of combustion air fan, motor bearing, etc.							T			
	Check burner electrical connections							T			
	Inspection for leakage through main gas valve(s)							T			
	Performance test of high pressure and low pressure gas switches				O						
	Inspection for wear of main gas pressure regulator						T				
	Inspection for leakage and/or corrosion of gas piping			O							
	Determine gas input by clocking the gas meter							T			
Burner (Direct-Fired Units Only) Oil Operation	Inspection for oil nozzle wear - Replace nozzle as required							T			
	Performance test, inspection for wear of oil solenoid and main oil modulating valve(s)							T			
	Inspection of oil pump unit							T			
	Checking for clogging of oil strainer							T			
	Leak test of piping (visual observation)			O							
	Determine and record oil consumption (Charts or Flow Meter)			O							
	Performance test of oil pressure cutout switch (Refer to burner documentation.)				O						

T = YORK Service Technician **O = Operator**

1. Units that provide year-round cooling: Once every four months, and as required due to excess purge requirements.
   Units that provide only seasonal cooling: Once at the beginning of the cooling season, once in the middle, and as needed due to an excess purge warning.
   Units that operate in both heating and cooling modes: Once at the beginning of the cooling season, once in the middle, and once approximately two weeks prior to switching over to heating operation. Also, as needed due to an excess purge warning.
2. Perform once per month, or as indicated by the YORK start-up technician.
3. Units should be leak-tested when excessive purging is noticed. Note: The solution chemistry should always be checked (and adjusted as necessary) prior to performing a leak test. If excessive purging is still present after the inhibitors have been added, an air leak is present. A leak test must be performed.
4. 50,000 - 60,000 Hours. More frequent rebuilds will be required if solids and/or dissolved copper is present in the solution.
5. End of first year and then every other year thereafter.
6. Once every 3 years.

SECTION 13 – PARAFLOW GLOSSARY OF TERMS

Absorber:

The concentrated solution coming back from the two generators is pumped to a solution spray header where it is sprayed over the tubes in the absorber. Refrigerant vapor is absorbed into the solution and the solution is thus diluted. This diluted solution is collected at the bottom of the absorber where it is again pumped to the two generators.

Alcohol (2-Ethylhexanol):

A liquid added to an absorption chiller to enhance the heat and mass transfer in the Absorber. It is an octyl alcohol whose chemical name is 2-Ethyl-1-Hexanol (C8H18O) with a molecular weight of 130.2, a boiling point of 364.3°F, and a flash point of 177.8°F @ 760 mmHg. Having a colorless, clear appearance, it has a somewhat pungent odor. By adding 2-Ethylhexanol to the absorption cycle, overall unit performance increases by 5-15%. In addition, cycle temperatures, pressures, and concentrations tend to decrease with the addition of 2-Ethylhexanol.

Alcohol Separator:

Performs the functions of separating the alcohol from the refrigerant leaving the condenser. The alcohol flows back to the solution where it is needed.

AutoPurge:

See SmartPurge™.

Burner Panel:

The control panel for the burner.

Condenser Bypass:

Due to the much smaller size of the condenser compared to the absorber, the entire volume of tower water is not typically passed through the condenser. Therefore, a portion of the tower water, depending on the size of the unit, the type of tubes, and the rated conditions, bypasses the condenser and reduces the flow/velocity through the condenser.

C.O.P.:

Coefficient of performance. A means of comparing the performance of a chiller as the ratio of the cooling output divided by the heat input.

Concentration:

The percent by weight of lithium bromide present in solution. New solution is sent with a concentration of 53%.

Condensate:

Condensed steam leaving the unit (Steam Units Only). The condensate leaving temperature is typically set for 180ºF. The condensate back pressure is adjusted to 15 PSIG.

Condenser (Tower) Water:

The external water loop which is used to remove heat from the unit. This water passes first through the absorber, then the condenser. Typical temperatures are entering the absorber at 85ºF, leaving the absorber (entering the condenser, i.e. crossover) at 92ºF, and leaving the condenser at 95ºF. Some external means of removing this heat is necessary. Typically, a cooling tower is used for this application.

Condenser:

Refrigerant from two sources - (1) liquid resulting from the condensed vapor coming from the high temperature generator, and (2) vapor produced by the low temperature generator enters the condenser. The refrigerant vapor is first condensed into liquid and the two refrigerant liquids are then combined and cooled by the condenser water. This refrigerant liquid then flows to the evaporator.

Dilution Cycle:

Intentionally running the solution, refrigerant, tower water, and chilled water pumps after unit has been shut down to allow the concentrated solution to become more dilute. This dilution process eliminates the potential for crystallization at normal ambient temperatures.

Drain Cooler:

A type of heat exchanger found on steam units. It is used to remove additional heat from the steam supply after it has passed through the high temperature generator. The drain cooler(s) pre-heat the dilute solution going to either the high-temperature generator, low-temperature generator, or both, depending on the model and series of the unit.

The drain coolers have the effect of increasing the overall efficiency of the cycle.

Evaporator:

The section of a chiller that is responsible for removing the heat from the chilled water circuit, thus cooling the chilled water to be used to cool a building, a manufacturing process, or whatever application it is intended. Typically, the chilled water is cooled from 54ºF to 44ºF. In an absorption chiller, the pure refrigerant generated in the high-temperature and low-temperature generators is cooled and condensed in the condenser and supplied to the evaporator. Here, it is immediately exposed to a much lower pressure which causes some immediate flashing (boiling). Most of the refrigerant cools to the saturation temperature and remains in liquid form. It is then pumped and sprayed over the Evaporator tube bundle. As the refrigerant passes over the outer surface of the tubes, it evaporates (i.e. flashes or boils) because of the low pressure, approximately 5.5-6.5 mmHg which is equivalent to a saturation temperature of 36-41ºF. The refrigerant vapor is then immediately drawn through the eliminator towards the absorber. This vacuum is caused by the hygroscopic action, the affinity lithium bromide has for the refrigerant vapor.

Evaporator Sprays:

A series of spray nozzles that evenly distribute refrigerant from the refrigerant pump discharge over the evaporator tubes.

High Temperature (First-Stage) Generator:

This component heats dilute (weak) lithium bromide solution coming from the absorber. The generator can be fired directly with the use of a burner or with a high pressure steam supply (115 PSIG). As the solution is heated, refrigerant vapor is boiled off and flows to the low-temperature generator. The resulting concentrated solution flows back to the absorber sprays.

G.P.M.:

A measure of volumetric flow rate (Gallons Per Minute).

Gas Train:

Several feet of gas pipe before the inlet to the burner. This section houses various pressure regulators, pressure cutouts, control valves, gauges, safety devices, etc.

Hot Water Heater:

Since most applications do not require cooling year-round, an additional component, a hot water heater, is added to direct-fired units as required. The hot water heater uses the superheated steam from the high-temperature generator and passes it directly through a heat exchanger to heat a water circuit in a building, etc. G-Model units have separate hot water heaters for both standard and high temperature options. S-Model units have changeover valves and use the evaporator as a standard hot water heater. For the high temperature option, S-Model units also have a separate hot water heater. The range of the standard hot water heater option is 130-140ºF, while the high temperature option is 155-175ºF.

Inhibitor:

A chemical used to help minimize or inhibit the corrosion of the internal steel surface area of the unit. It works by helping to promote the formation of an adherent film (magnetite) on the steel surfaces. This film acts as a barrier against corrosion. The present inhibitor used in ParaFlow units is Advaguard 750 ™

Insulation:

Units should be insulated in the field according to the installation manual. Insulation should be installed for a variety of reasons:

1. Decreases the heat loss through the walls of the vessel to its surroundings, thus increasing the efficiency of the machine.
2. Helps reduce the potential of crystallization in the event of a power failure.
3. Offers burn protection for operating personnel in high temperature areas.
4. Eliminates condensation on low temperature areas of the machine.

Isolation Valves:

One isolation valve is located at each Buffalo Pump inlet and outlet. It is a positive sealing, butterfly type valve mounted between standard ANSI flanges. Each valve incorporates an EPDM liner on the valve face to act as a sealing surface. When closed, the valves will isolate the unit vacuum from the pump area to offer ease of serviceability when working on the pumps.

MBH:

A standard unit of measure for the heat input of Direct Fired units equivalent to 1000 BTU/Hr. As reference, 1 Ton of chilling capacity = 12,000 BTU/Hr = 12 MBH. **Note: Do not confuse 1 Ton of chilling capacity with the unit of measure for weight, which is 1 Ton = 2000 lb.**

Control-Panel (Micropanel):

The "brains" of the unit. The control-panel is the electronic control panel which instructs the entire unit on when and how to run. Integrated into the logic of the control-panel are sensors to measure key temperatures and pressures, which are then used to monitor real-time conditions. The control-panel logic is contained in Form 155.17-O2 (Control-Panel Operation Manual).

Model Number:

A series of abbreviations or designations used to identify ParaFlow™ units.

Molybdate:

(Lithium Molybdate, Li_2MoO_4). Inhibitor used in YORK's absorption units. Used on older model Paraflow™ units. See also Inhibitor.

Oil Trap:

The oil trap is located between the purge pump suction connection and the unit. It is designed so it will hold one complete oil charge of the vacuum pump. In the event air was to get into the unit through the vacuum pump, the low pressure in the absorber would induce the oil into the system. Therefore, the oil trap is used as a safety measure to protect the absorption unit from oil ingress.

ParaFlow™:

Our trademark name of two-stage absorption chillers with a parallel-flow design.

Pass Baffle:

Plates (baffles) inserted into a water box to create chambers which force the water to pass through different portions of the tube bundle, called passes. Although the pressure drop increases with increasing passes, the tradeoff for heat transfer optimization and nozzle locations are justified.

Power Panel

The power panel serves as single-point wiring location for the unit's incoming power wiring. It houses all the unit pump contactors and overloads, as well as fuses and terminal lugs for ease of servicability. A transformer is included to reduce the incoming unit voltage to the required control voltage to the control-panel.

Pressure Drop:

The amount of pressure decrease experienced between two locations. Often referred to when describing the drop in pressure found while passing water through the tubes in a chiller. Typically measured in PSI or Ft H_20.

Purge Chamber:

The purge chamber on G-Model units is rectangular in shape and is integral with the alcohol separator, separated by a steel plate. It is located on the refrigerant outlet of the low-temperature generator. On S-Model units, the purge chamber is a stand-alone, cylindrical pipe capped off on each end, located at the upper corner of the condenser. The function of the purge chamber is to collect and hold non-condensables until they are purged out. On units equipped with SmartPurge™, a transducer continually monitors the pressure within the tank. When this pressure reaches 60 mm, a purge initiates.

The purge tank pressure is sealed off from the unit's internal pressure by means of an inverted U-shaped pipe filled with solution. If the pressure within the purge tank were to exceed 100 mm, it would overcome the inverted "U" seal and expel non-condensables back into the absorber section of the unit.

Purge Eductor:

An eductor is a liquid powered jet pump. Jet pumps have no moving parts and use a high-pressure stream of liquid to pass through a nozzle to cause a portion of a low pressure stream coming into the side of the pump to combine with the nozzle stream. This causes a reduction in pressure at the low-pressure inlet and induces the rest of the low-pressure inlet substance to flow into the body of the pump.

Purge Pump:

An external pump connected to the purge system of the unit. This pump is used to evacuate non-condensables from the unit.

Purging:

A process by which non-condensables present in a unit are removed through the use of a vacuum pump.

Refrigerant:

(Water, H_2O). De-ionized water is used as the refrigerant.

Refrigerant Pump:

A hermetically-sealed, centrifugal pump located downstream of the evaporator outlet box. This pump receives liquid refrigerant from the evaporator and discharges it back up to the evaporator sprays. It continues to re-circulate the refrigerant while the chiller is operating.

Rupture Disk:

Although ParaFlow™ absorption units operate at less than atmospheric pressure (a vacuum), if certain safeties fail and/or incorrect valves are closed, the unit could experience higher pressures in certain chambers. Therefore, a pressure relief apparatus, a rupture disk, is added.

Solution Heat Exchangers:

A counterflow solution-to-solution heat exchanger. A component that exchanges heat between two streams of Lithium Bromide solution. The hotter the solution being supplied to the generators is, the less heat that needs to be added, thus improving efficiency. Likewise, the cooler the solution is going to the absorber, the less heat that needs to be removed by the cooling towers. Therefore, the S.T.S. heat exchangers pre-heat the solution going to the generators and cool the solution going to the absorber. On G-Model units, there are three S.T.S. heat exchangers: a low temperature, an intermediate temperature, and a high temperature. On S-Model units, there are only two S.T.S. heat exchangers: a low temperature and a high temperature.

Low Temperature (Second-Stage) Generator:

The energy source for the production of refrigerant vapor in the low-temperature generator is the hot refrigerant vapor produced by the high temperature generator.

Approximately 40% additional refrigerant is produced at no additional expense of fuel. The result is a much higher efficiency than in conventional single-stage absorption chillers.

This additional refrigerant vapor is produced when dilute solution from the heat exchanger is heated by the refrigerant vapor coming form the high-temperature generator.

The additional concentrated solution that results is returned to the heat exchanger where it is mixed with the concentrated solution returning from the high temperature generator.

The refrigerant vapor from the high-temperature generator is condensed into a liquid (tube side of the second stage generator), giving up its heat. This condensed refrigerant then travels to the condenser.

Sight Glass:

A leak-tight port hole used to visually inspect liquid levels within the unit. A threaded design with a quartz glass window is presently being used.

SmartPurge™:

System designed to automatically remove non-condensables from the unit's purge tank. The system also monitors the frequency of purging and alerts the operator in the event that purging becomes excessive.

Solution:

A mixture of deionized water with a certain % by weight of dissolved lithium bromide (LiBr). Corrosion inhibitors are also added to the solution to reduce the internal corrosion rates in the unit.

Solution Pump:

A hermetically sealed, centrifugal pump located under the absorber. It receives diluted lithium bromide solution from the absorber shell and circulates it through a

13

heat exchanger, then up to the generator. The discharge of this pump operates in a pressure that is above atmospheric pressure. The pump is cooled by the solution it is pumping.

Solution Spray Pump(s):

The solution spray pump(s) manifest themselves in many ways on YORK absorption chillers. On smaller S-Model units, it shares its motor with the main solution pump. On larger S-Models, it has a separate pump altogether. On smaller G-Model units, there are two, completely separate pumps - one for weak solution, and one for strong solution. In all cases, it pumps solution to the absorber spray header.

The weak solution spray pump re-circulates the weak solution in the solution tank back up to the absorber spray header. The strong solution pump circulates the solution coming back from the generators up to the absorber spray header.

Solution Tank:

This tank, sometimes called the solution sump, is located directly under the absorber shell on all units. It can be seen more easily on the G-Model units, as an almost separate tank. On S-Model Units, it is integral with the absorber. It collects the diluted solution after it has gone through the absorber bundle to ensure an ample supply of solution for the suction of the main solution pump.

The second function of the solution tank is to help create a vortex just before the solution pump suction to remove any non-condensables that could hinder the absorption process in the absorber shell. It does this by geometry of the entrance to the solution tank.

The solution tank contains at least one sight glass so that the level of solution in the tank can be determined.

Specific Gravity (S.G.):

The ratio of the mass of a liquid to the mass of an equal volume of distilled water at 39°F.

S-Model Units:

The newer series of absorption chillers which followed the G-Model units. S-Model units units are more compact with vertical tube bundles, and an overall rectangular, boxy shape. The efficiency of the S-Model units is also slightly better than the older style G-Model units. We offer Direct-Fired units ranging from 12SC (200 Tons) to a 19S (680 Tons) and Steam units which include a 14SC (280 Tons) as well as 16SL (440 Tons) to a 19S (680 Tons). It should be noted that three unit sizes have been renamed and may be referred to by either designation. They are the 12SC = 13S, 13SC = 14S, and a 14SC = 15S.

Steam Valve:

The capacity control valve which regulates the amount of steam to the unit (Steam units only).

Tube Sheet (End Sheet):

The book-ends of the mainshell. The tube sheets are located at each of the axial ends of the unit, where the tubes are rolled and waterboxes are mounted.

Tube Support:

A smaller gauge steel sheet, identical in tube hole layout to the tube sheet, but used internally to provide support and rigidity for the bundle of tubes. Internally, the tube supports are not rolled like the tube sheets.

Vacuum:

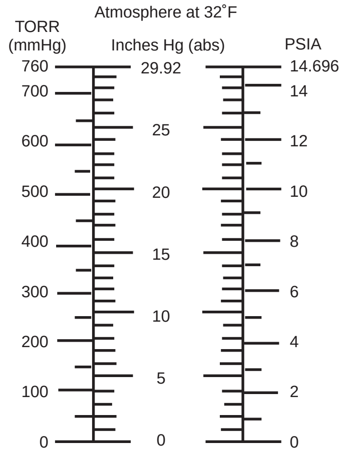
When the pressure within a vessel is less than standard atmospheric pressure.

The term “vacuum” usually refers to any pressure below atmospheric pressure. The degree of vacuum can be expressed in many ways, but most commonly, as in this manual, it is measured in inches of mercury or millimeters of mercury.

One atmosphere is equal to 760 millimeters of mercury absolute (Torr); 29.92 inches of mercury absolute; or 14.696 pounds per square inch absolute (see Fig. 49).

When vacuum is measured relative to atmospheric pressure and toward absolute zero, the negative sign (–) is used to indicate that it is a negative gauge pressure value. When vacuum is considered in the other direction, i.e., from absolute zero, the term absolute (or abs.) is used (See Figure 49).

From Figure 49, we can see that a pressure reading of 300 Torr is the same as 11.8 in Hg (abs.) and 5.8 PSI (abs.).



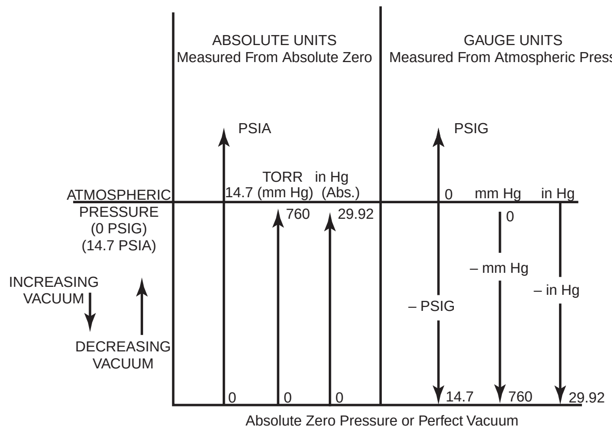


FIG. 49 – PRESSURE EQUIVALENTS AND VACUUM UNITS OF MEASUREMENT

Water Box:

A structure designed to contain the water both entering and exiting the unit by using nozzles to restrict the water into a contained area. The nozzle directs the water into the waterbox where pressure builds up, forcing the water through the tubes. As the water exits the tubes on the opposite end, it is restricted by the waterbox on the other side of the tube bundle. Again, pressure builds up, and the water is either forced by a pass baffle back through another section of the tube bundle or directly out of the outlet nozzle.

YPC:

York ParaFlow™ Chiller

APPENDIX A – TYPICAL SIGHT GLASS LEVELS

TYPICAL SIGHT GLASS LEVELS – S-MODEL UNITS

Refer to Appendix B for typical location of sight glasses for the various S-Model absorption units. These levels are for full load operating conditions only. The levels will vary for other load conditions. The actual levels for any given machine will be determined at start-up. They should be recorded by the start-up technician at this time for future reference.

Absorber (G1)

A level should be present in the absorber sight glass at full load conditions. The level will be above the glass for all other operating conditions.

Refrigerant Sump (G2)

The operating refrigerant level should be above this glass at full load conditions.

Evaporator Shell (G3)

A level up to 1/2 should be present in this glass at full load conditions.

High-Temperature Generator (G4)

The level will typical be on average about 1/4 - 3/4 of a sightglass. This level will fluctuate as the solution float valve opens and closes.

Low-Temperature Generator (G5)

This level will range from as high as 3/4 of a sightglass to no level. A full sight glass may indicate a solution supply or return problem.

Oil Separator (G6)

Empty. No level should ever be present in this sight glass.

TYPICAL SIGHT GLASS LEVELS – G-MODEL UNITS

Refer to Appendix B for typical location of sight glasses for the various G-model absorption units. These levels are for full load operating conditions only. The levels will vary for other load conditions. The actual levels for any given machine will be determined at start-up. They should be recorded at this time for future reference. Please note that not all the sight glasses shown will be present on all machines.

Absorber Tank (typically two sight glasses) (G1)

Approximately 1/2 glass in the upper absorber tank sightglass.

Refrigerant Tank (G2)

The level should be above all tank sight glasses.

Evaporator Spillover Sight Glass (G3)

Just ready to spill over the evaporator pan.

High-Temperature Generator (G4)

Approximately 1/2 - 3/4 full.

Low-Temperature Generator (G5)

Flowing Down

Oil Separator (G6)

Empty. No level should ever be present in this sight glass.

APPENDIX B – VALVE LOCATION DIAGRAMS (S MODEL UNITS)

B

VALVE TAG CHART

VS1	High-Temperature Generator (Strong Solution return)
VS2	Low Temperature Generator (Weak Solution Supply)
VR3	Evaporator (Refrigerant Spray Header Supply)
VS4	Condensate Drain Cooler 1 (Weak Solution Supply)
VR5	High-Temperature Generator #2 (Condensate Return)[1]
VR6	High-Temperature Generator #1 (Condensate Return)
VR7	Refrigerant By-Pass Setting Valve
VR8	Refrigerant Blowdown Valve
VR9	Refrigerant Pump Isolation Valve (Suction)
VR10	Refrigerant Pump Isolation Valve (Discharge)
VR11	Refrigerant Sampling Valve (Discharge Refrigerant Pump)
VS12	Main Solution Pump Isolation Valve (Suction)
VS13	Main Solution Pump Isolation Valve (Discharge)
VS14	Solution Sampling Valve (Discharge Main Solution Pump)
VS17	Solution Sampling Valve (Low Temperature Generator Return)
VS18	Solution Sampling Valve (High-Temperature Generator Return)
VS19	Solution Sampling Valve (Low Temperature Heat Exchanger - Weak Solution Inlet)
VS20	Solution By-Pass Setting Valve
VS21	Solution Spray Sampling Valve - Weak Solution Absorber Spray Header
VS22	Strong Solution Spray Pump Isolation Valve (Suction)
VS23	Strong Solution Spray Pump Isolation Valve (Discharge)
VS24	Solution Sampling Valve (High Temperature Heat Exchanger - Weak Solution Inlet)
VS25	Solution Sampling Valve (Discharge Strong Solution Spray Pump)
VS26	Solution Flow Rate Setting Valve (Weak Solution Spray Header)
VS28	Solution Flow Rate Setting Valve (Strong Solution Spray Header)
VS29	Solution By-Pass Valve (Weak Solution to Strong Solution Sprays)
VS30	Mixture Strong Solution From High and Intermediate HXER’s Leaving Low Temperature Heat Exchanger
VS31	Low Temperature Generator - Float By-Pass Valve
VS34	Weak Solution Spray Pump Isolation Valve (Suction)
VS35	Weak Solution Spray Pump Isolation Valve (Discharge)
VS36	Solution Sampling Valve (Discharge Weak Solution Spray Pump)
VR37	BZT (Inhibitor) Charging Valve (High-Temperature Generator)
VR39	Pressure Gauge Valve (Condenser Pressure)
VR40	Pressure Gauge / Transducer Isolation Valve (System #1)
VR41	Pressure Gauge / Transducer Isolation Valve (System #2)
VS43	Solution Sampling Valve (Low-Temperature Generator - Weak Solution Supply)
VS44	Solution Sampling Valve (Discharge Main Solution Pump)
VS45	Mixture Strong Solution From High and Intermediate HXER’s Entering Low Temperature Heat Exchanger

PURGE OPERATION VALVES

VP1 From Condenser To Purge Eductor
VP2 From Purge Tank
VP3 Direct Purge Condenser
VP4 Direct Purge Absorber
VP5 Main Valve, Purge Pump Isolation
VP6 Hot Water Heat Exchanger #1
VP7 Solution Tank (Connect To Mechanical Booster Pump)
VP8 Check Valve
VP9 Hot Water Heat Exchanger #2
VP10 Purge Tank Transducer Isolation Valve
VP11 Solution Flow Rate Setting To Eductor
VP12 Refrigerant Tank (Connect To Mechanical Booster Pump)
VP13 Direct Purge Condenser
VP14 Direct Purge Condenser
VP15 Tube Side - High Temperature Heat Exchanger (HTSTS)
VP16 Tube Side - Intermediate Temperature Heat Exchanger (ITSTS)
VP17 Shell Side - Intermediate Temperature Heat Exchanger (ITSTS)
VP18 Shell Side - Low Temperature Heat Exchanger (LTSTS)
VP19 SmartPurge Purge Pump Isolation Valve
VP20 SmartPurge - Purge Tank Isolation Valve
VP21 Purge Line Isolator Valve
VP22 Purge Line Isolation Valve

B

CHANGEOVER AND DRAIN VALVES

VA	Cooling-Heating Changeover Valve (Refrigerant To Condenser)
VA	Isolation Valve / Refrigerant Changeover Valve
VA1	Cooling-Heating Changeover Valve (Refrigerant To Condenser)
VB[1]	Cooling-Heating Changeover Valve (Solution To First Stage)
VB	Isolation Valve / Solution Changeover Valve
VB1	First-Stage Generator “B” Float Valve By-Pass
VC[1]	Cooling-Heating Changeover Valve (From First Stage)
VD[2]	Cooling-Heating Changeover Valve
VD1	Steam Drain Discharge Valve
VD2	Steam Discharge Valve
VD3	Steam Drain Discharge Valve (Solenoid)
VD4	Steam Control Valve (Field Assembled)
VE[2]	Cooling-Heating Changeover Valve

NOTES: 1 High Temperature Heating Option Only
2 Standard Heating Option Only

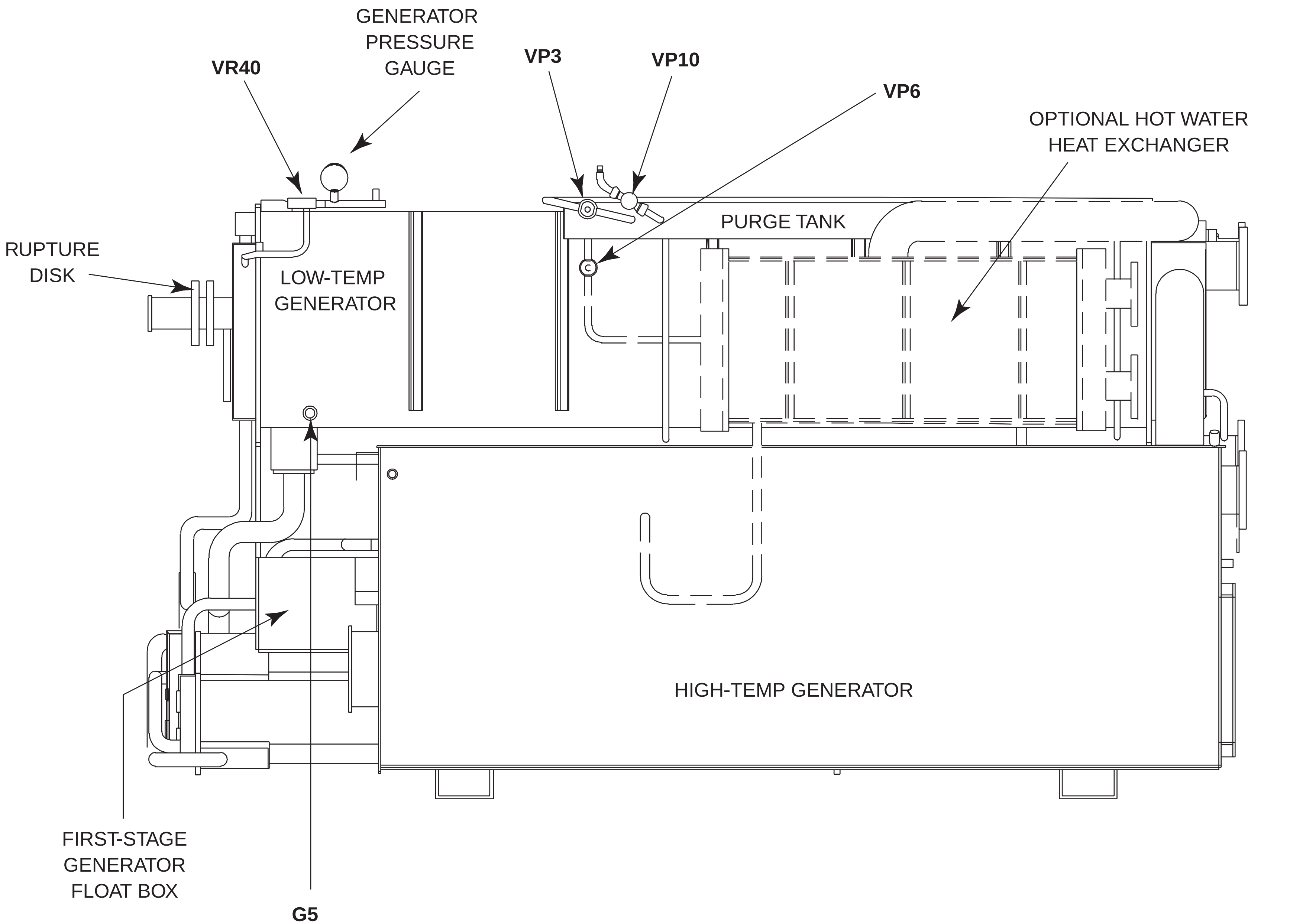


FIG. 50 – MODELS YPC-DF-12SC-15S VALVE LOCATION DIAGRAM

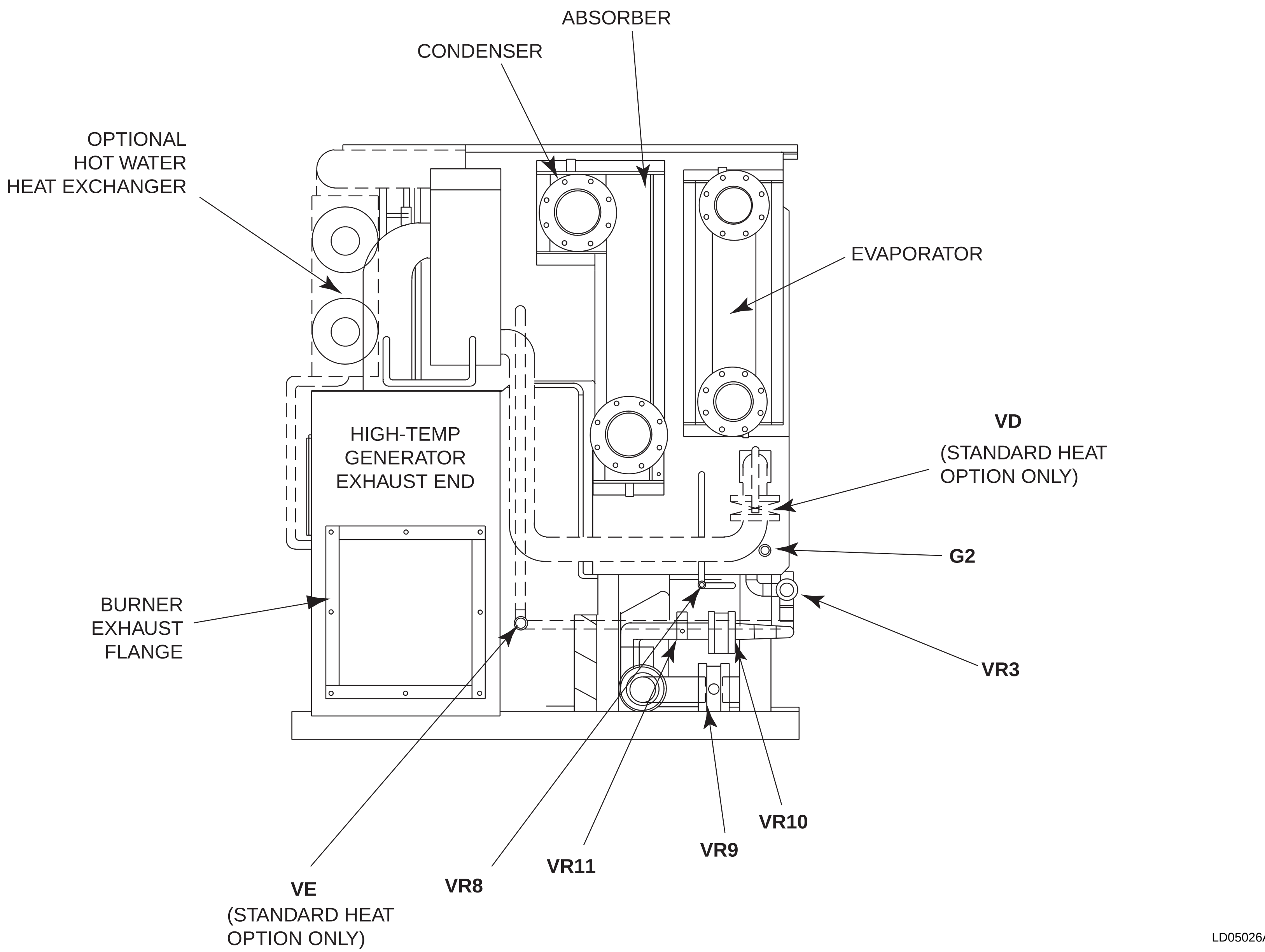


FIG. 50 (CONTINUED) – MODELS YPC-DF-12SC-15S VALVE LOCATION DIAGRAM

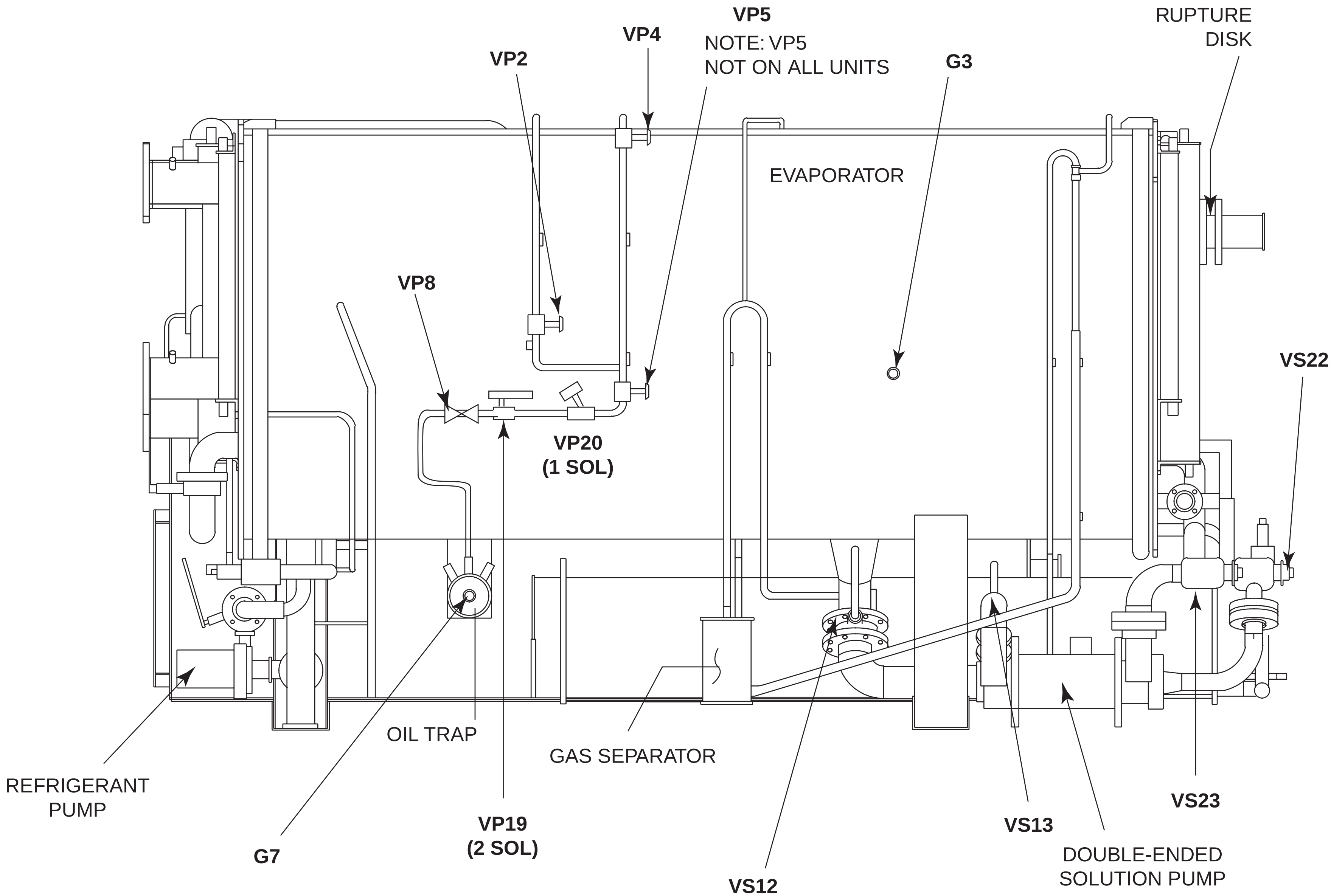


FIG. 51 – MODELS YPC-DF-12SC-15S VALVE LOCATION DIAGRAM

LD05026

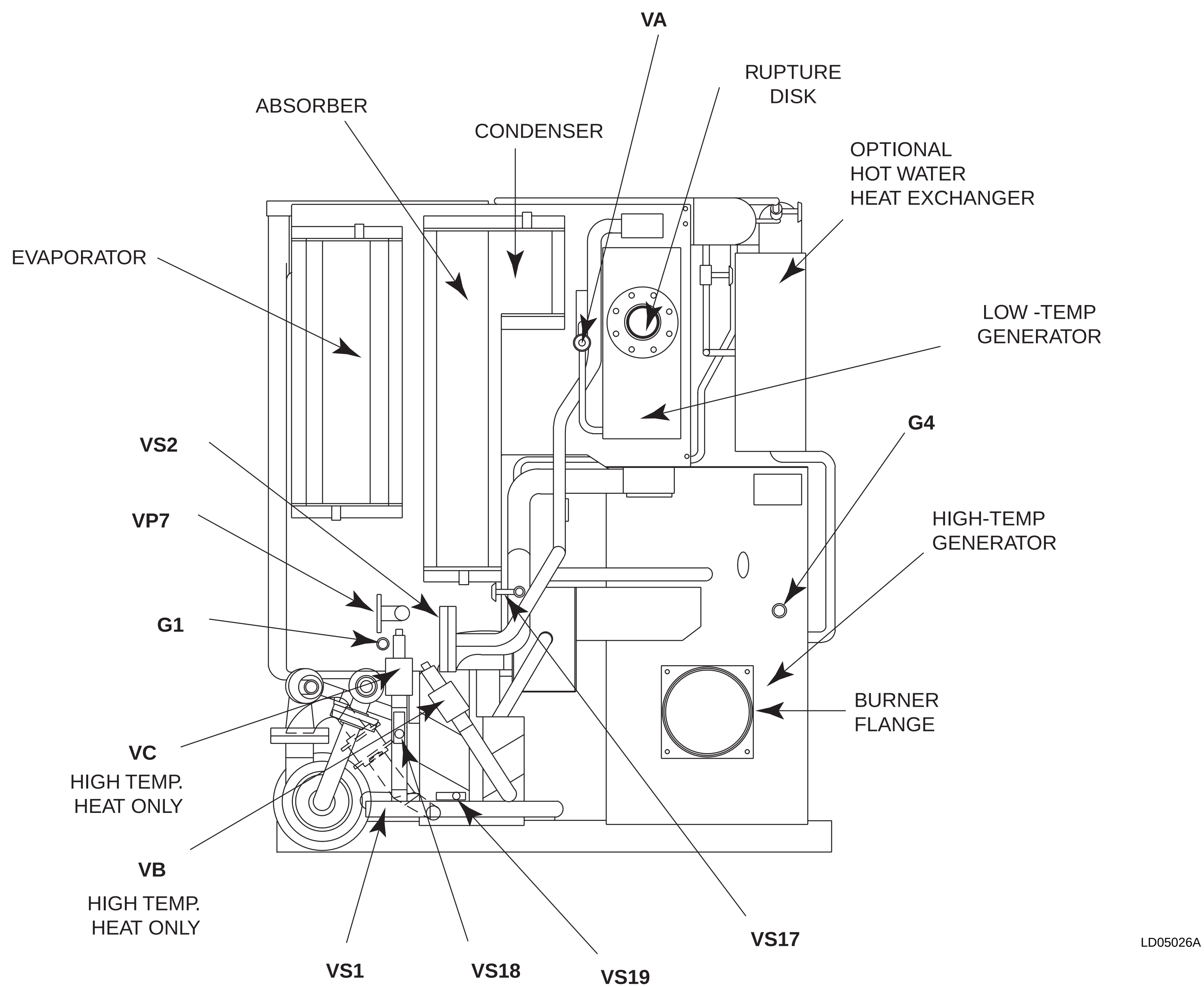
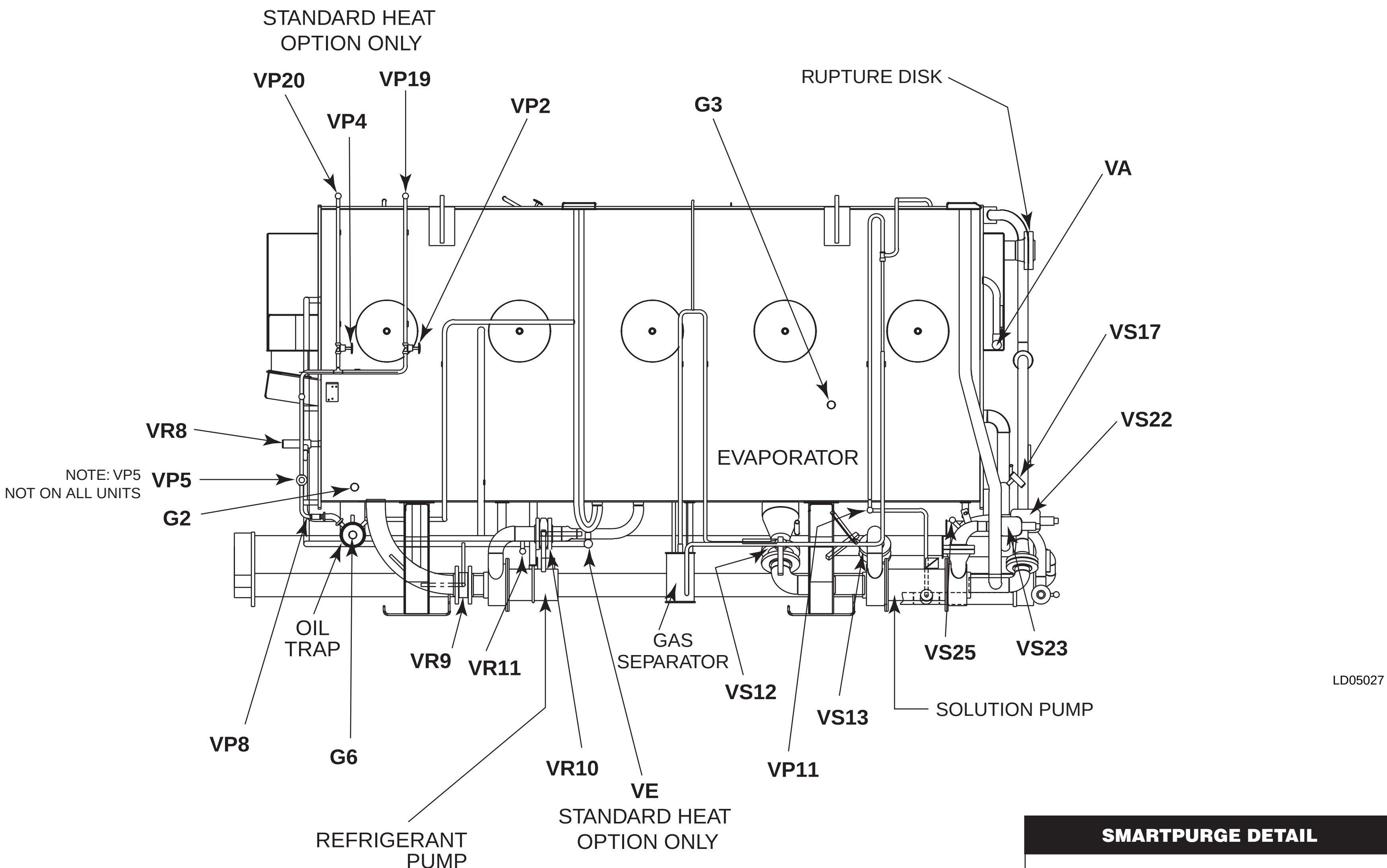


FIG. 51 (CONTINUED) – MODELS YPC-DF-12SC-15S VALVE LOCATION DIAGRAM



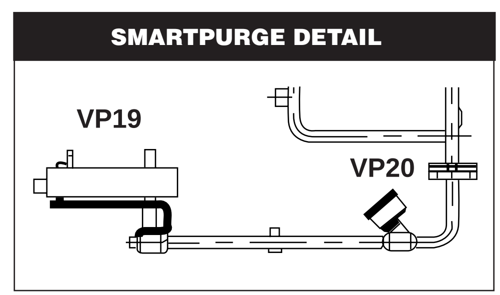


FIG. 52 – MODEL YPC-DF-15SL-16S VALVE LOCATION DIAGRAM

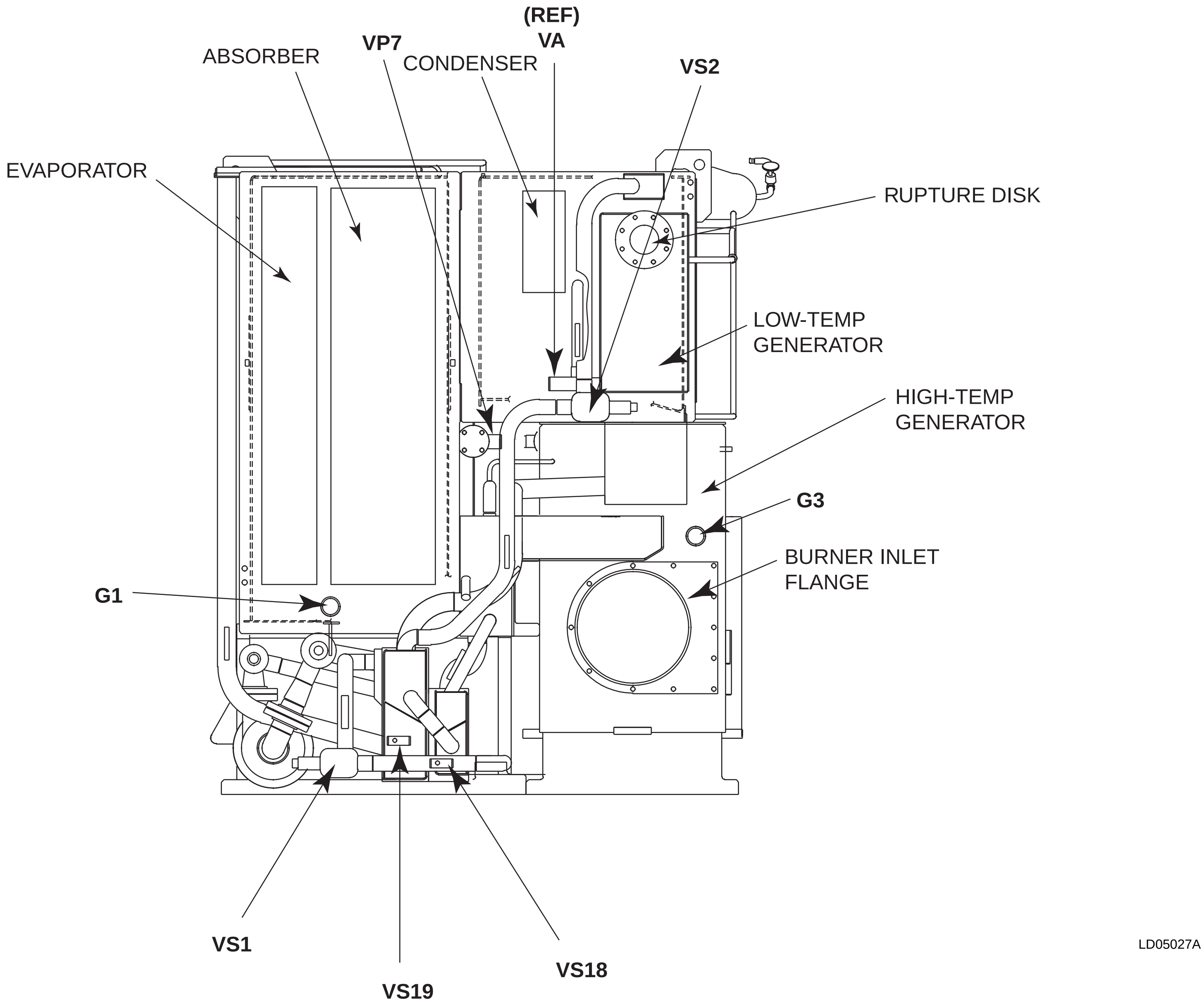


FIG. 52 (CONTINUED) – MODEL YPC-DF-15SL-16S VALVE LOCATION DIAGRAM

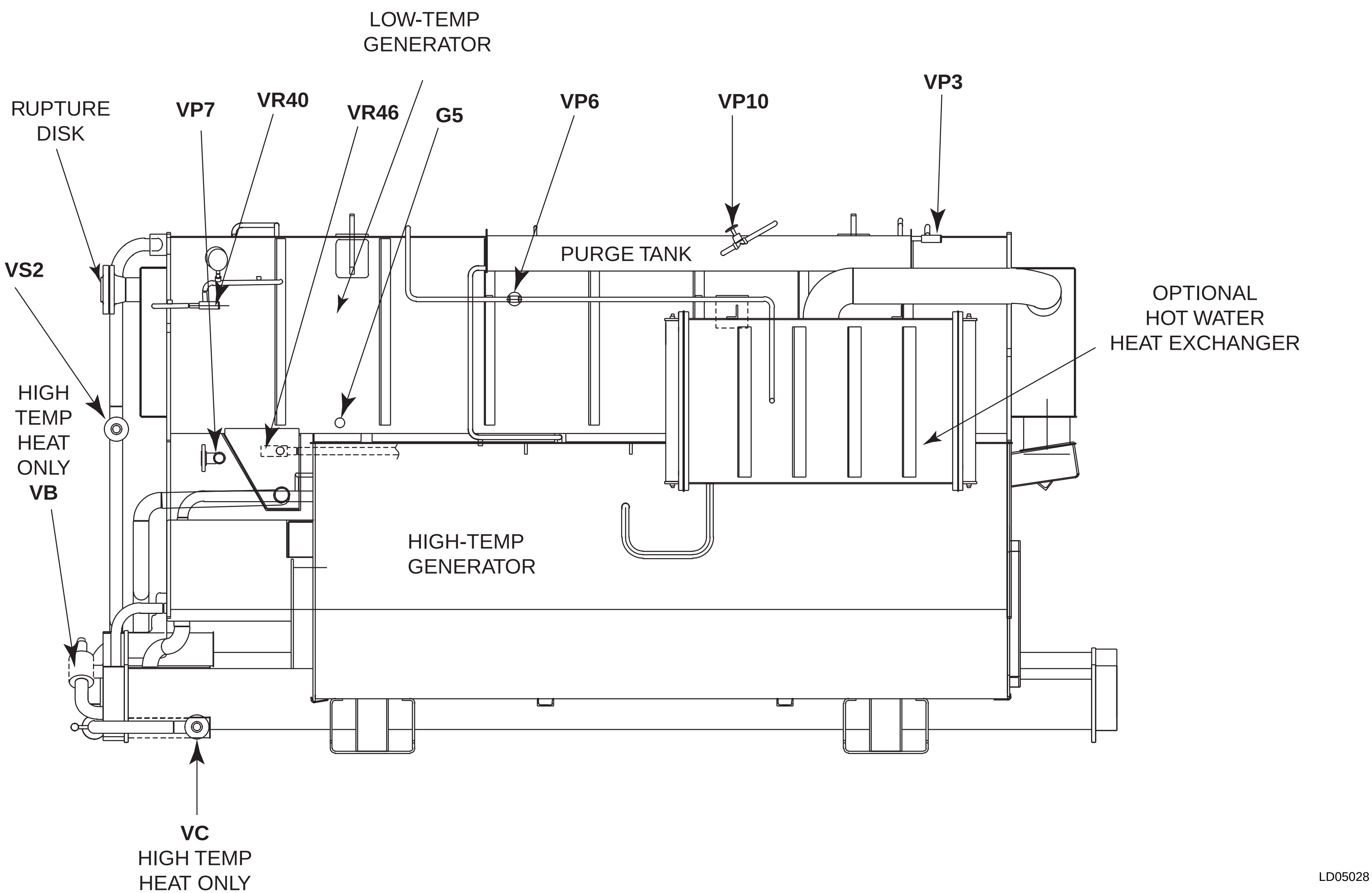


FIG. 53 – MODEL YPC-DF-15SL-16S VALVE LOCATION DIAGRAM

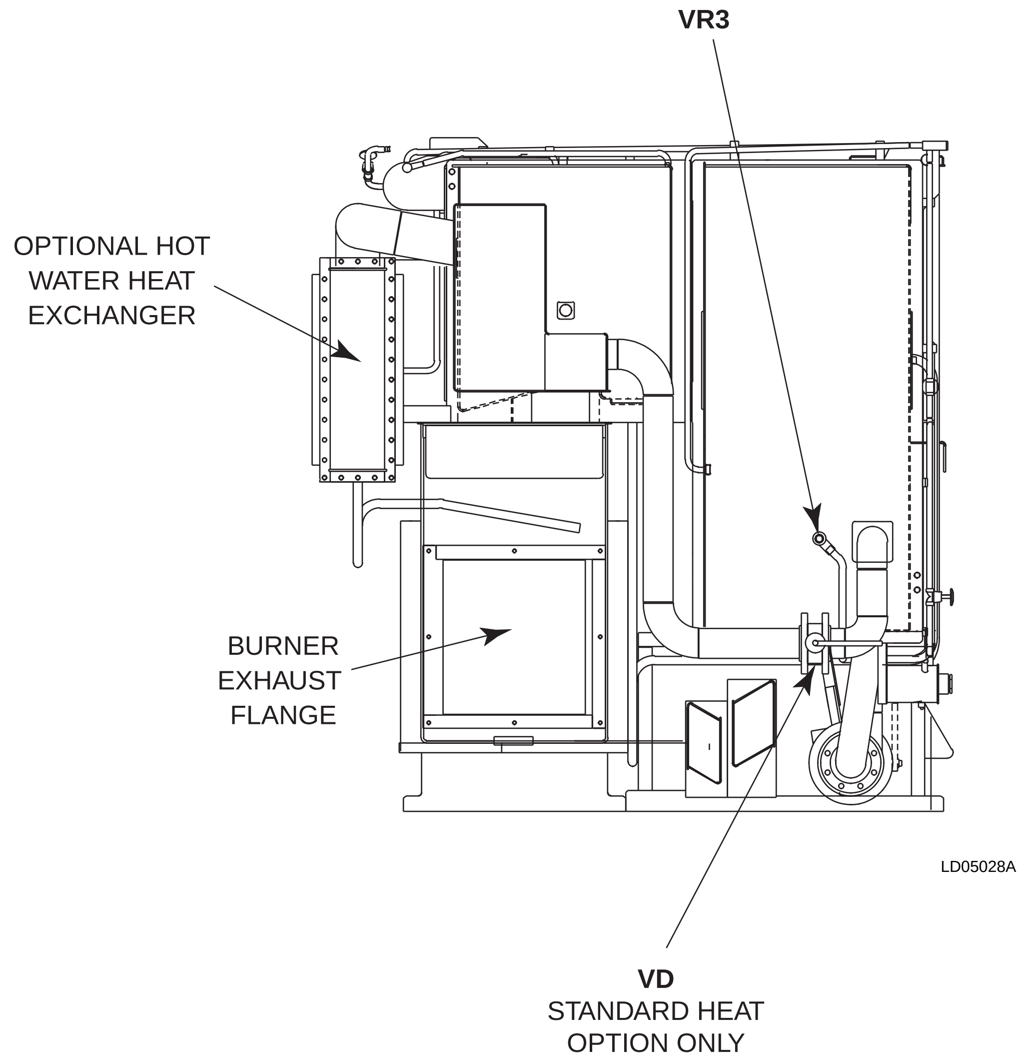


FIG. 53 (CONTINUED) – MODEL YPC-DF-15SL-16S VALVE LOCATION DIAGRAM

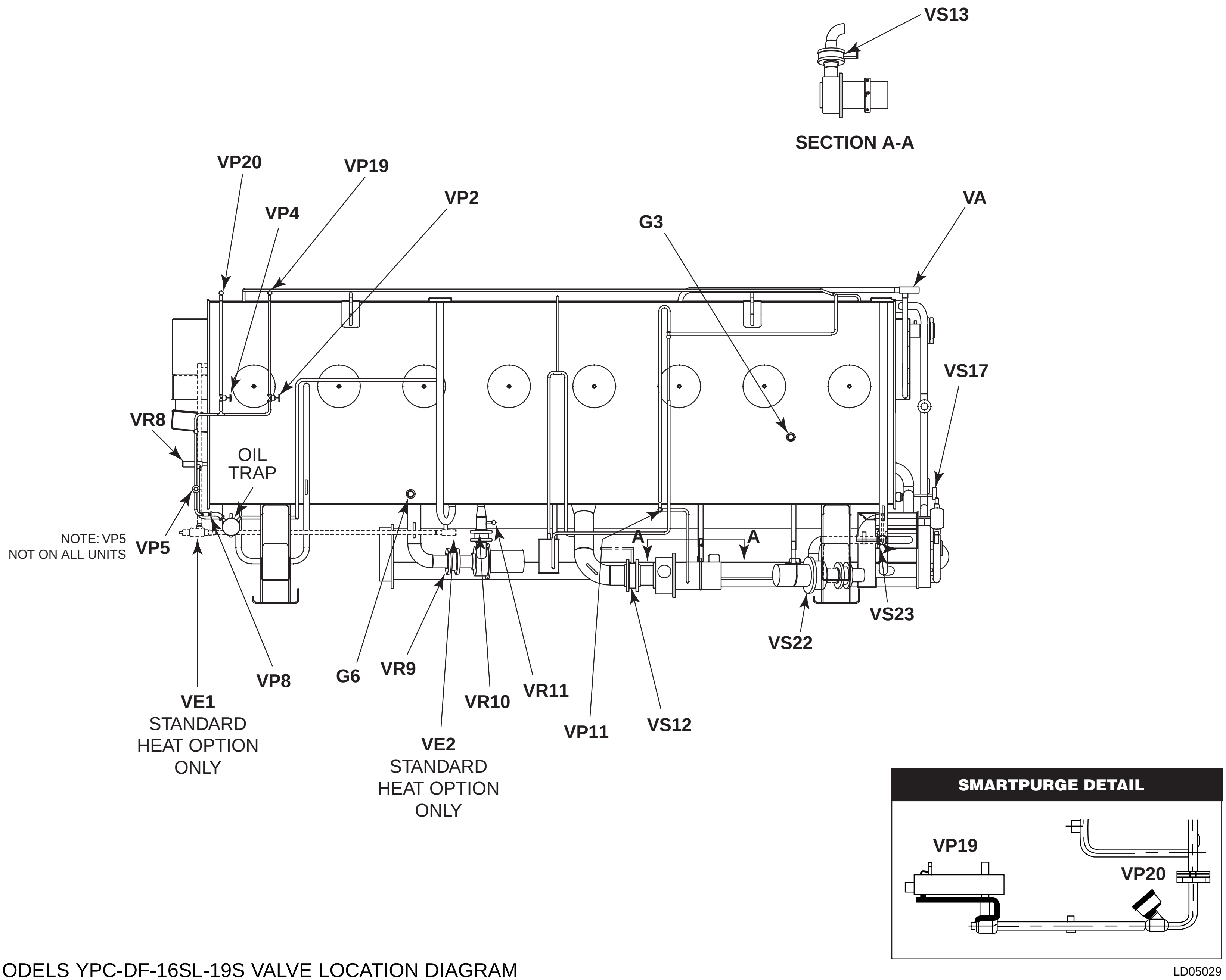


FIG. 54 – MODELS YPC-DF-16SL-19S VALVE LOCATION DIAGRAM

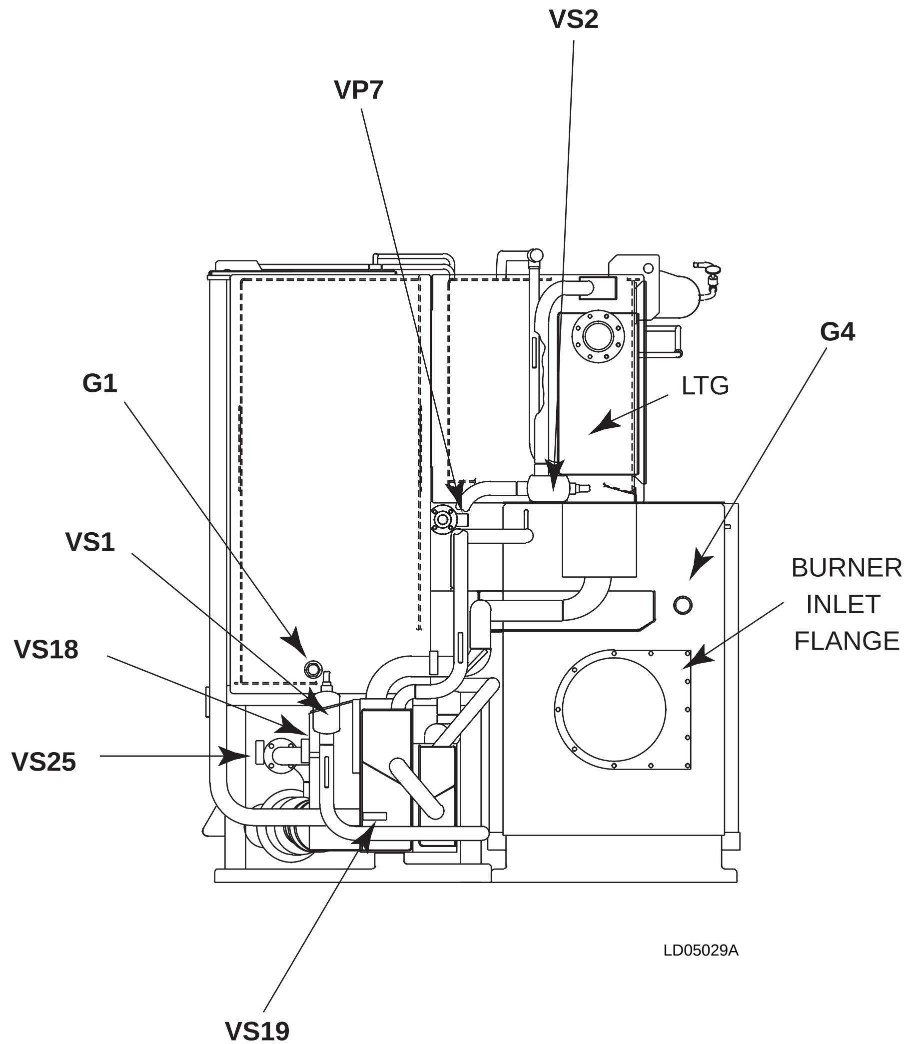


FIG. 54 (CONTINUED) – MODELS YPC-DF-16SL-19S VALVE LOCATION DIAGRAM

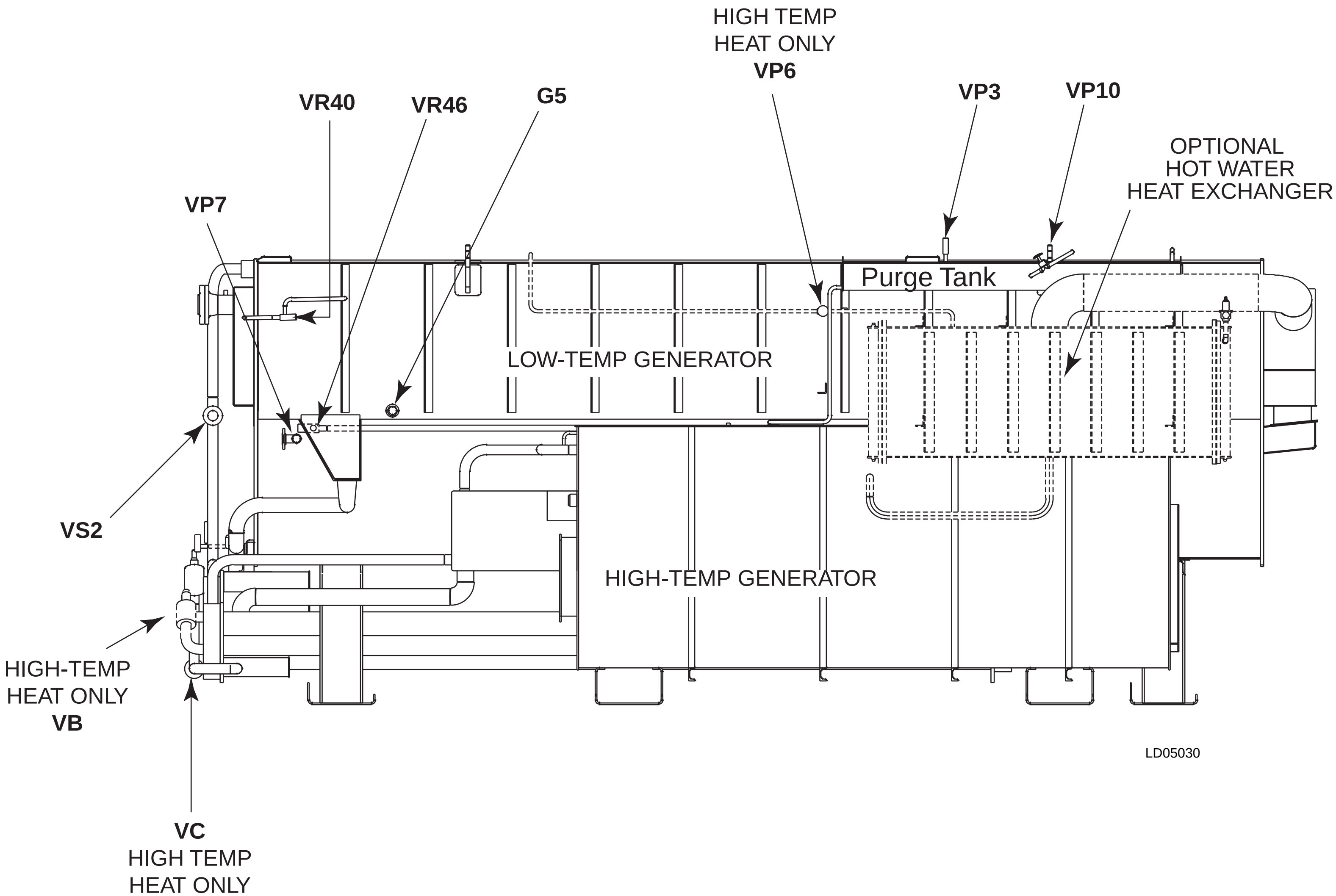


FIG. 55 – MODELS YPC-DF-16SL-19S VALVE LOCATION DIAGRAM

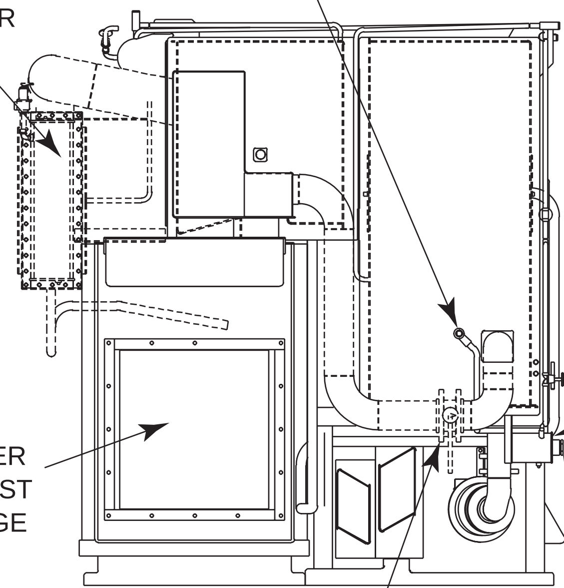


FIG. 55 (CONTINUED) – MODELS YPC-DF-16SL-19S VALVE LOCATION DIAGRAM

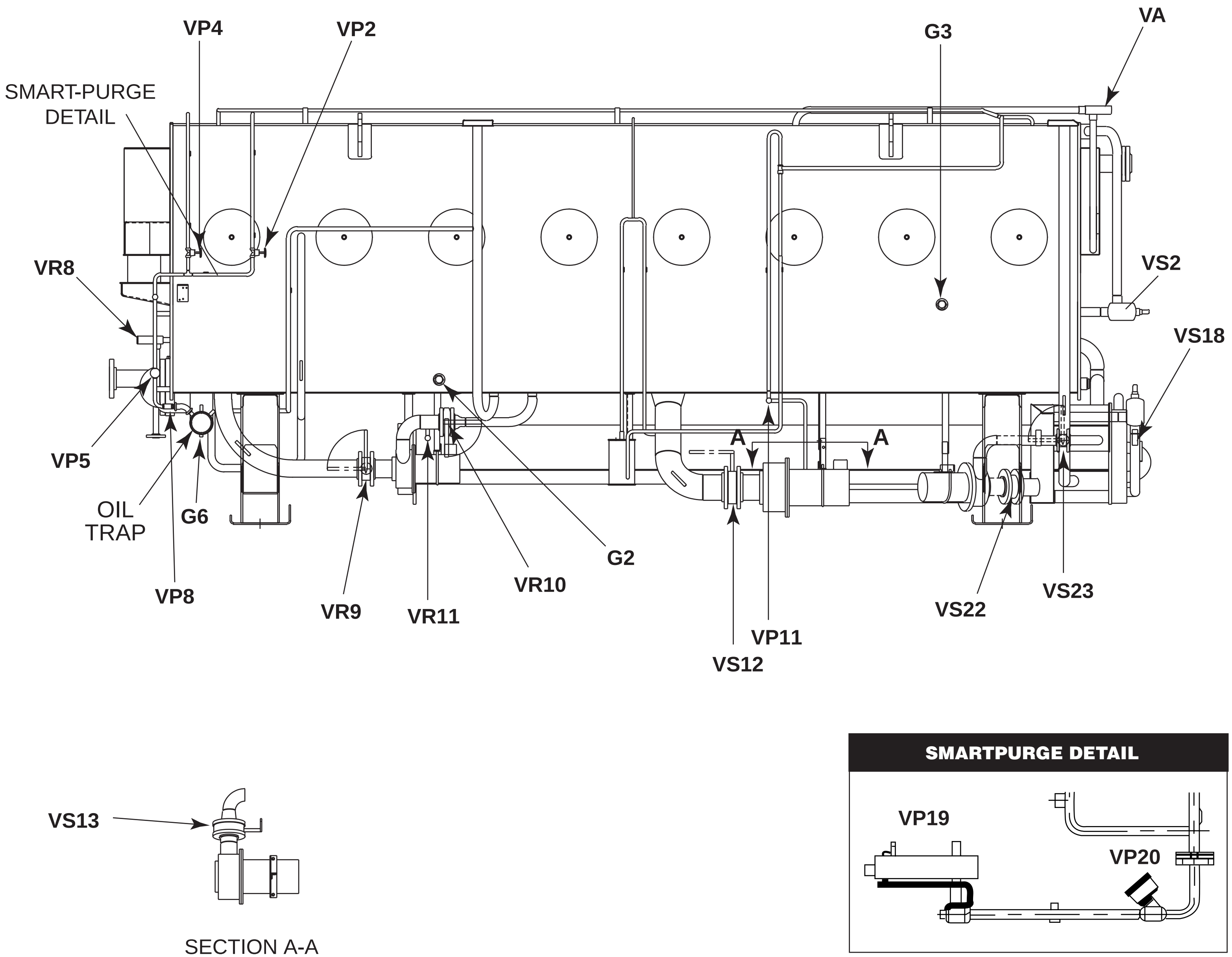


FIG. 56 – MODELS YPC-ST-16SL-19S VALVE LOCATION DIAGRAM

LD05031

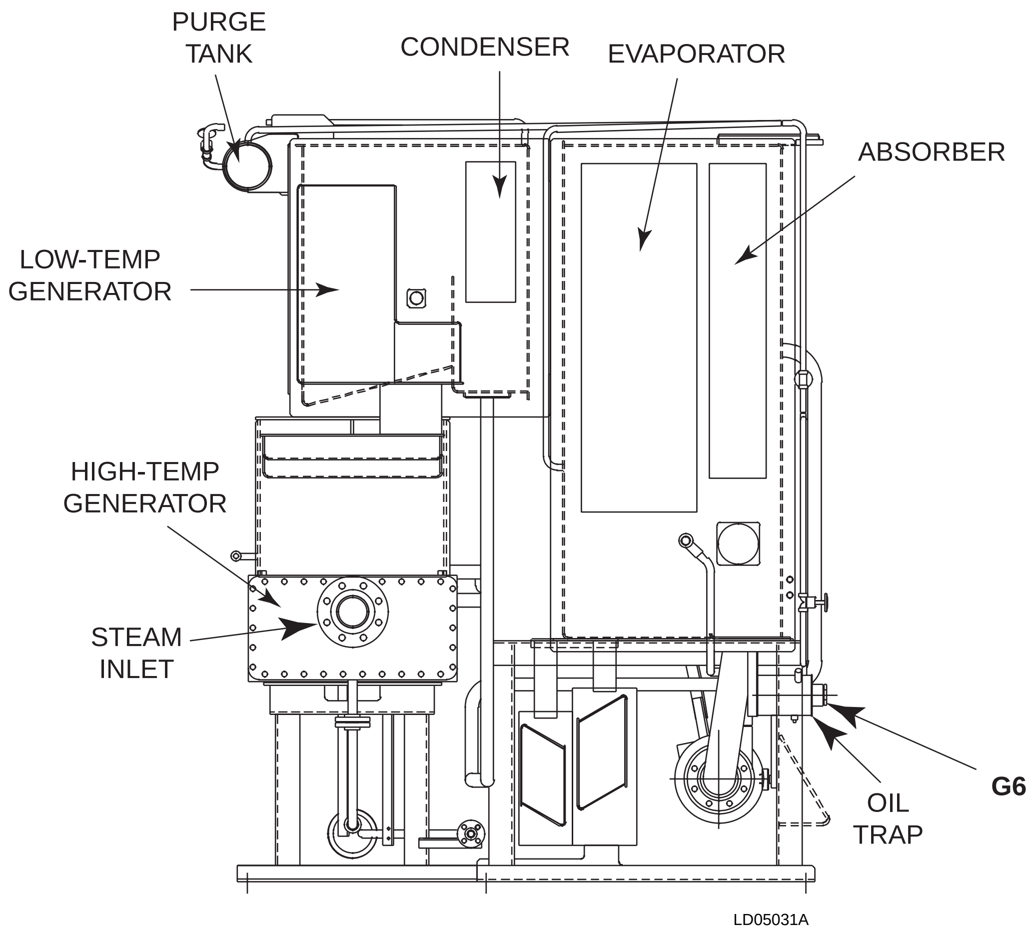


FIG. 56 (CONTINUED) – MODELS YPC-ST-16SL-19S VALVE LOCATION DIAGRAM

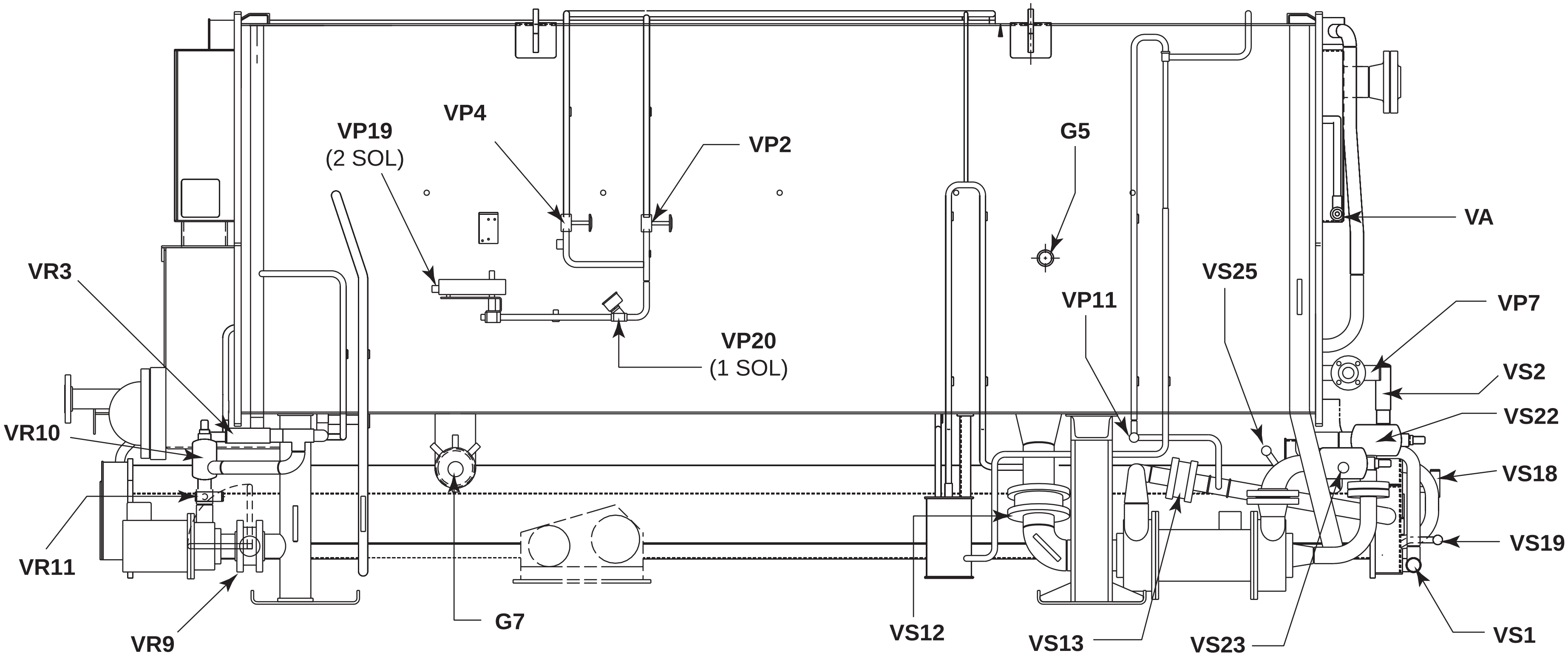


FIG. 57 – MODEL YPC-ST-14SC VALVE LOCATION DIAGRAM

LD05858A

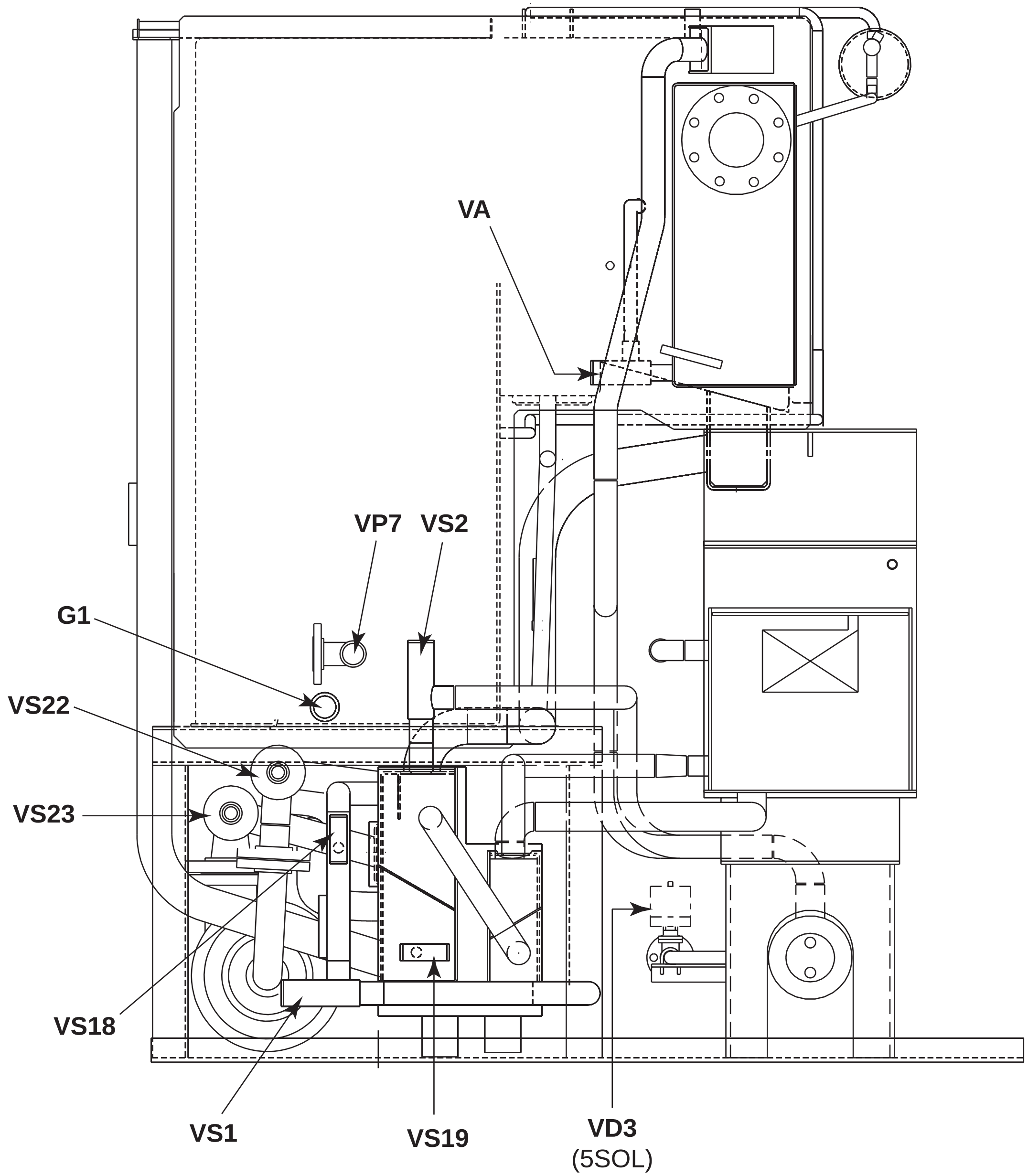


FIG. 57 (CONTINUED) – MODEL YPC-ST-14SC VALVE LOCATION DIAGRAM

LD05858

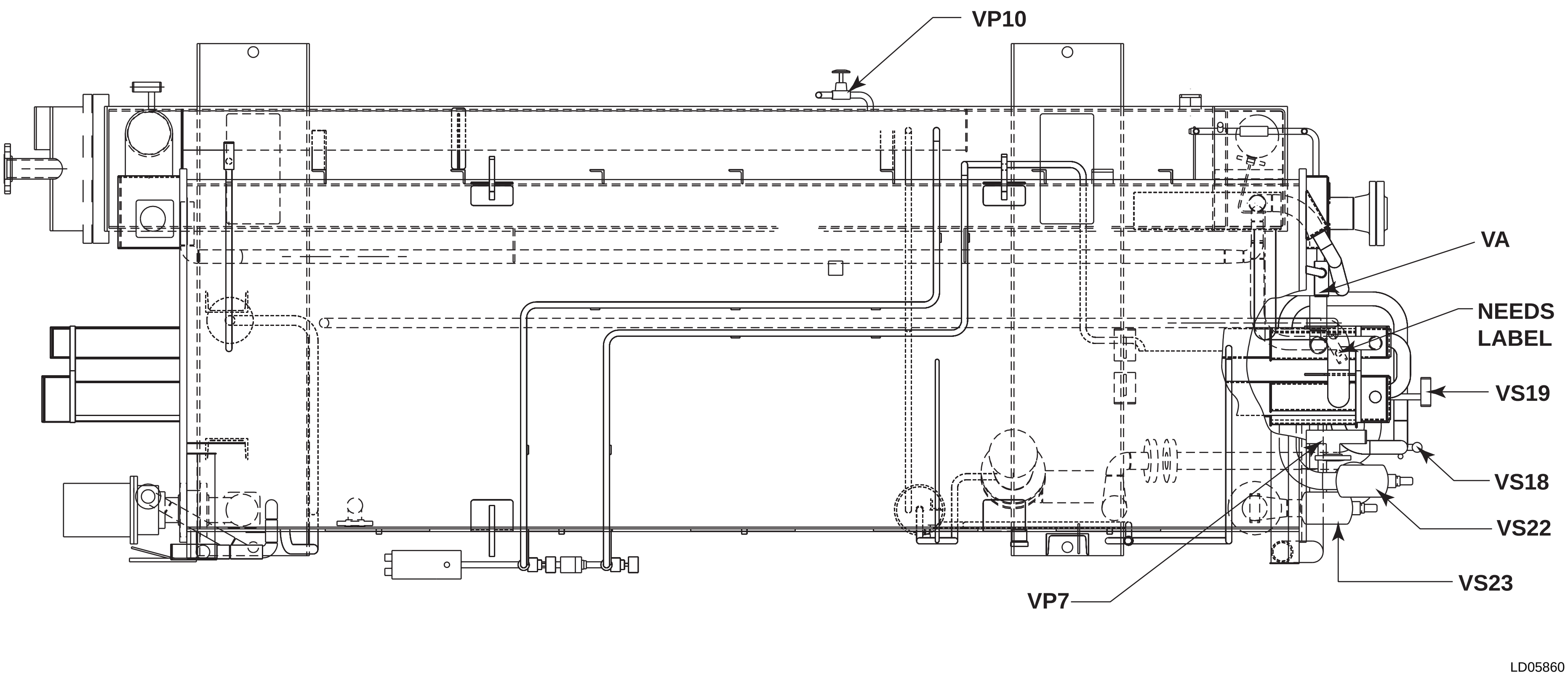


FIG. 57 (CONTINUED) – MODEL YPC-ST-14SC VALVE LOCATION DIAGRAM

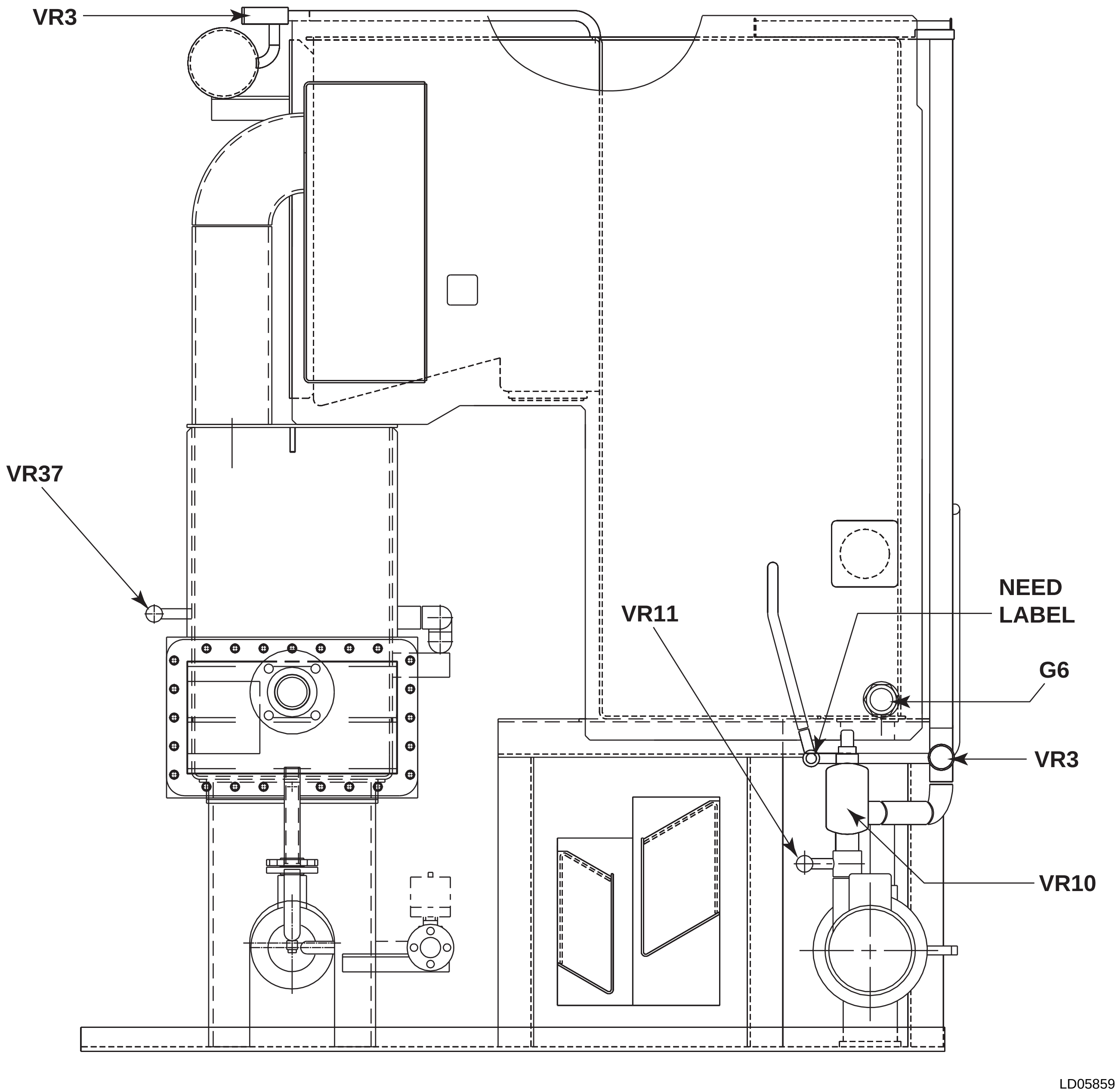


FIG. 57 (CONTINUED) – MODEL YPC-ST-14SC VALVE LOCATION DIAGRAM

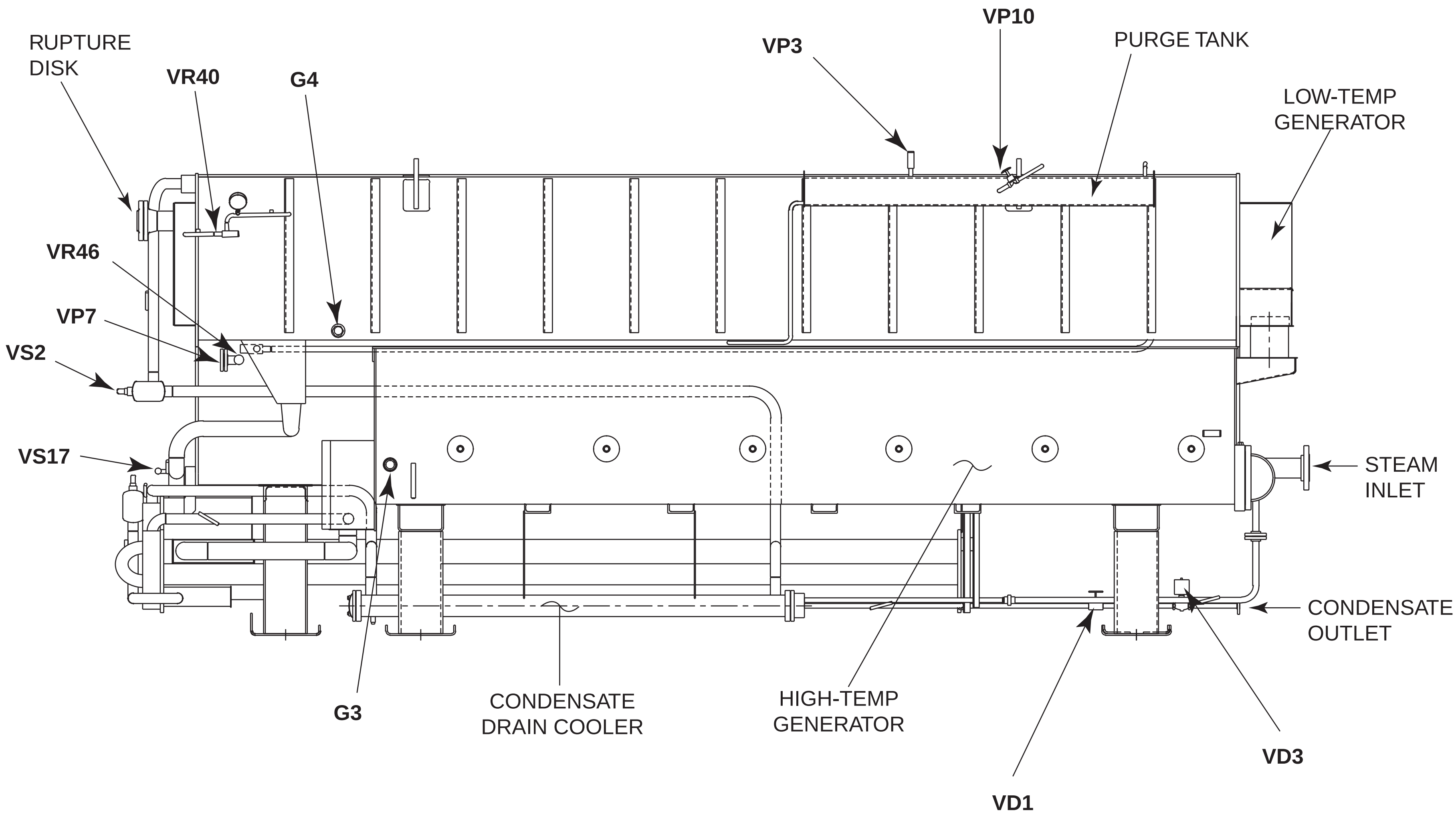


FIG. 58 – MODELS YPC-ST-16SL-19S VALVE LOCATION DIAGRAM

LD05032

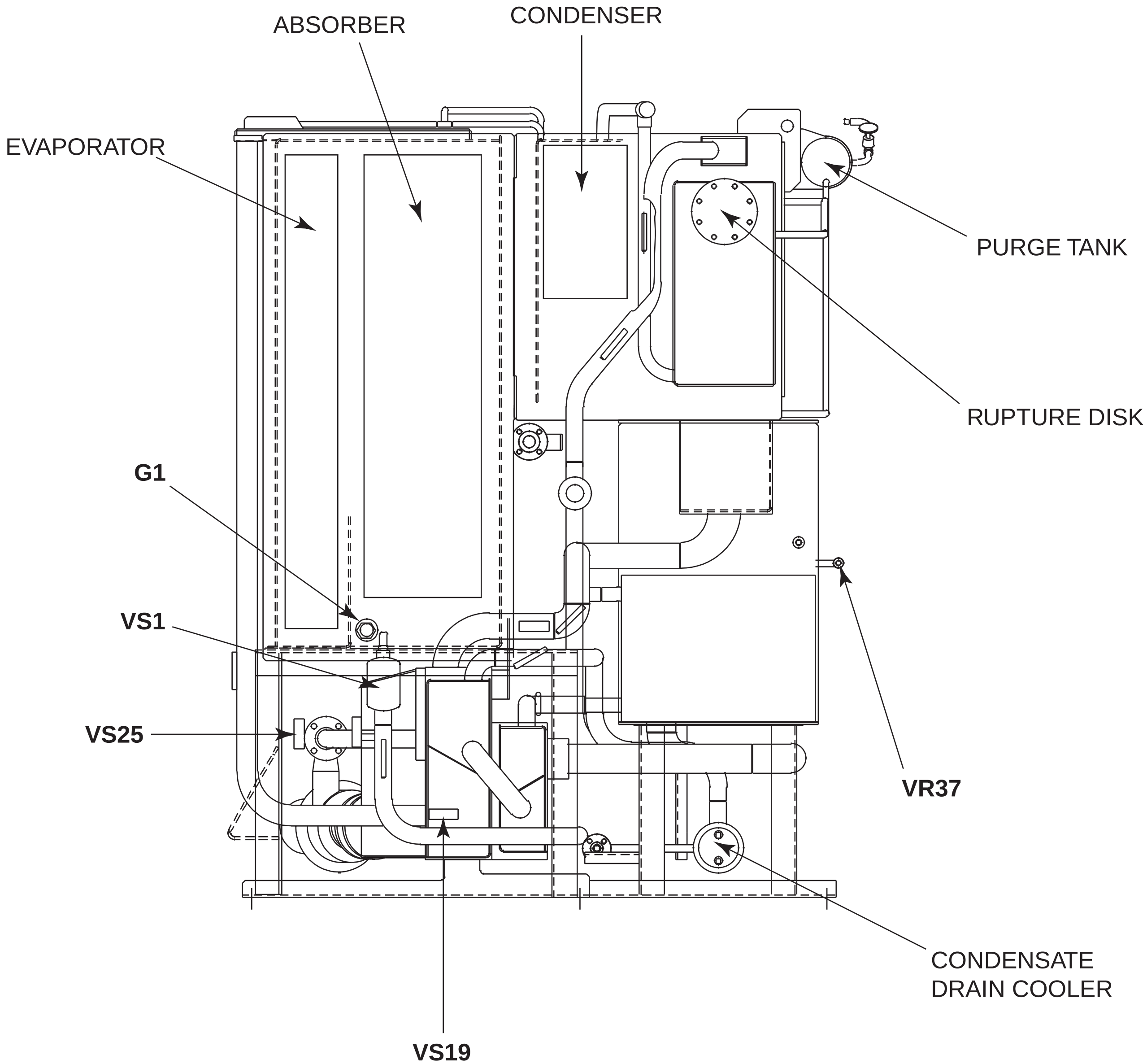


FIG. 58 (CONTINUED) – MODELS YPC-ST-16SL-19S VALVE LOCATION DIAGRAM

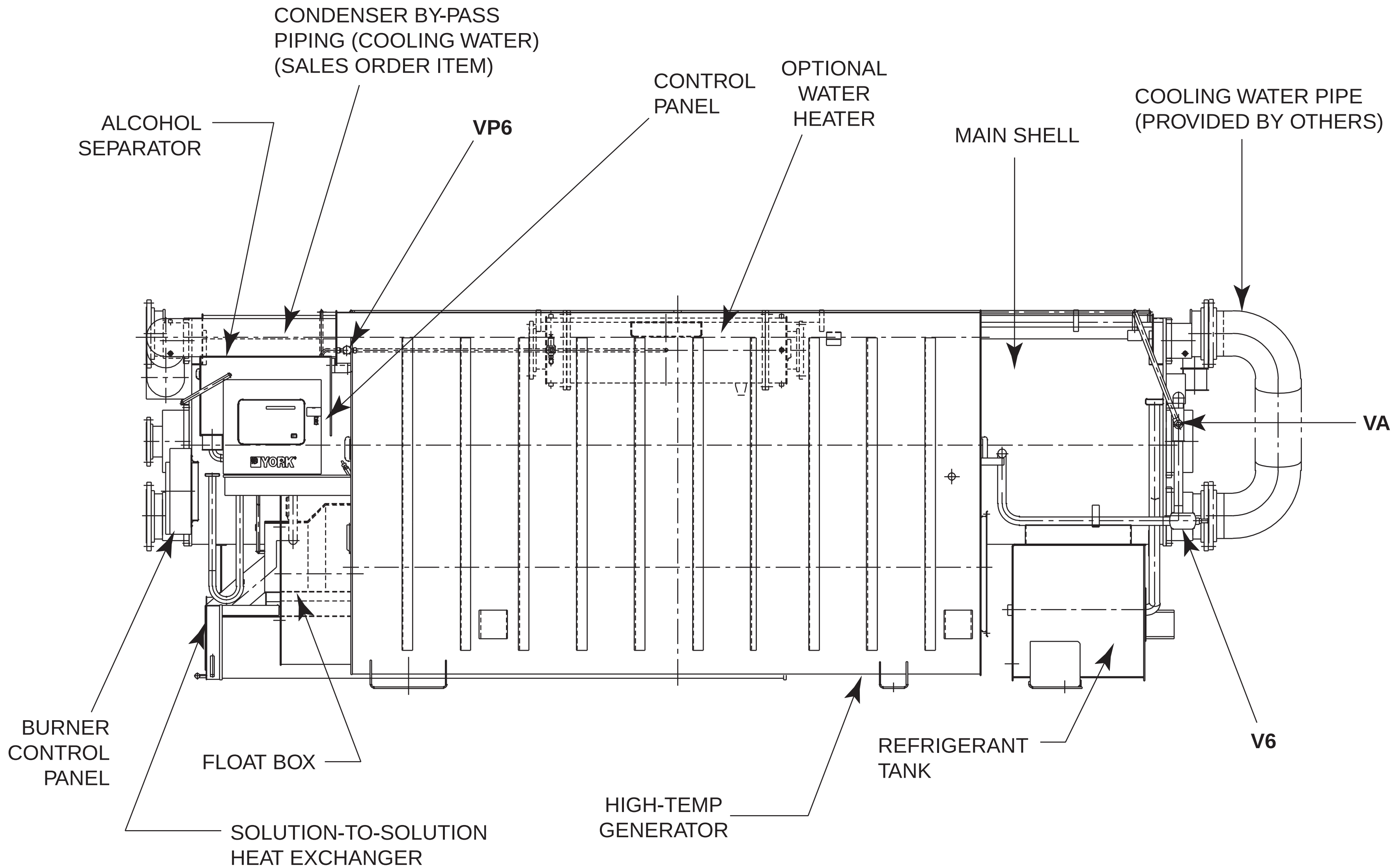


FIG. 59 – MODEL YPC-DF-19G VALVE LOCATION DIAGRAM

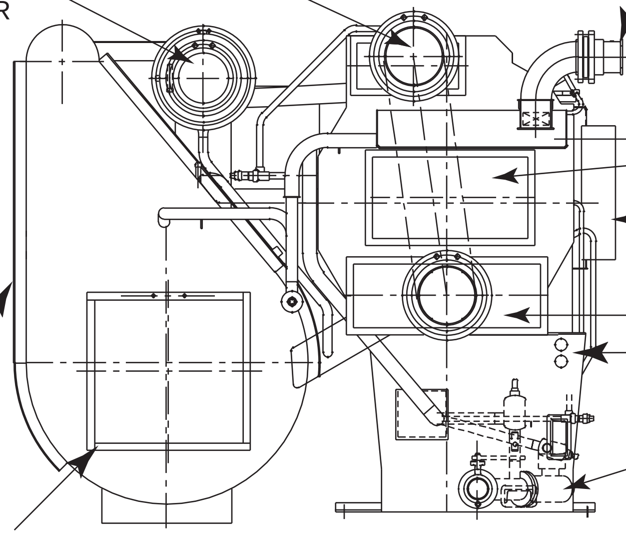


FIG. 59 (CONTINUED) – MODEL YPC-DF-19G VALVE LOCATION DIAGRAM

LD05033A

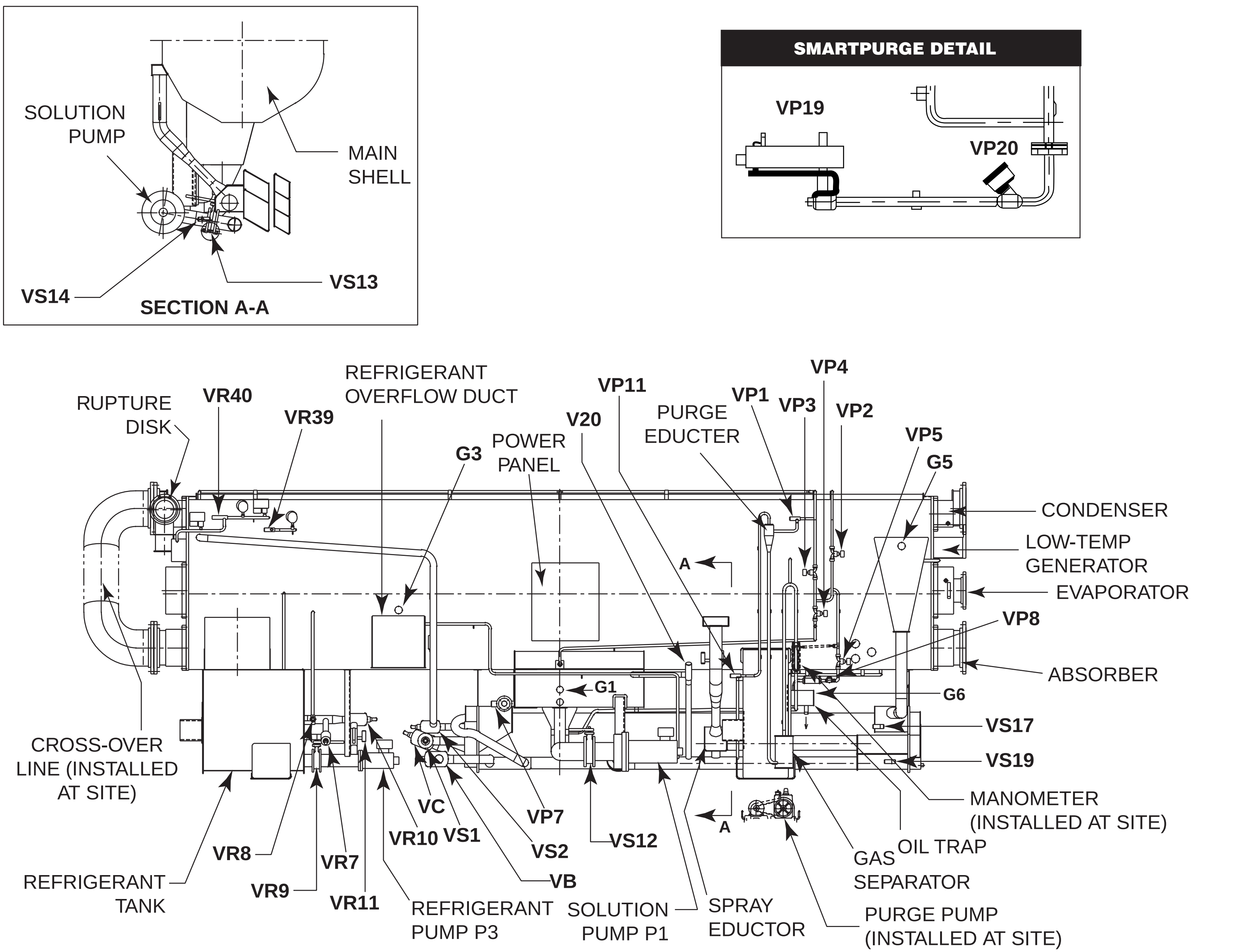


FIG. 60 – MODEL YPC-DF-19G VALVE LOCATION DIAGRAM

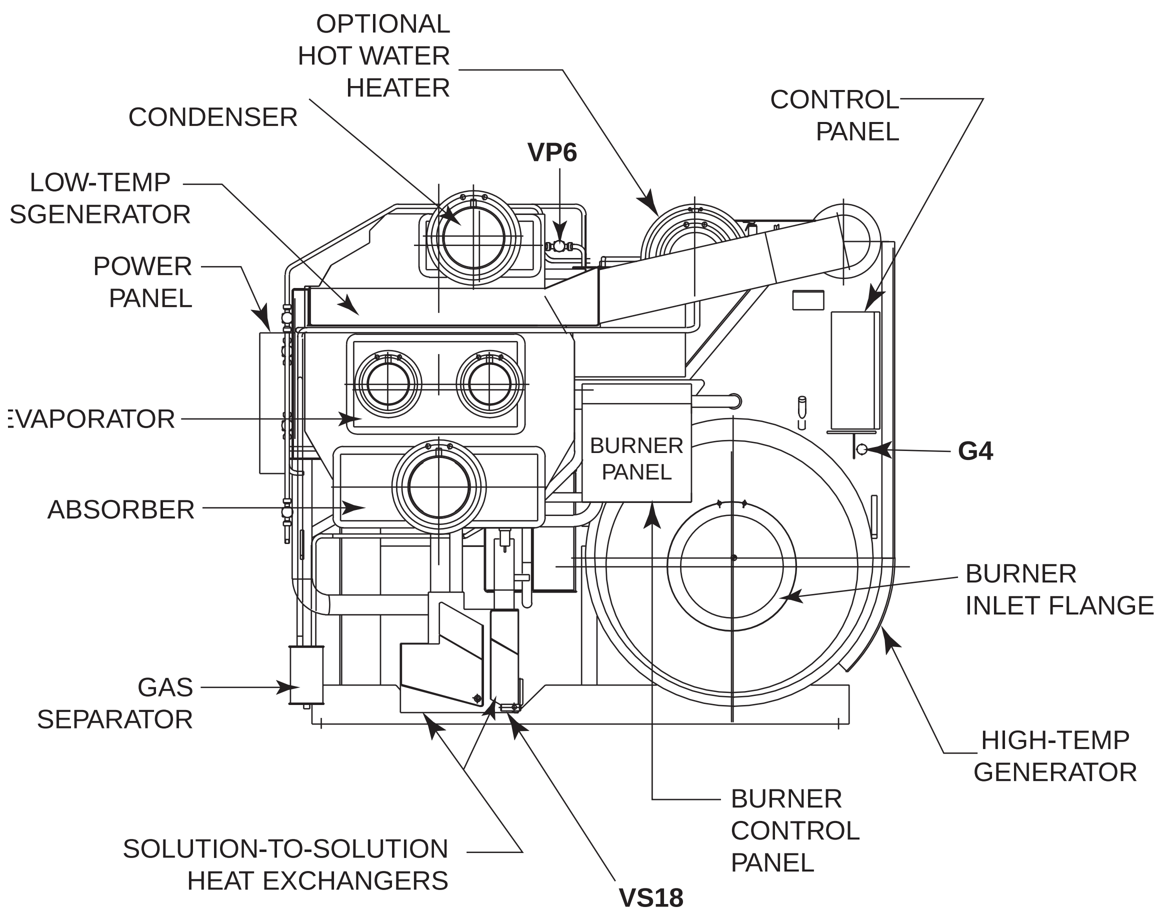


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FIG. 60 (CONTINUED) – MODEL YPC-DF-19G VALVE LOCATION DIAGRAM

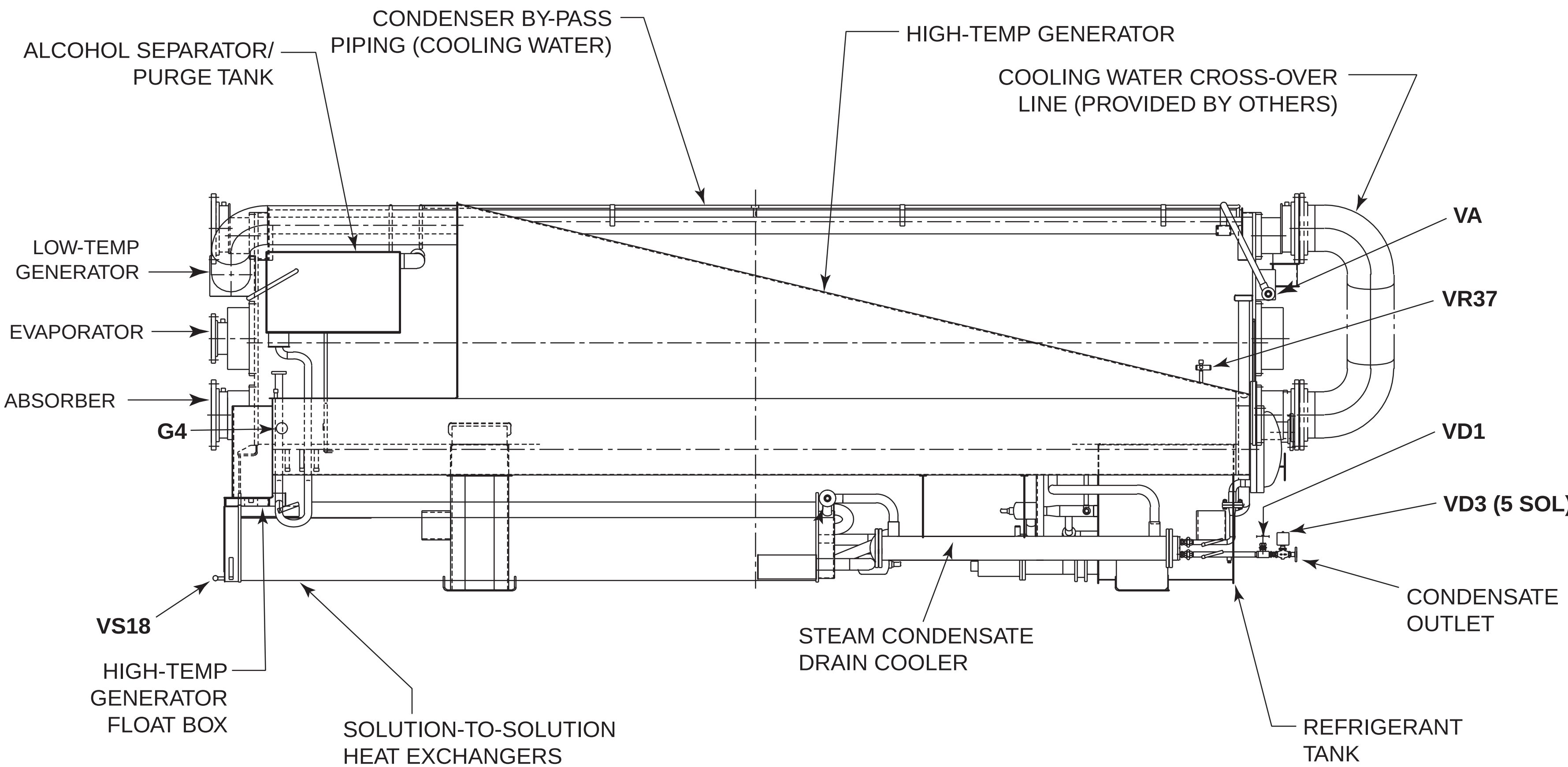
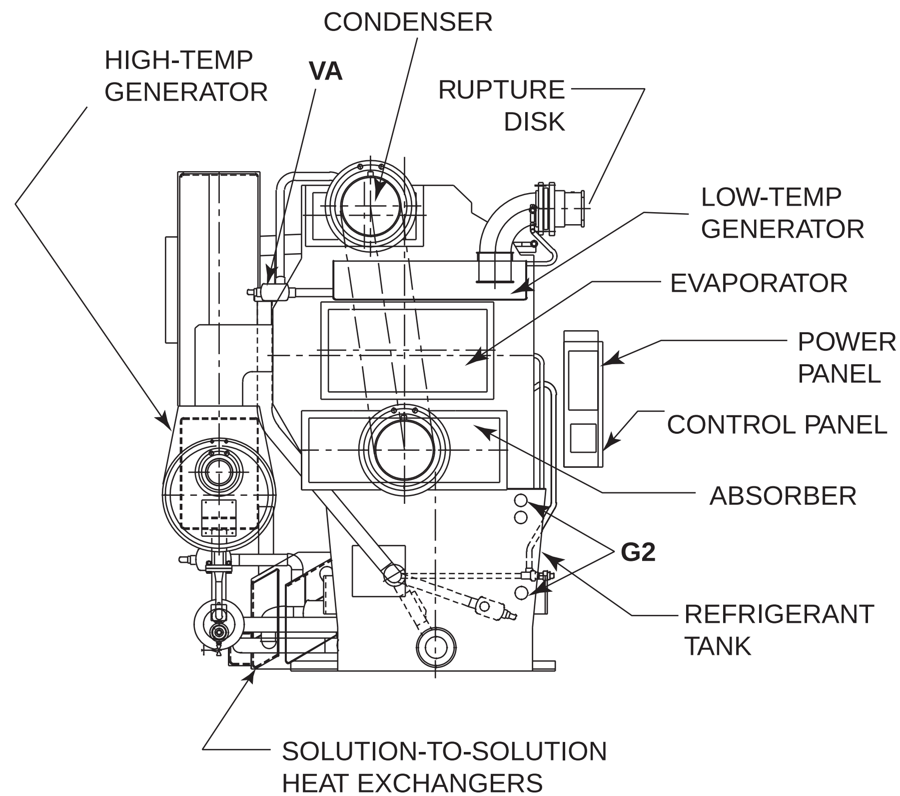


FIG. 61 – MODEL YPC-ST-19G VALVE LOCATION DIAGRAM

LD05035



LD05035A

FIG. 61 (CONTINUED) – MODEL YPC-ST-19G VALVE LOCATION DIAGRAM

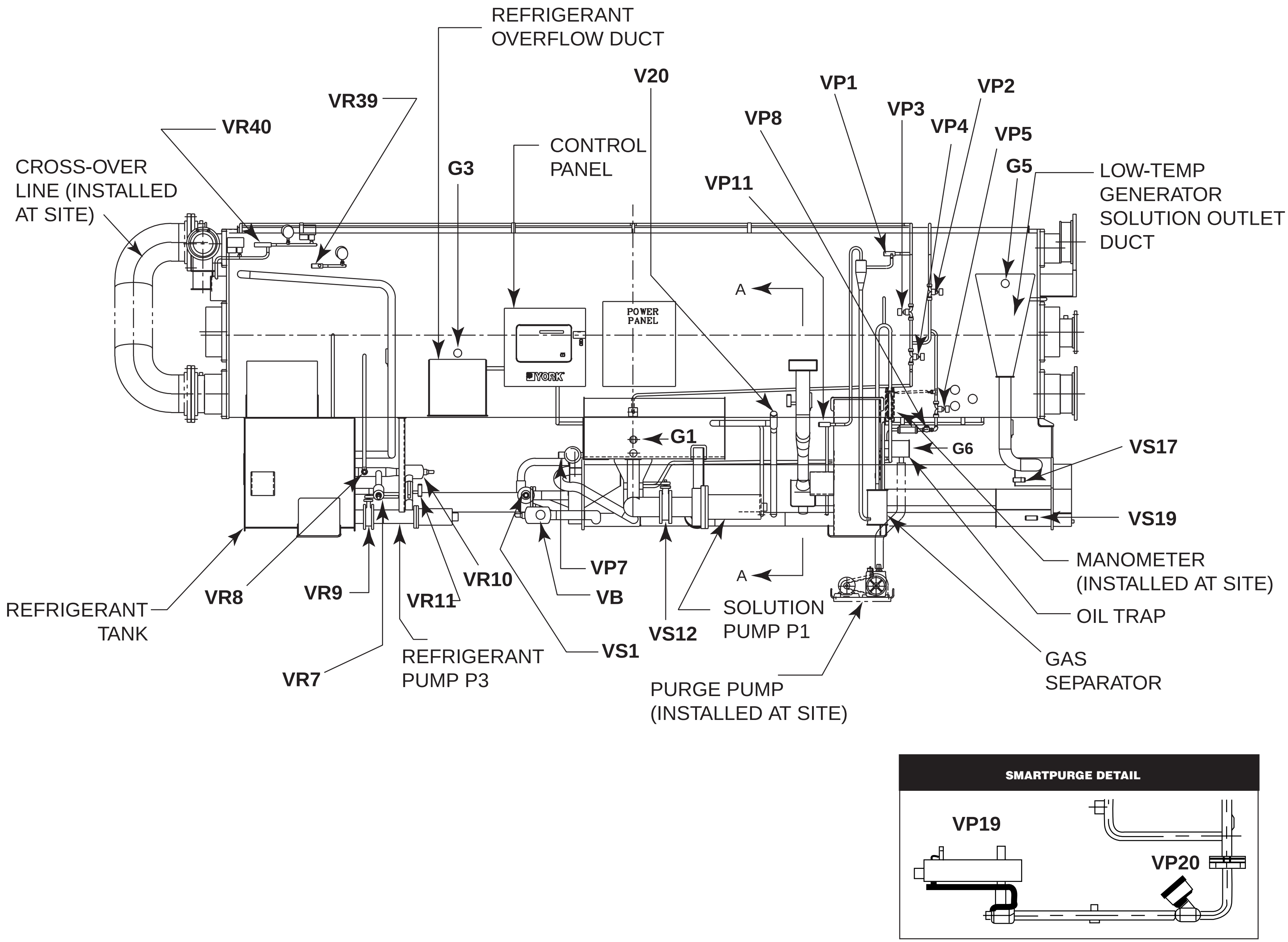
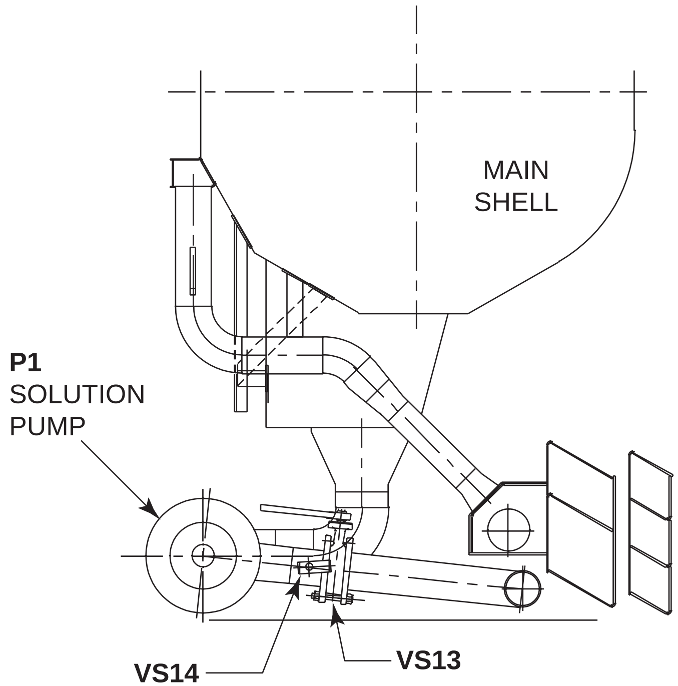


FIG. 62 – MODEL YPC-ST-19G VALVE LOCATION DIAGRAM



SECTION A-A (FROM PAGE 104)

FIG. 62 (CONTINUED) – MODEL YPC-ST-19G VALVE LOCATION DIAGRAM

LD05036A

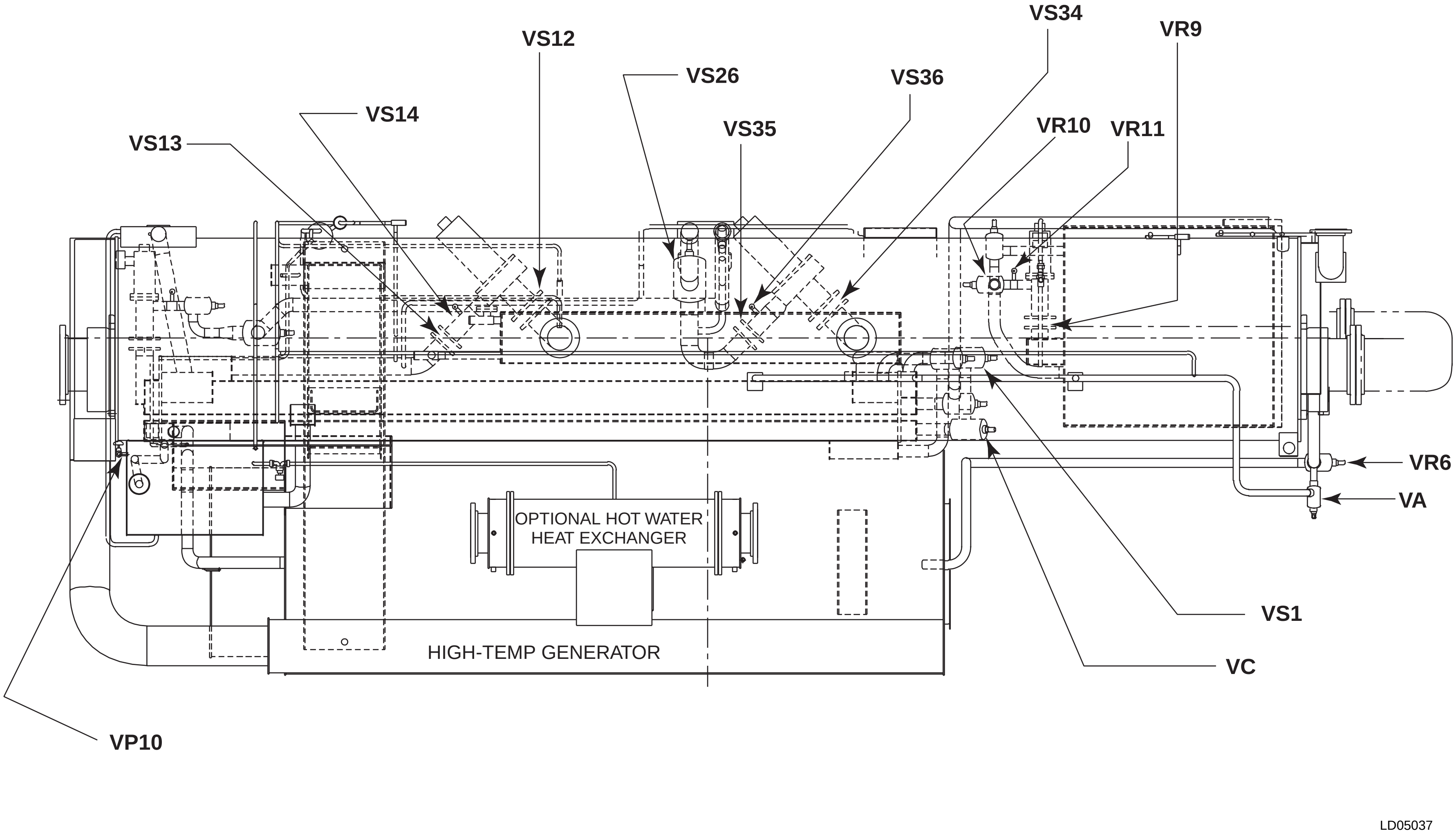


FIG. 63 – MODEL YPC-DF-19GL VALVE LOCATION DIAGRAM

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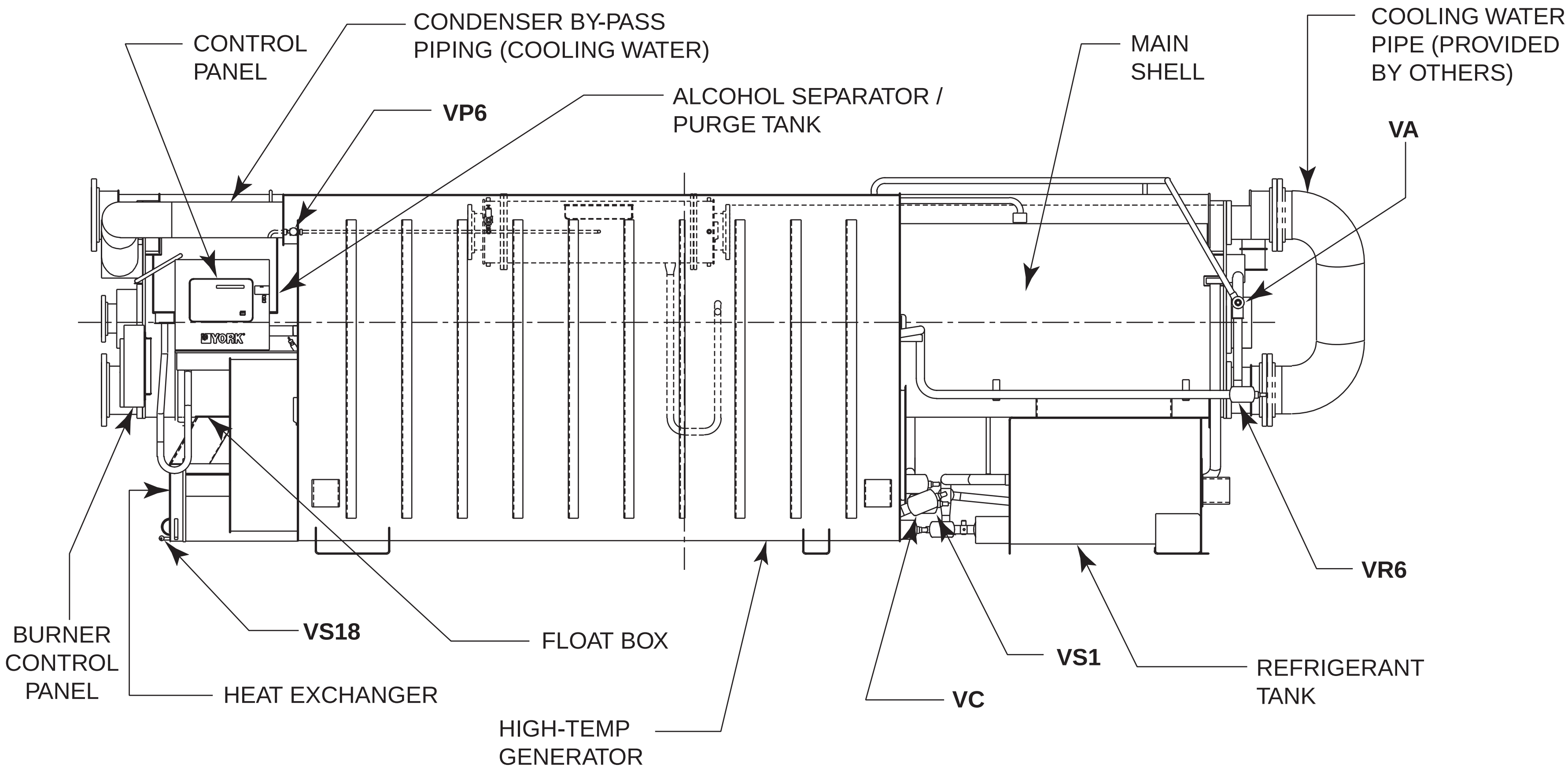

FIG. 64 – MODEL YPC-DF-19GL VALVE LOCATION DIAGRAM

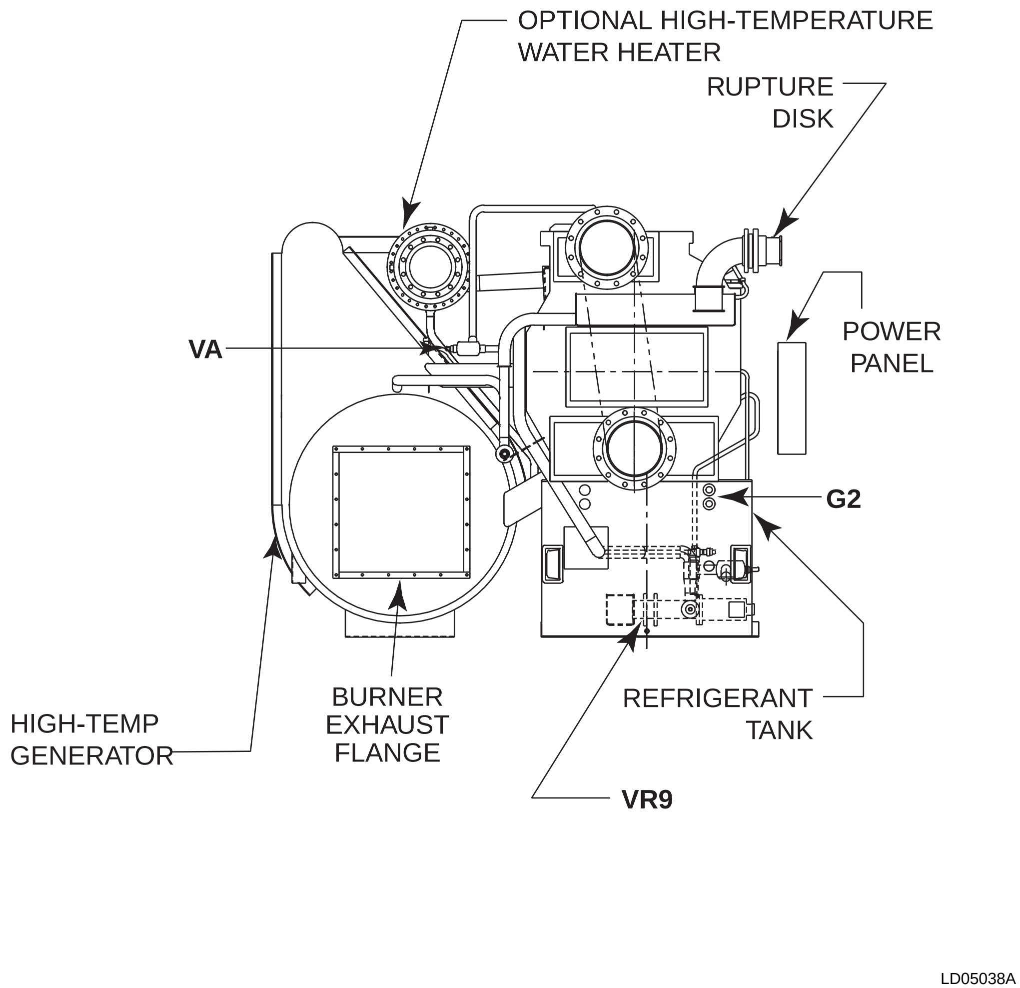

FIG. 64 (CONTINUED) – MODEL YPC-DF-19GL VALVE LOCATION DIAGRAM

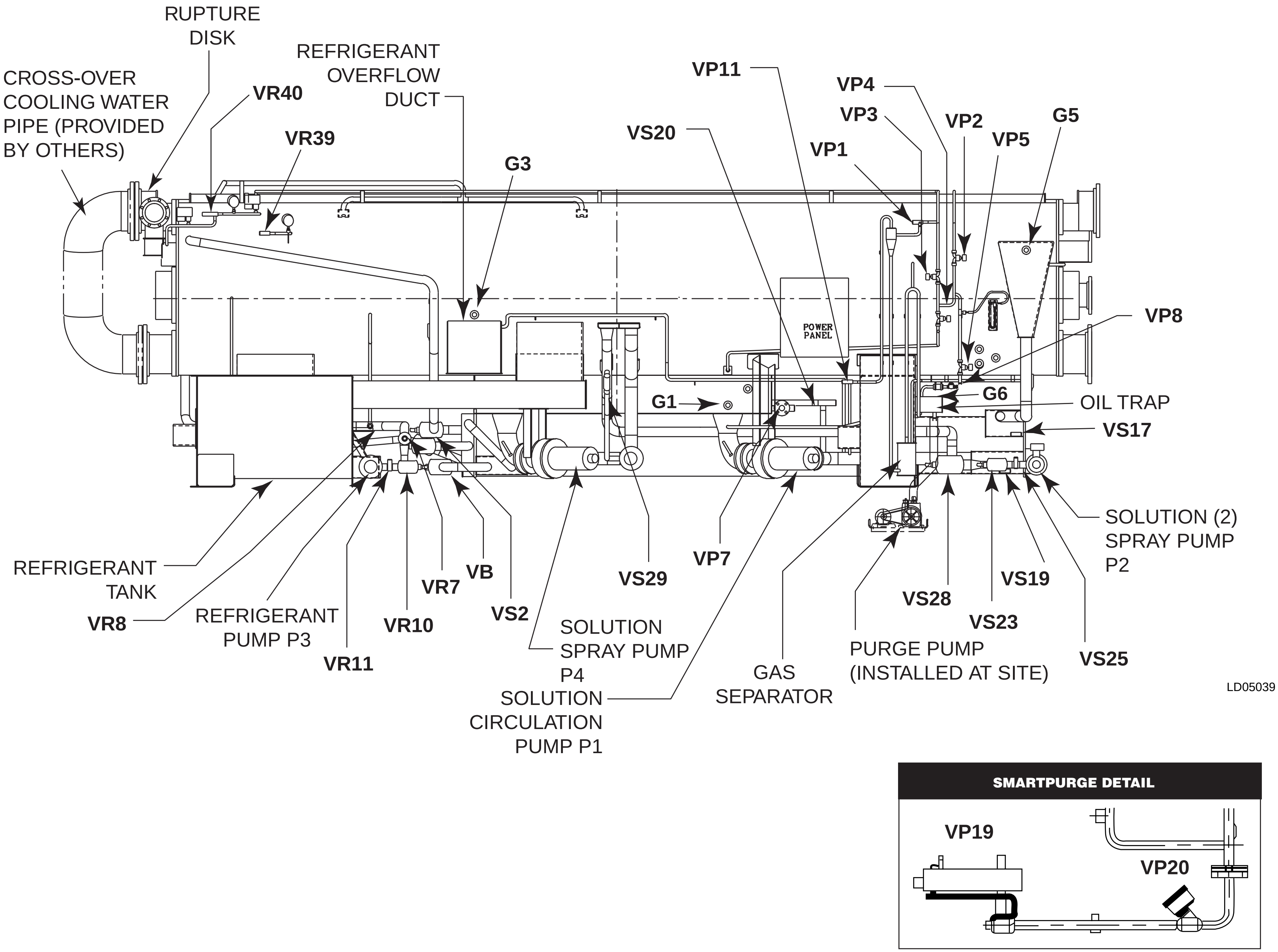

FIG. 65 – MODEL YPC-DF-19GL VALVE LOCATION DIAGRAM

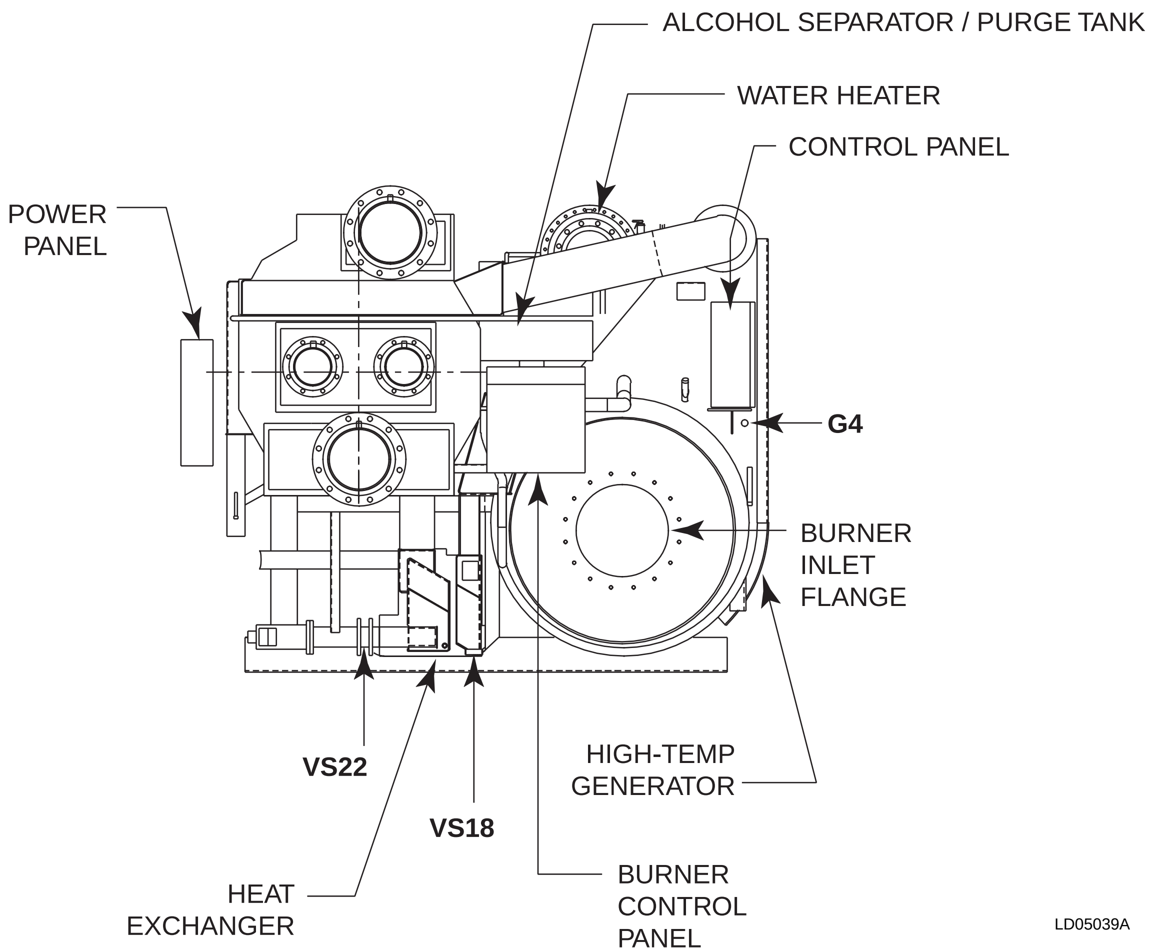

FIG. 65 (CONTINUED) – MODEL YPC-DF-19GL VALVE LOCATION DIAGRAM

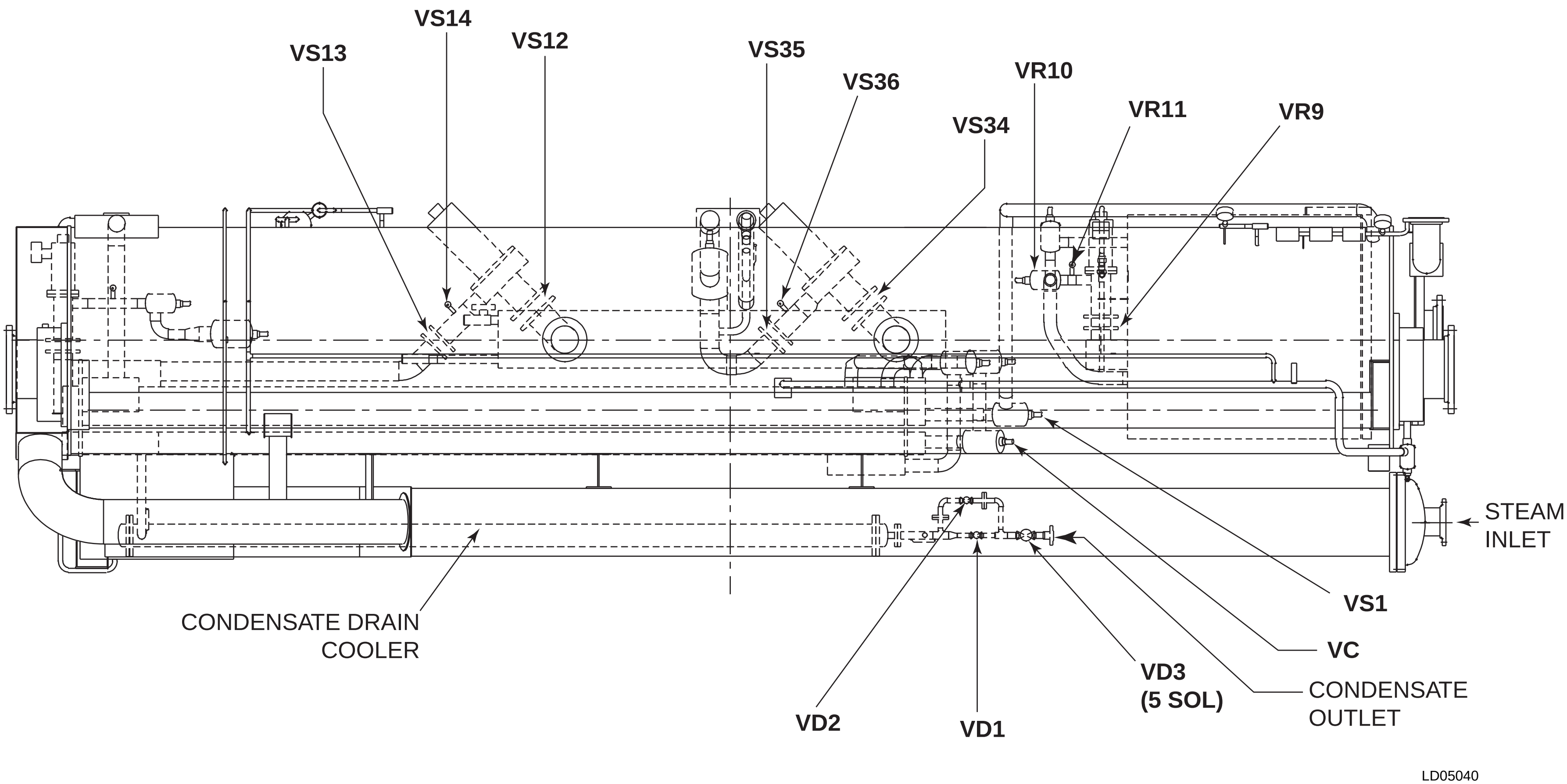

FIG. 66 – MODEL YPC-ST-19GL VALVE LOCATION DIAGRAM

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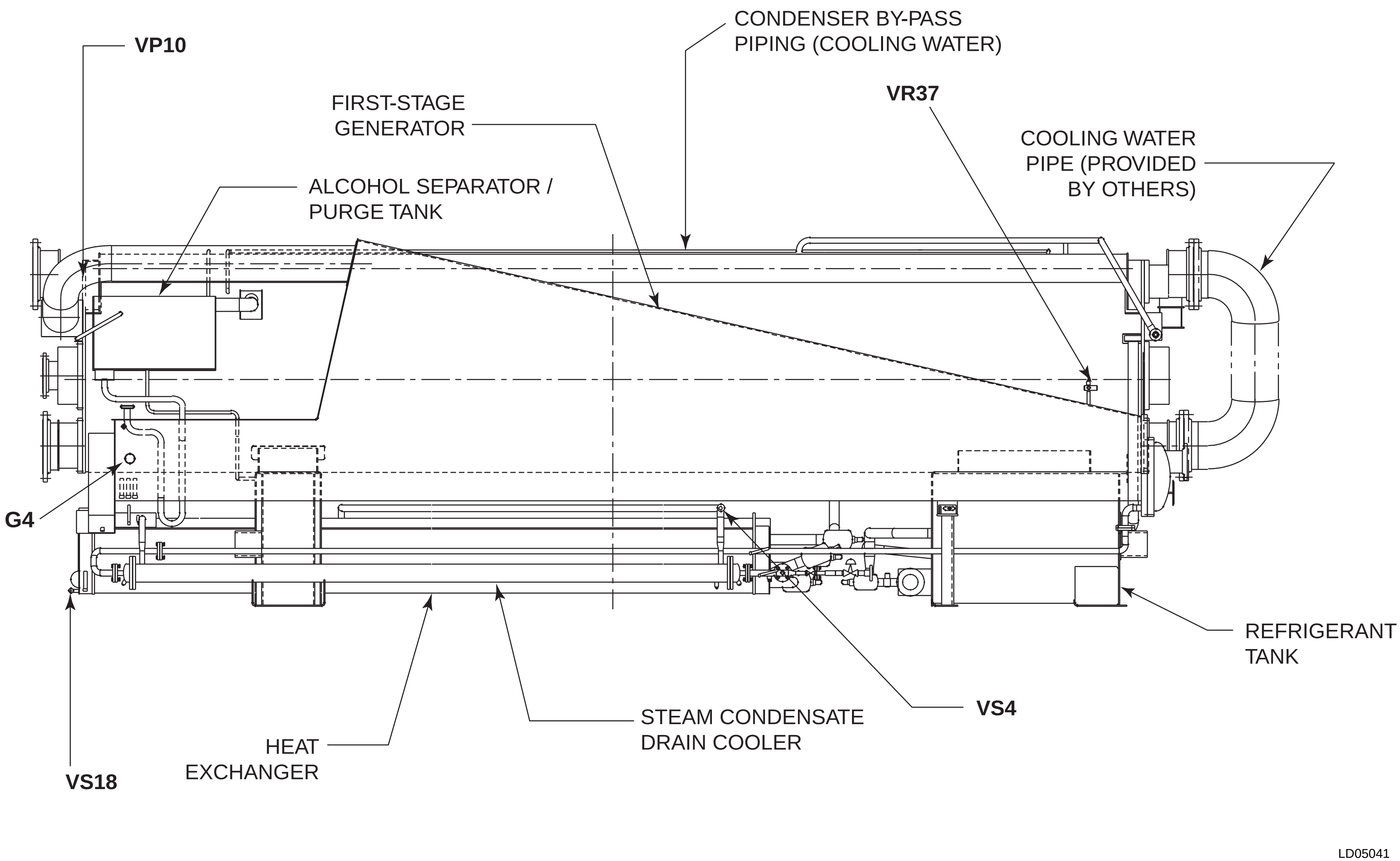

FIG. 67 – MODEL YPC-ST-19GL VALVE LOCATION DIAGRAM

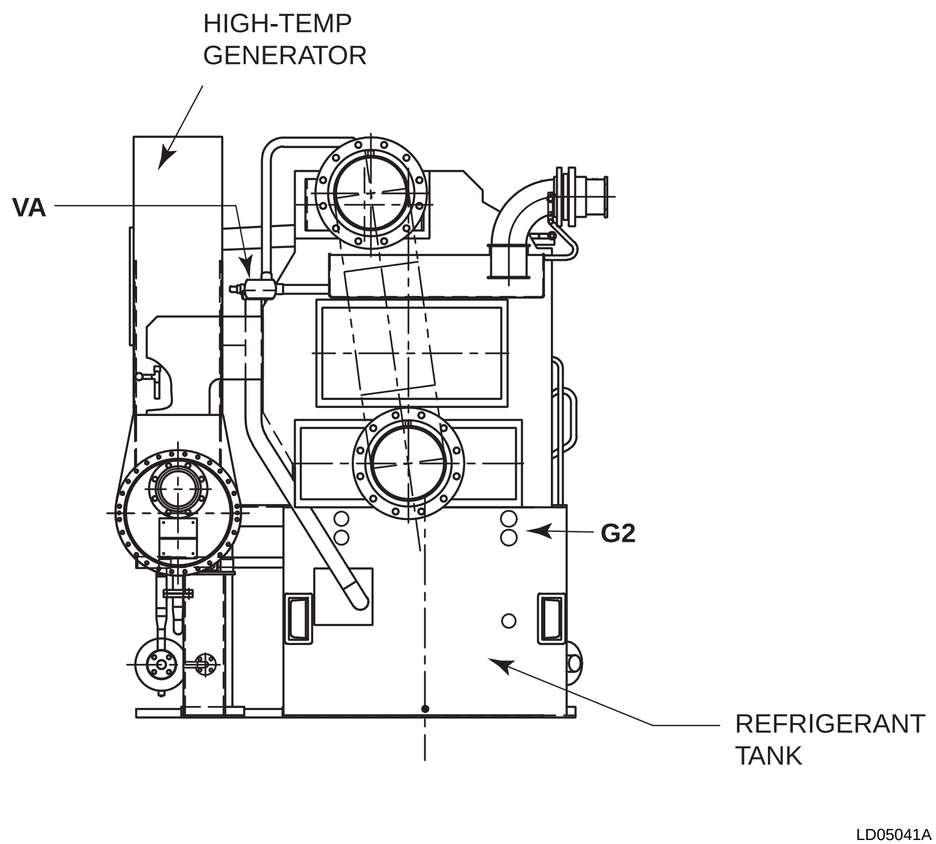

FIG. 67 (CONTINUED) – MODEL YPC-ST-19GL VALVE LOCATION DIAGRAM

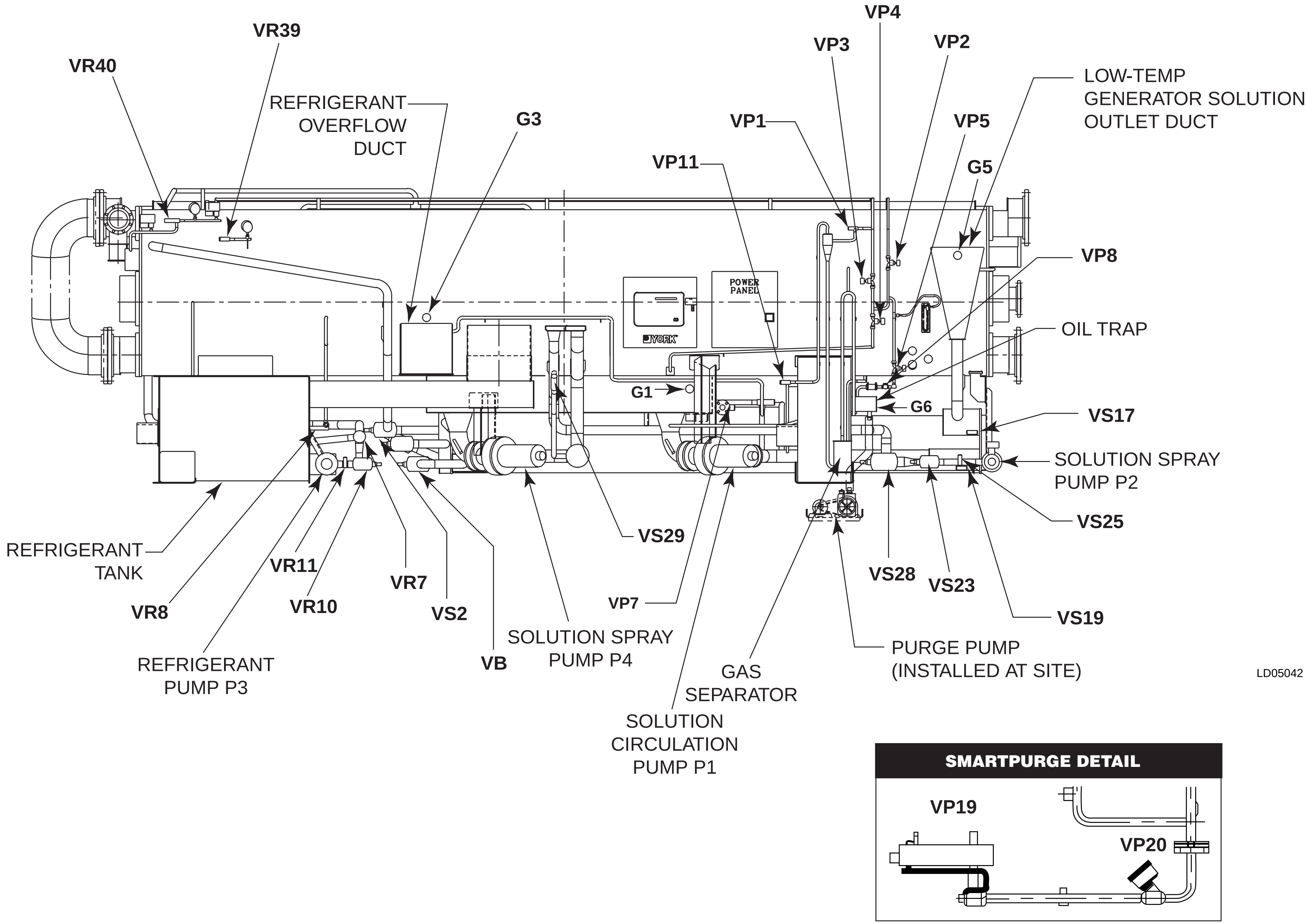

FIG. 68 – MODEL YPC-ST-19GL VALVE LOCATION DIAGRAM

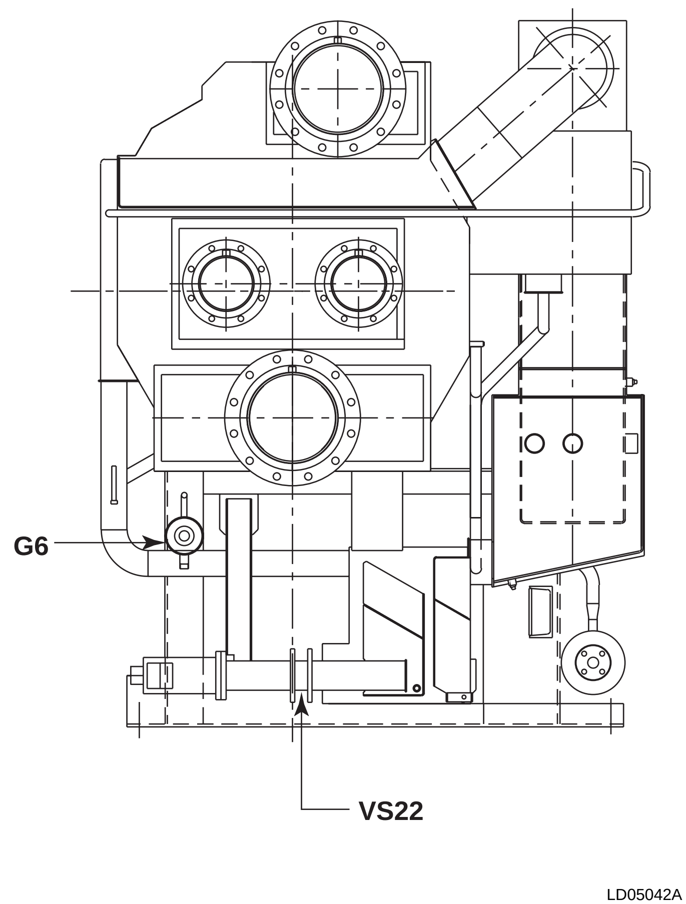

FIG. 68 (CONTINUED) – MODEL YPC-ST-19GL VALVE LOCATION DIAGRAM

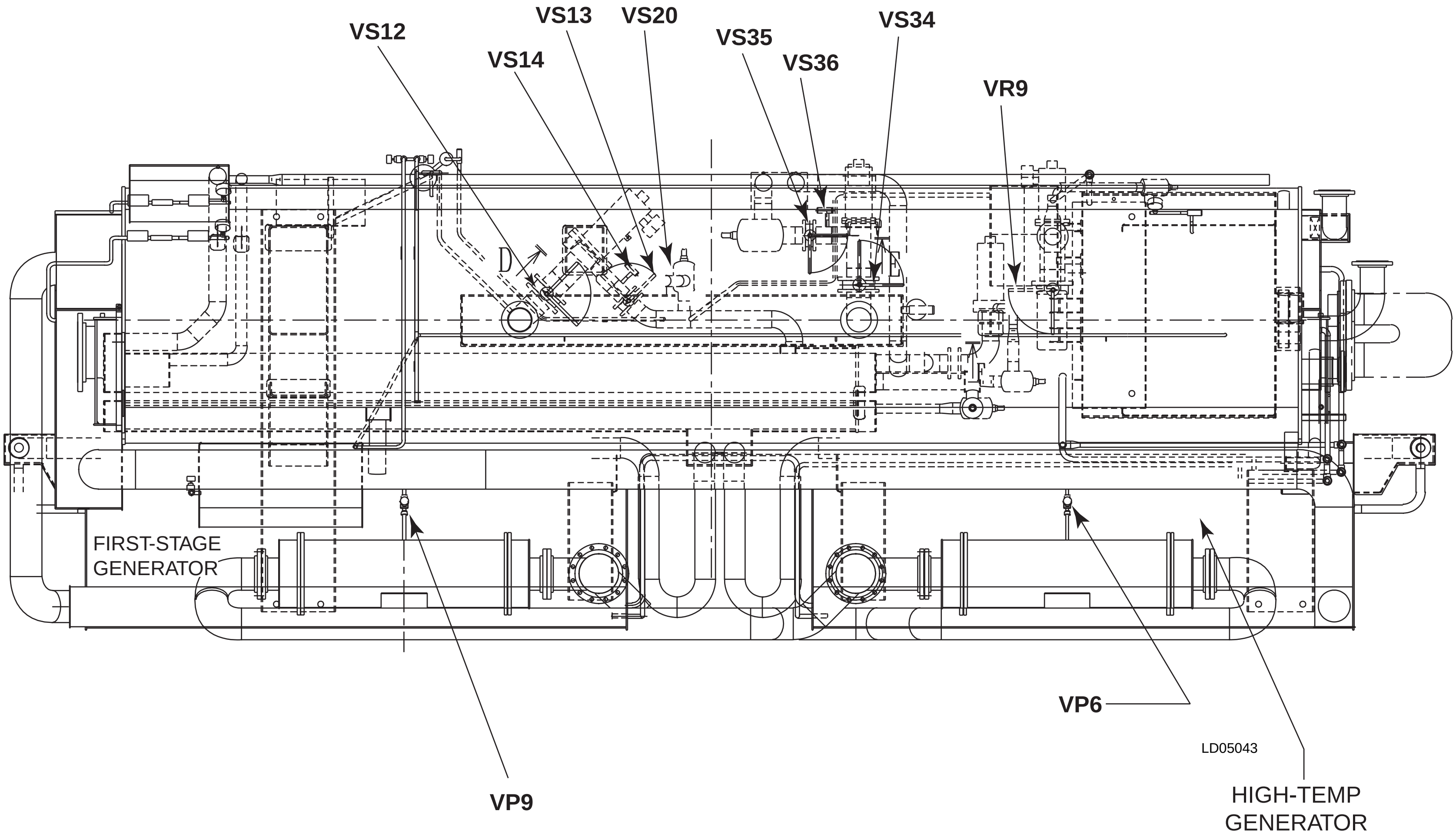

FIG. 69 – MODEL YPC-DF-20G VALVE LOCATION DIAGRAM

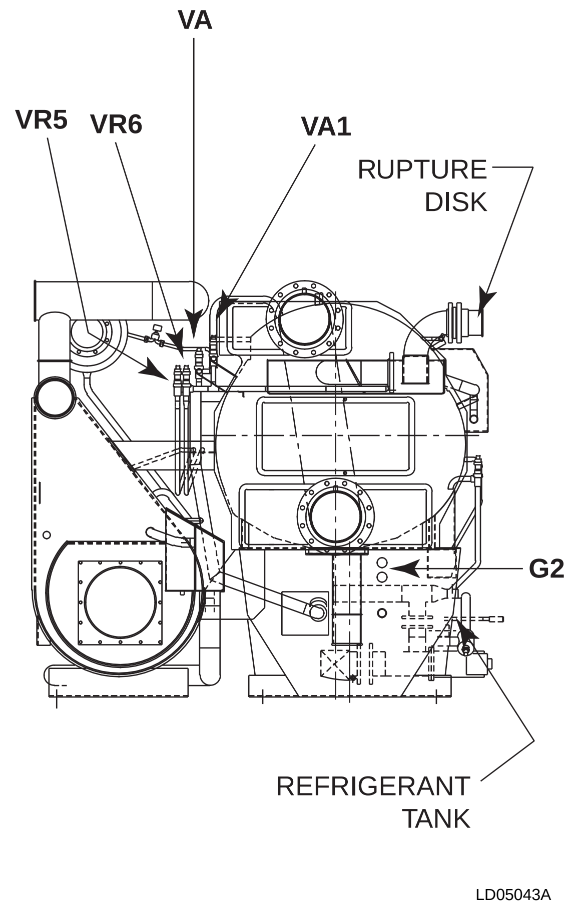

FIG. 69 (CONTINUED) – MODEL YPC-DF-20G VALVE LOCATION DIAGRAM

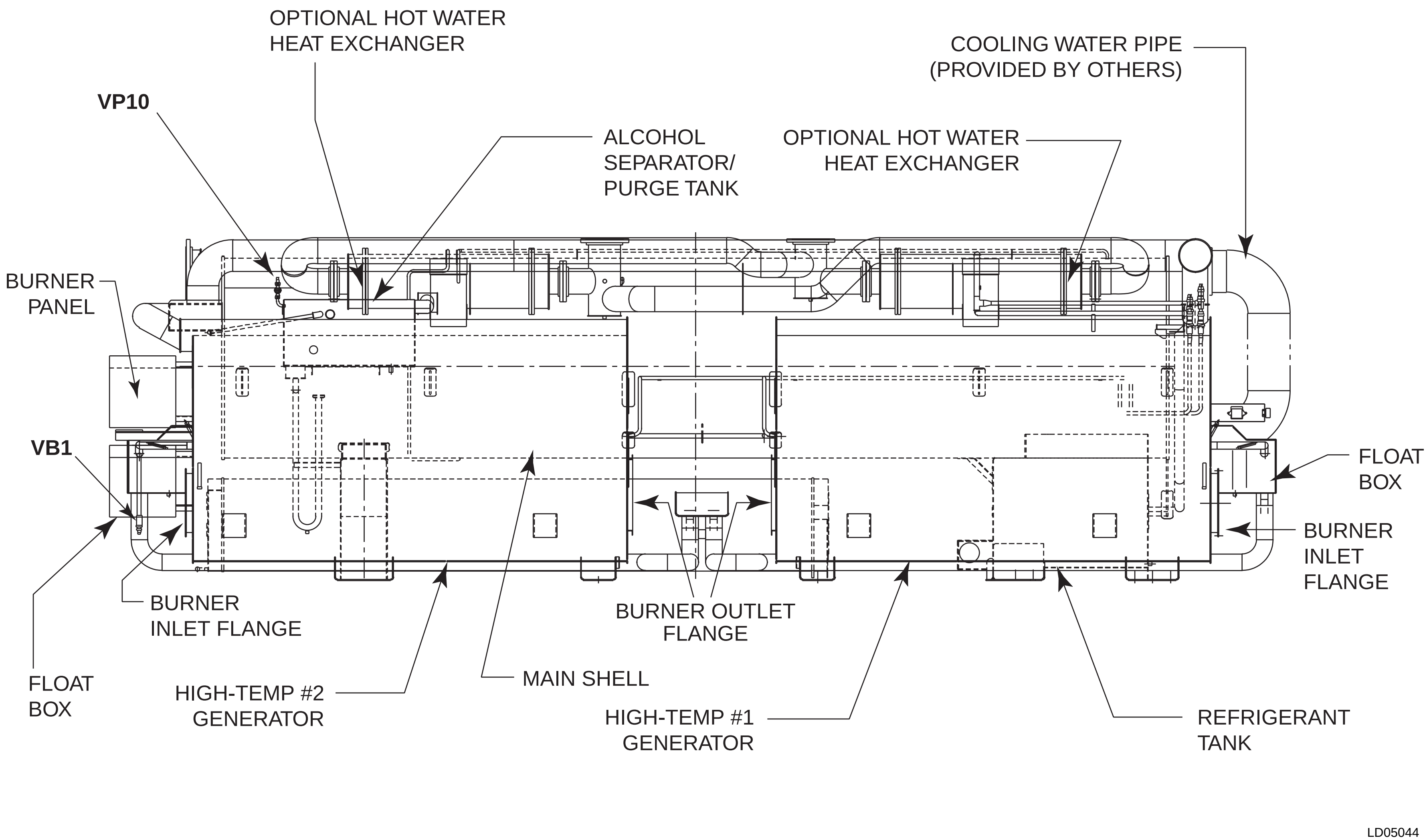

FIG. 70 – MODEL YPC-DF-20G VALVE LOCATION DIAGRAM

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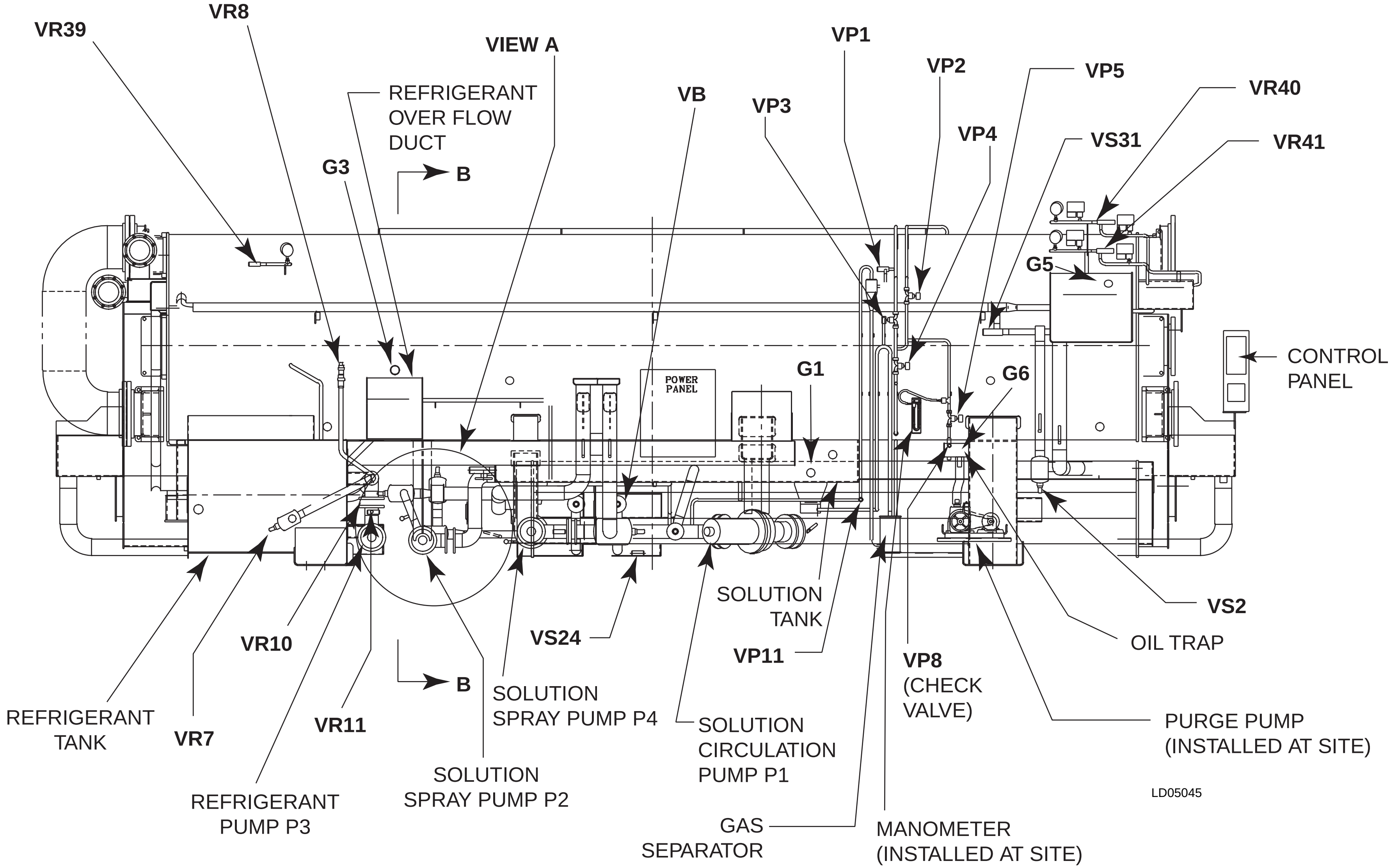


FIG. 71 – MODEL YPC-DF-20G VALVE LOCATION DIAGRAM

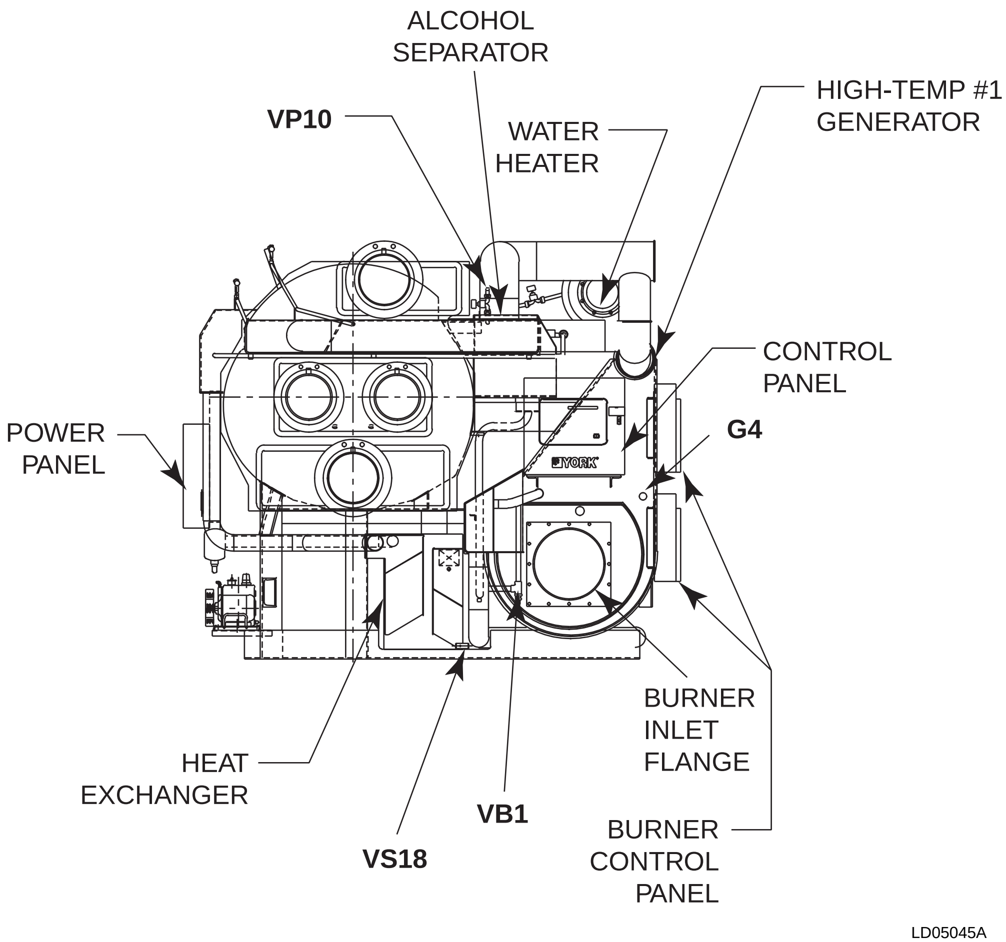


FIG. 71 (CONTINUED) – MODEL YPC-DF-20G VALVE LOCATION DIAGRAM

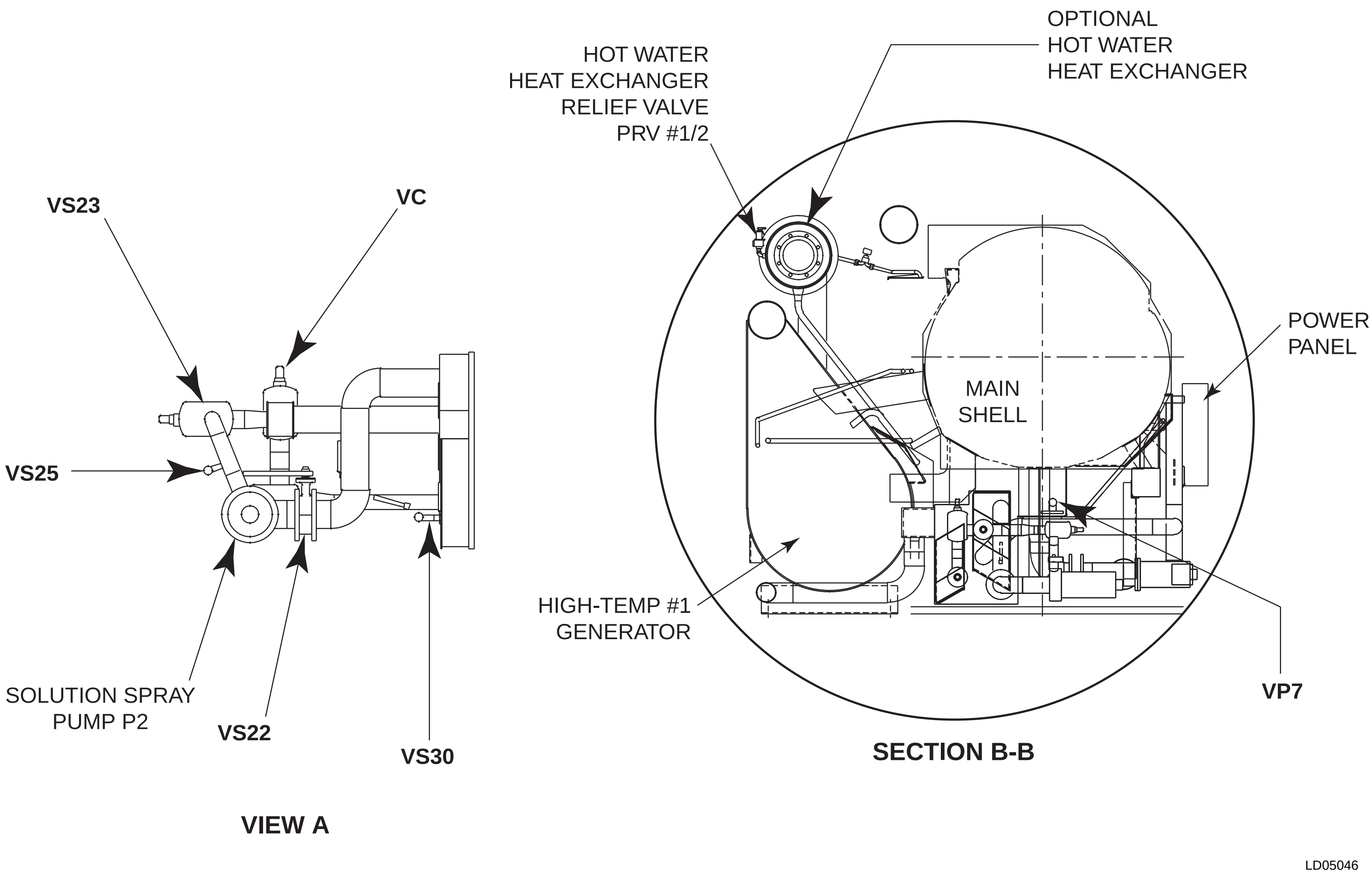


FIG. 72 – MODEL YPC-DF-20G VALVE LOCATION DIAGRAM

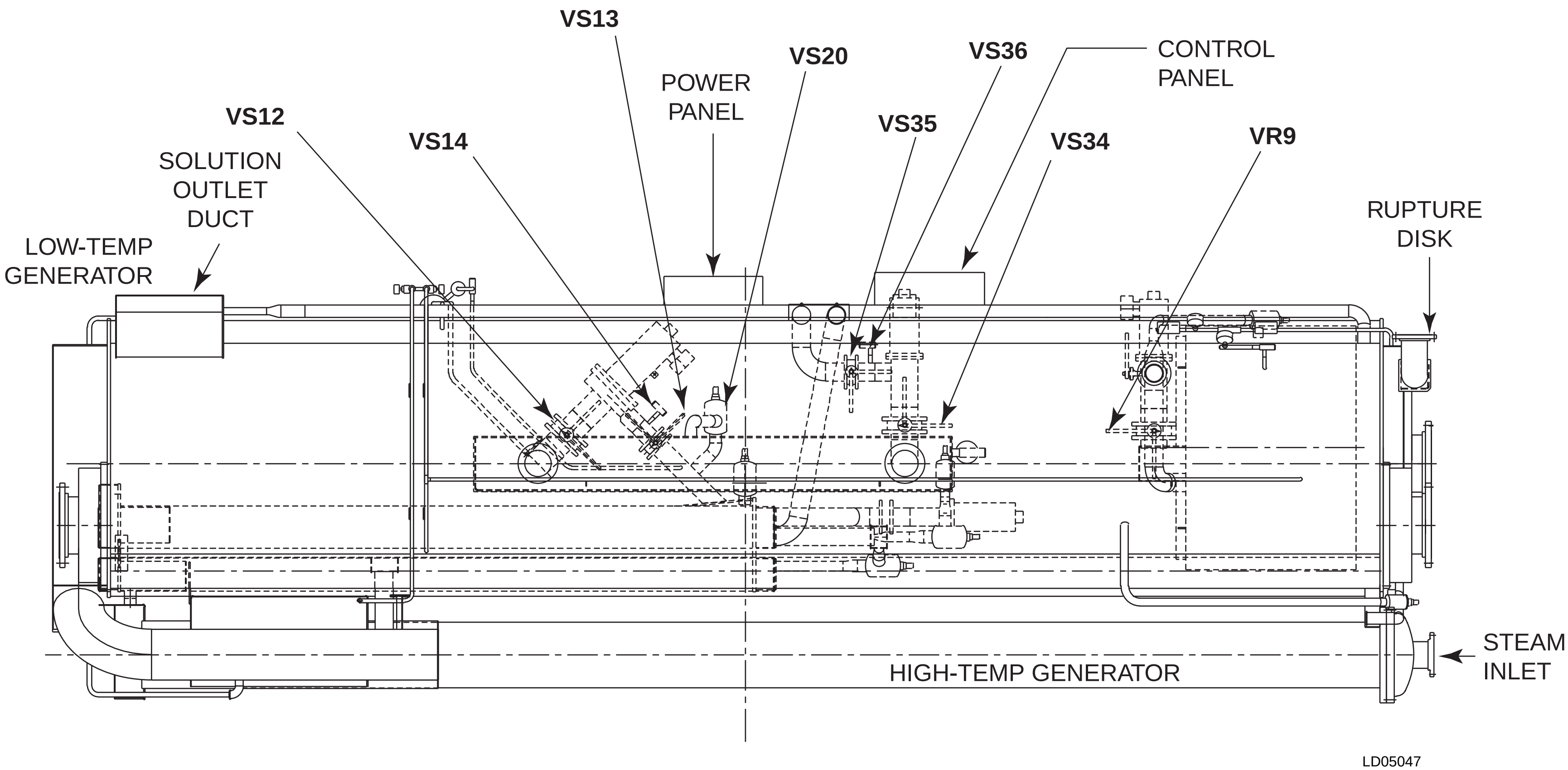


FIG. 73 – MODEL YPC-ST-20G VALVE LOCATION DIAGRAM

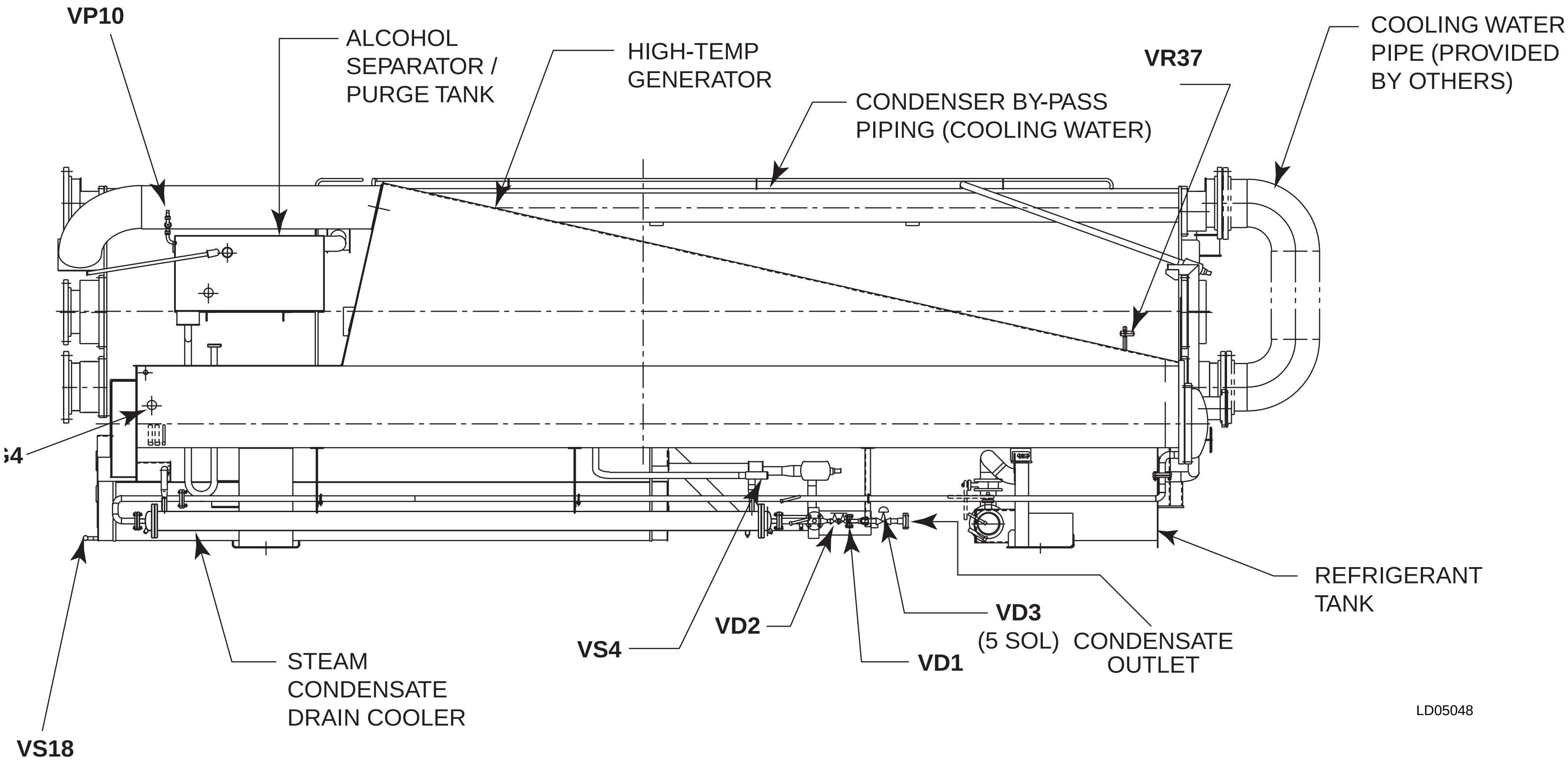


FIG. 74 – MODEL YPC-ST-20G VALVE LOCATION DIAGRAM

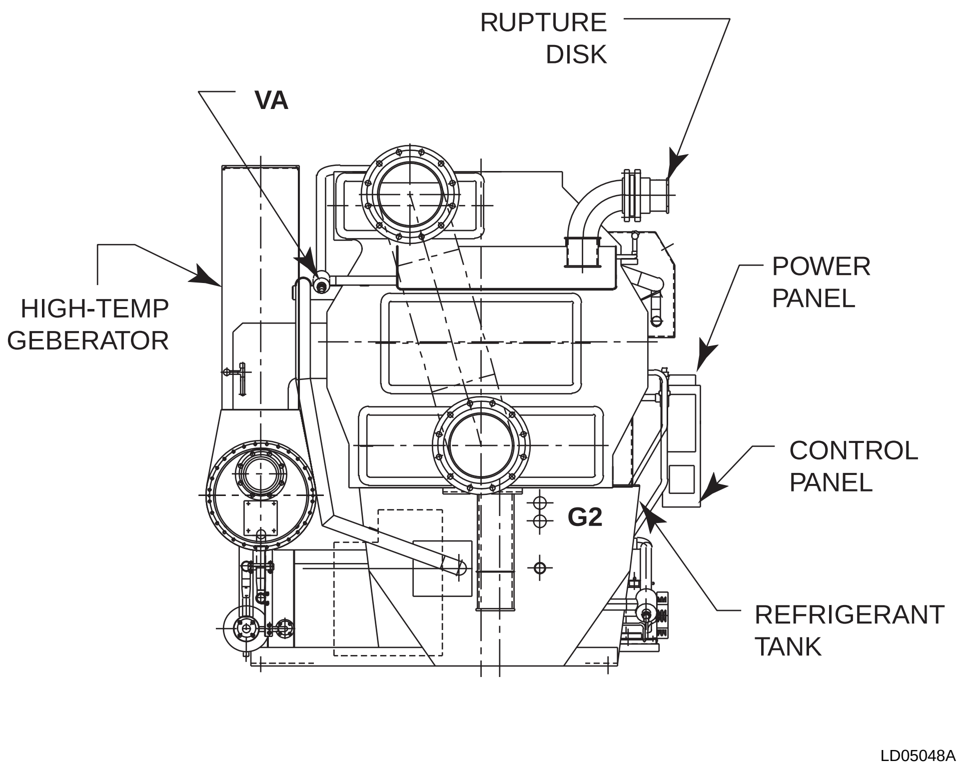


FIG. 74 (CONTINUED) – MODEL YPC-ST-20G VALVE LOCATION DIAGRAM

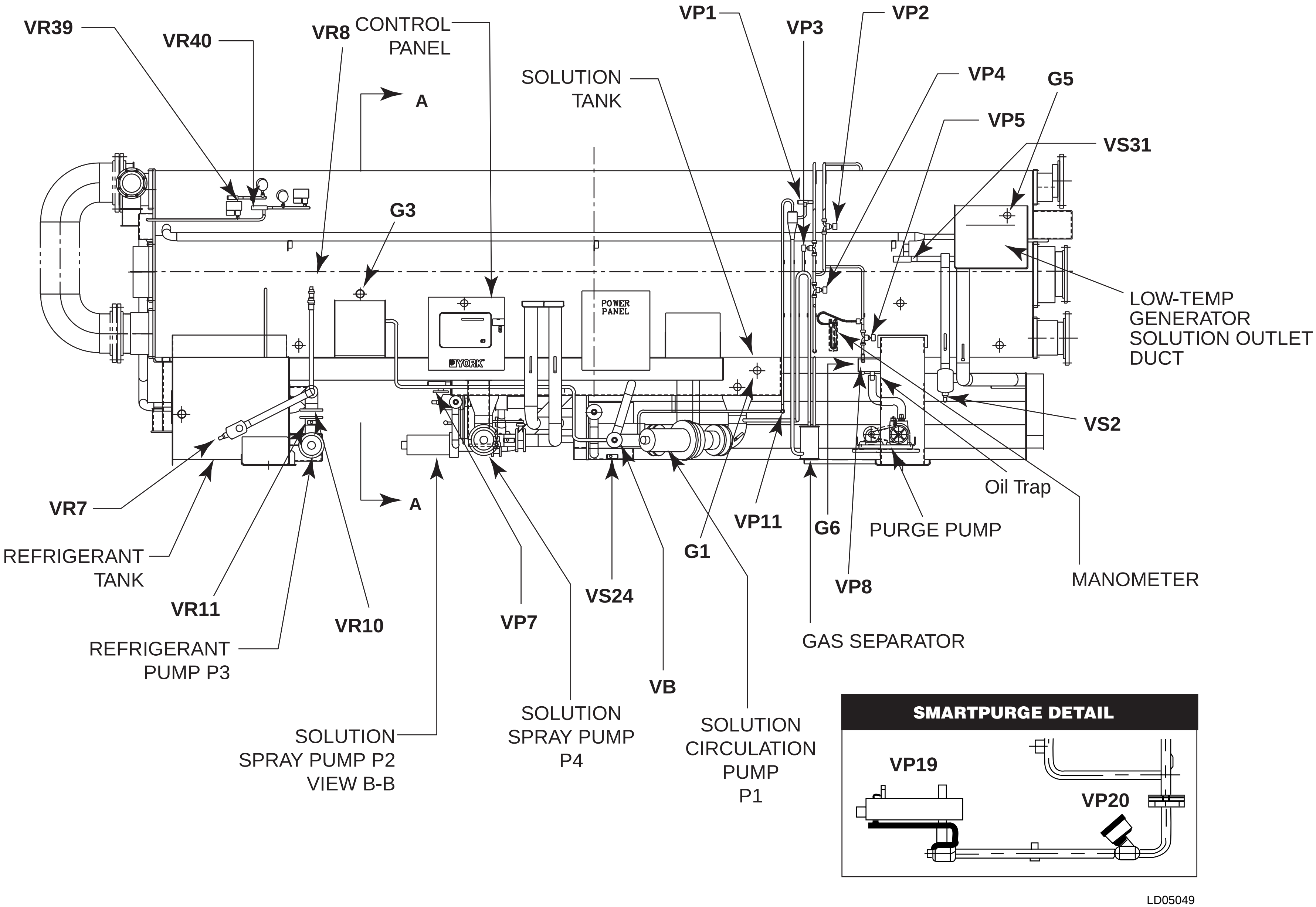


FIG. 75 – MODEL YPC-ST-20G VALVE LOCATION DIAGRAM

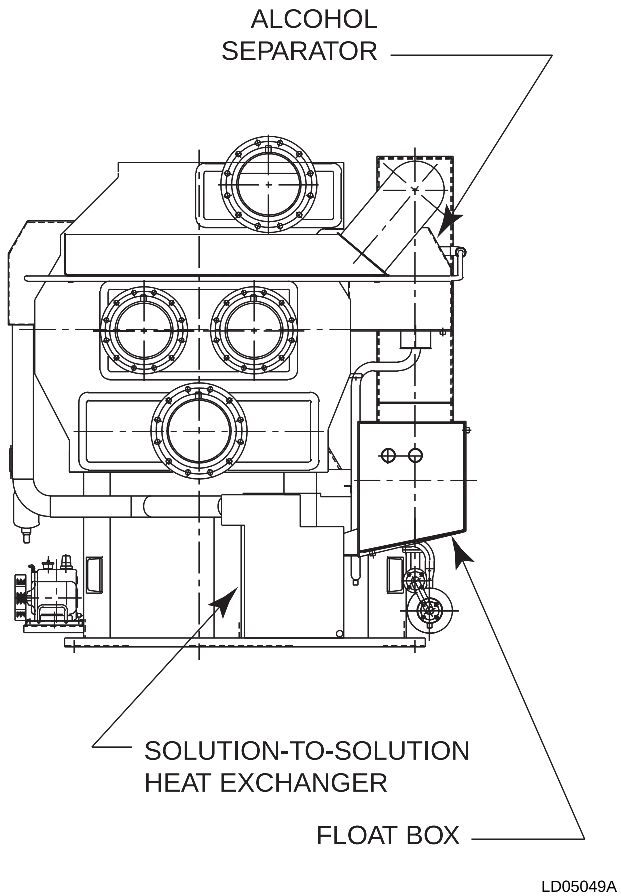
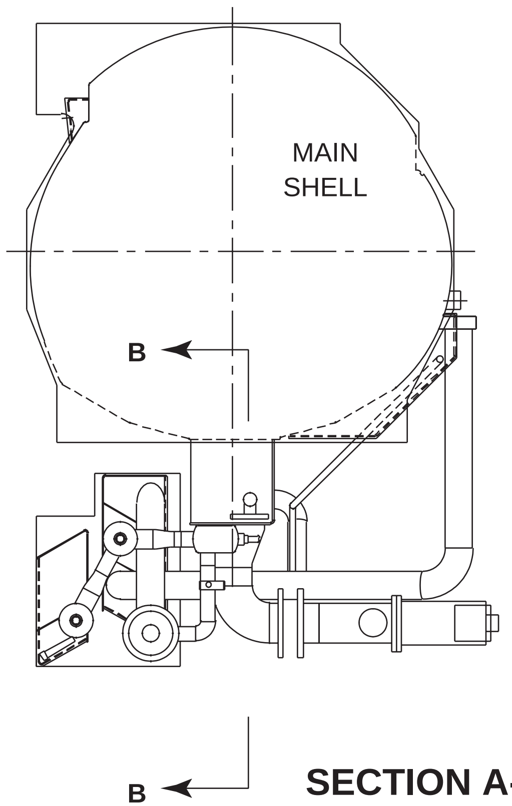
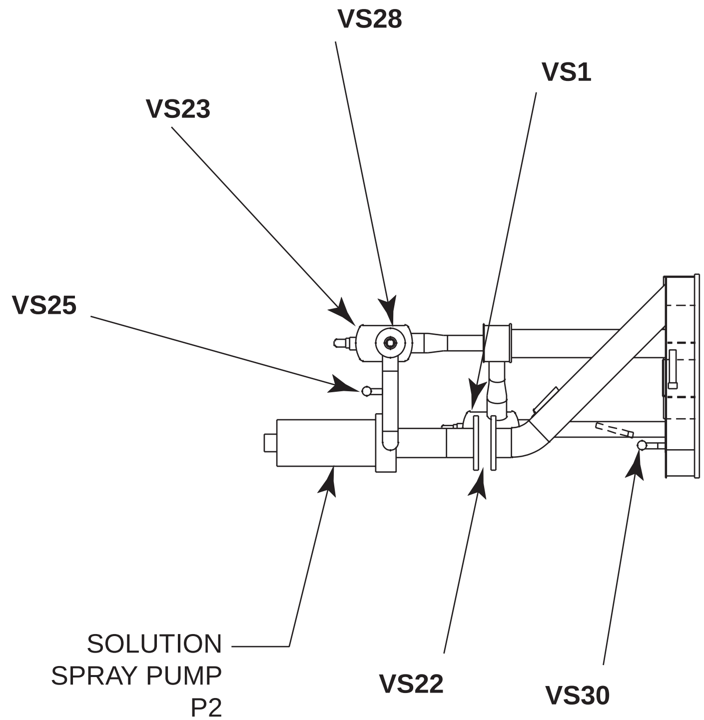


FIG. 75 (CONTINUED) – MODEL YPC-ST-20G VALVE LOCATION DIAGRAM



SECTION A-A
(FROM PAGE 128)



VIEW B-B
(FROM PAGE 128 AND SECTION A-A)

LD05050

FIG. 76 – MODEL YPC-ST-20G VALVE LOCATION DIAGRAM

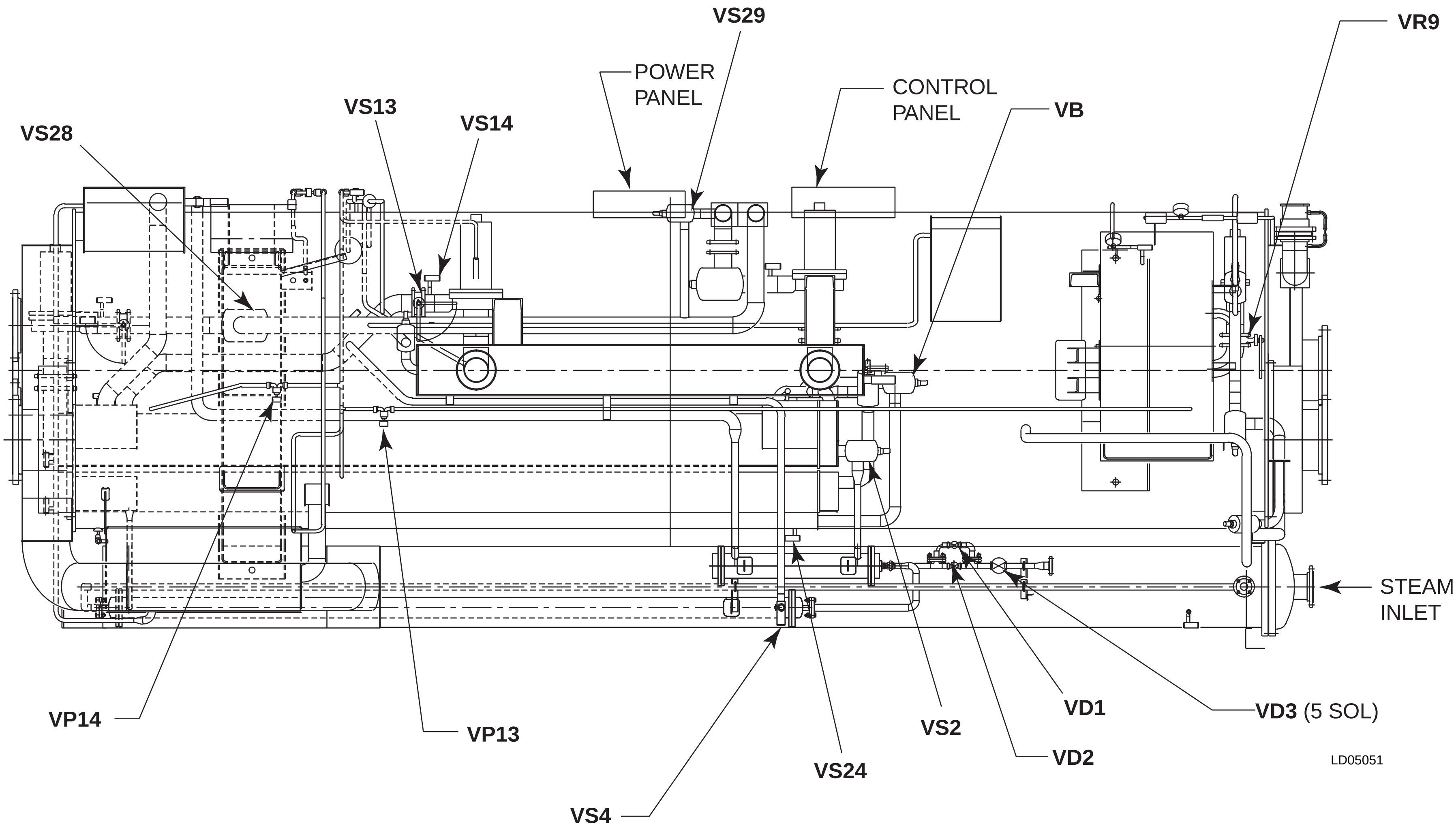


FIG. 77 – MODEL YPC-ST-21G VALVE LOCATION DIAGRAM

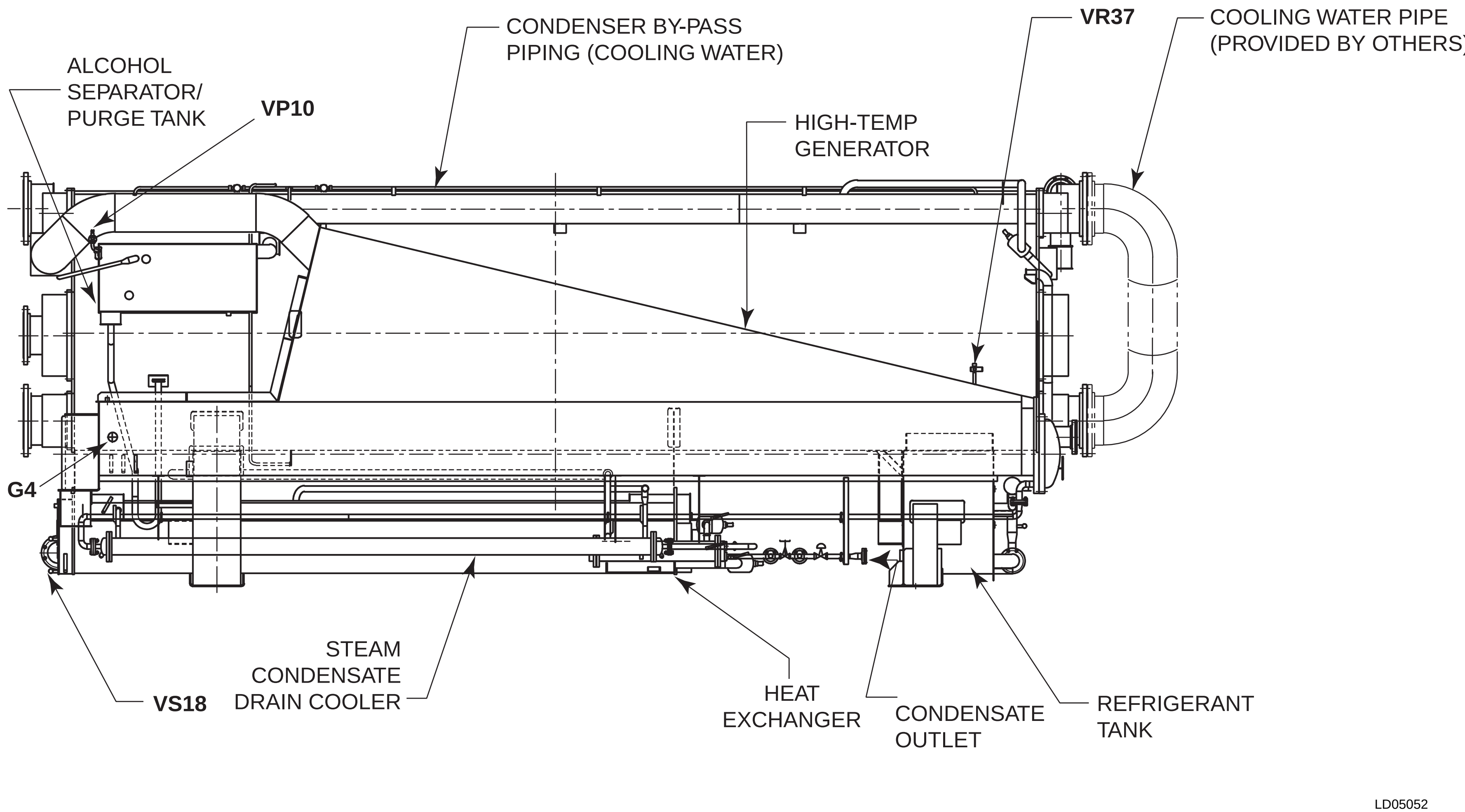


FIG. 78 – MODEL YPC-ST-21G VALVE LOCATION DIAGRAM

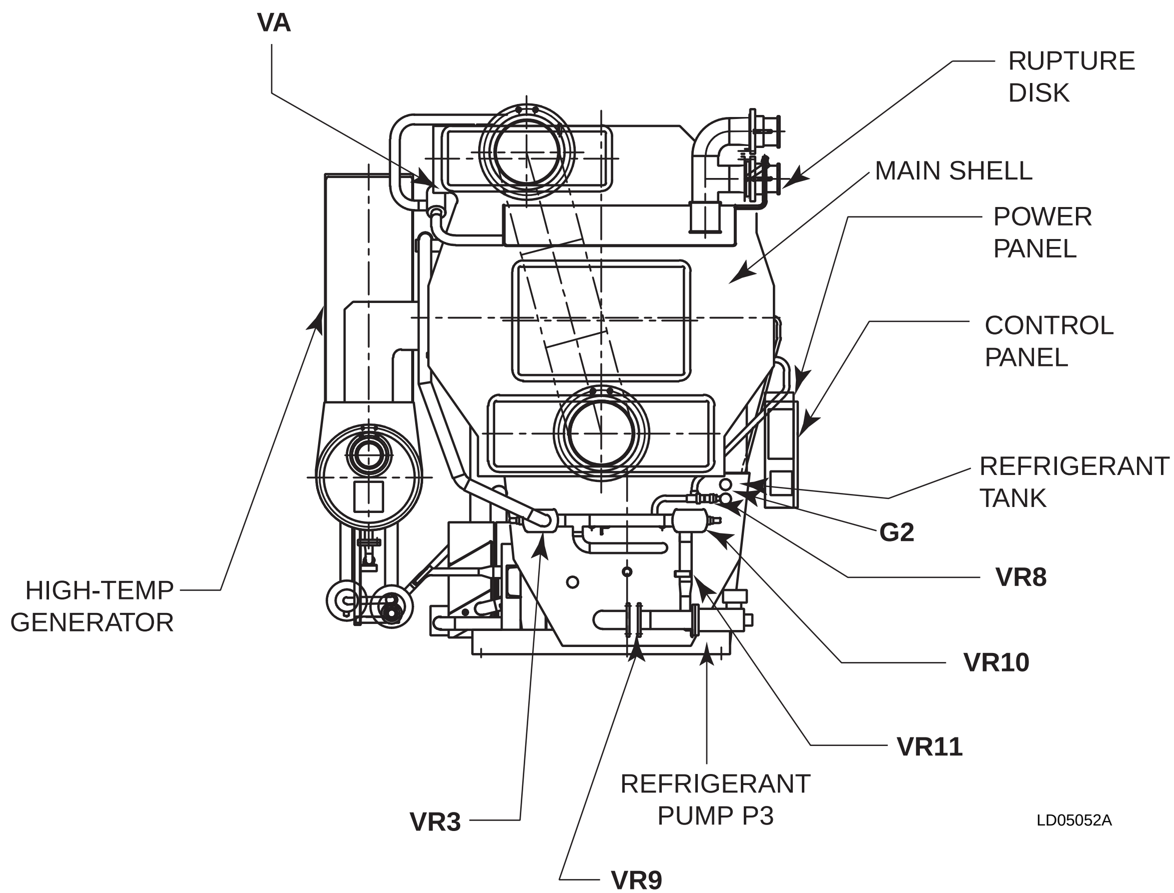
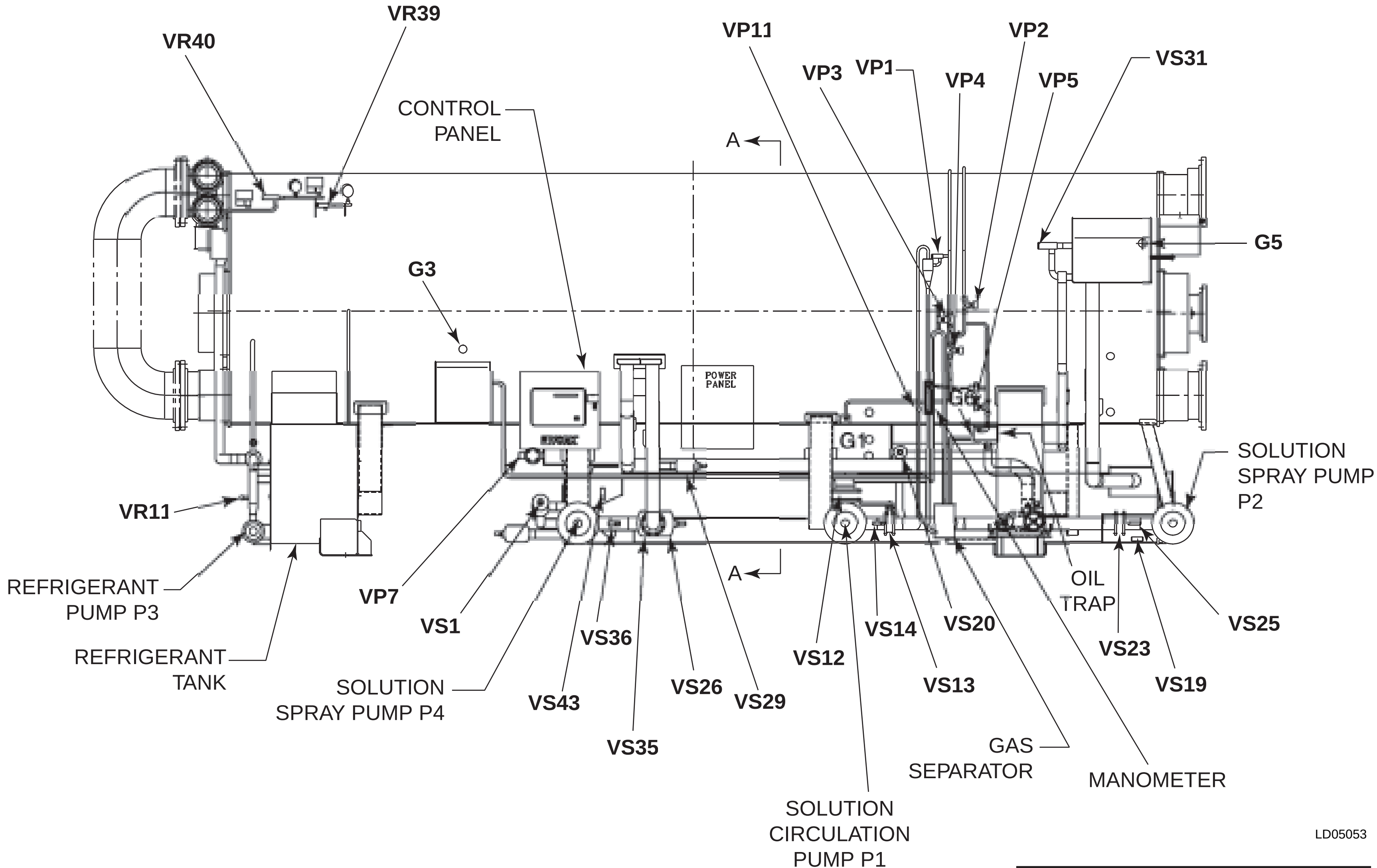


FIG. 78 (CONTINUED) – MODEL YPC-ST-21G VALVE LOCATION DIAGRAM



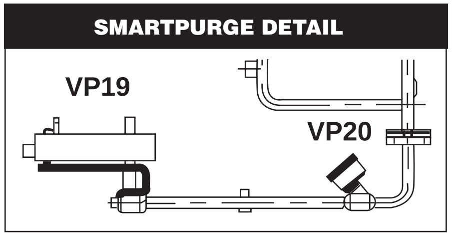
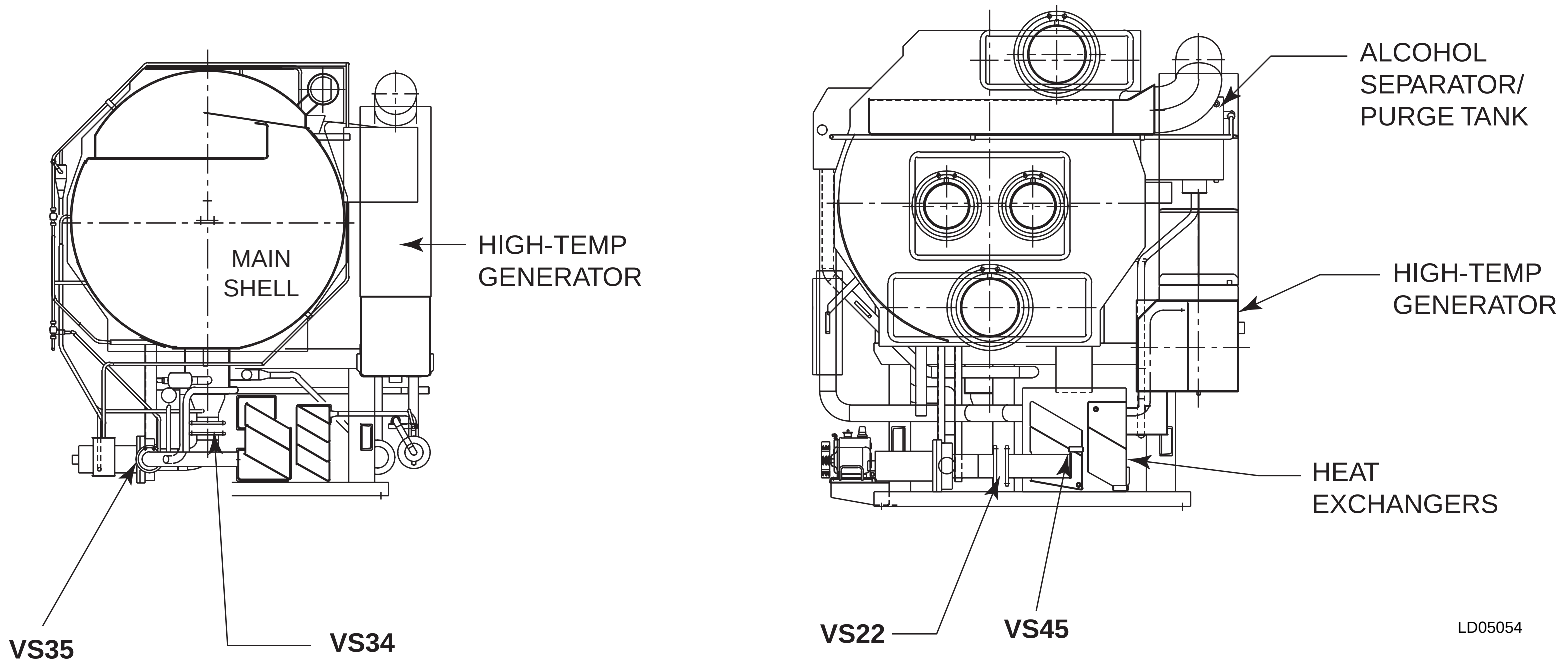


FIG. 79 – MODEL YPC-ST-21G VALVE LOCATION DIAGRAM



SECTION A-A

FIG. 80 – MODEL YPC-ST-21G VALVE LOCATION DIAGRAM

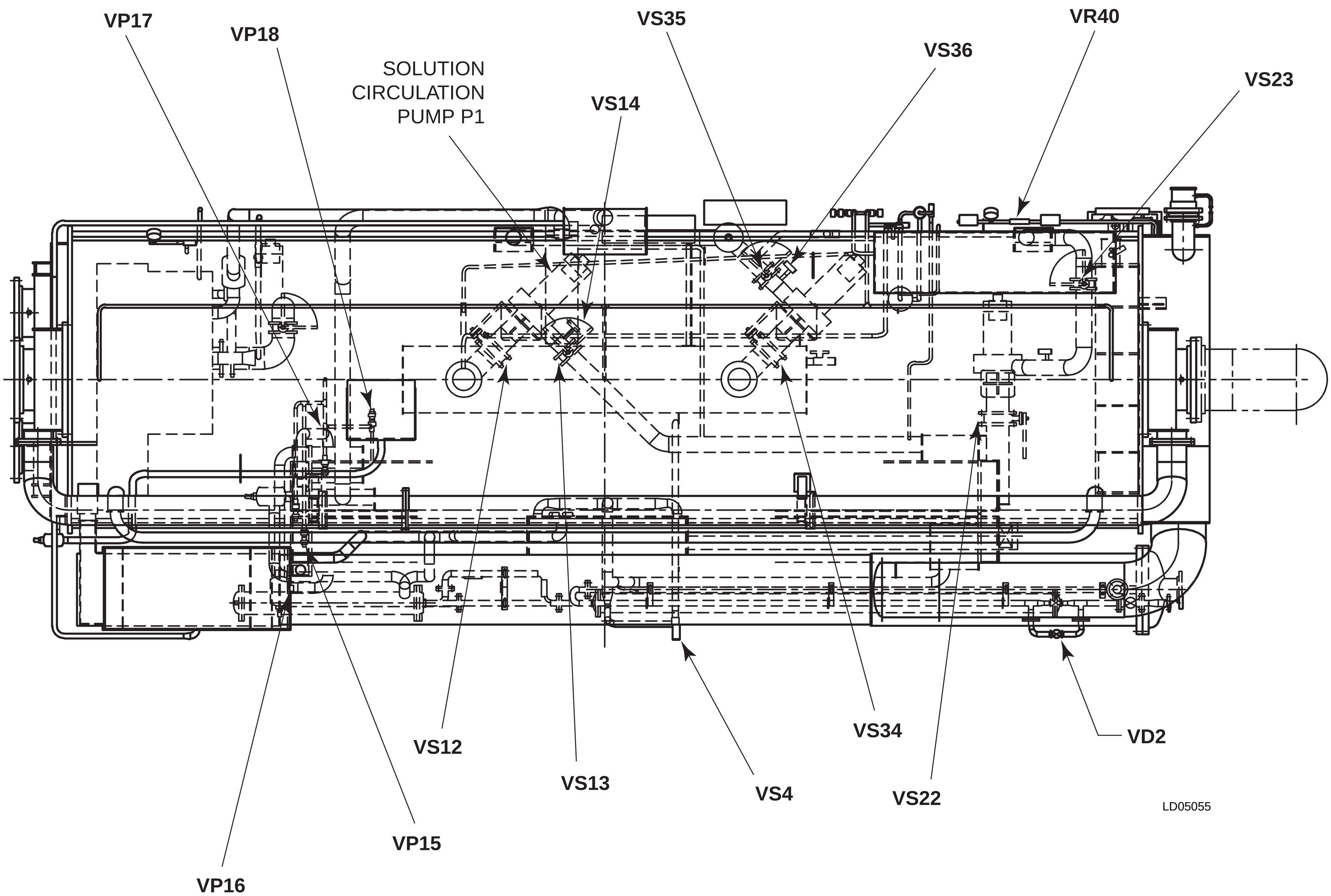


FIG. 81 – MODEL YPC-ST-22G VALVE LOCATION DIAGRAM

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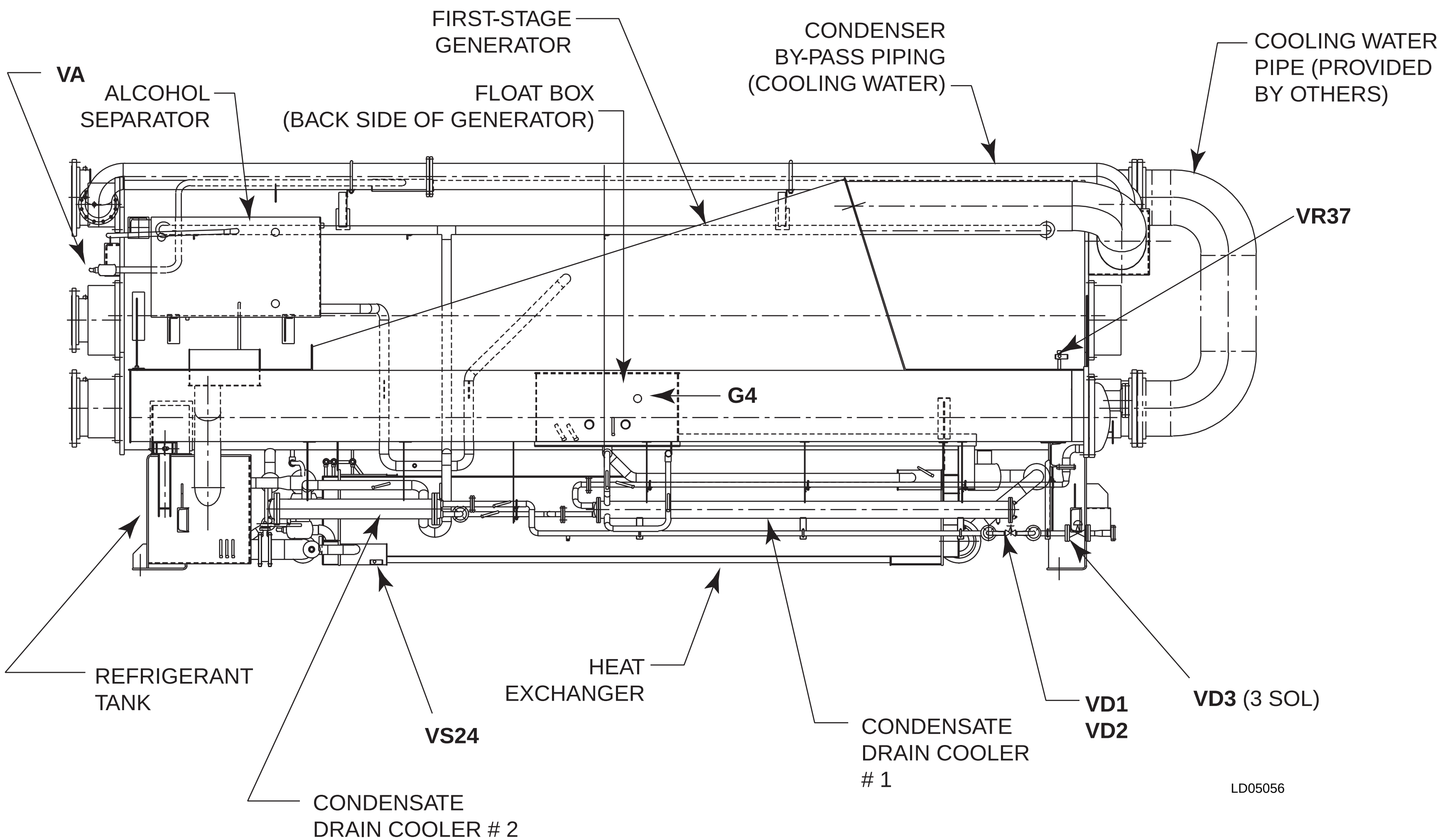

FIG. 82 – MODEL YPC-ST-22G VALVE LOCATION DIAGRAM

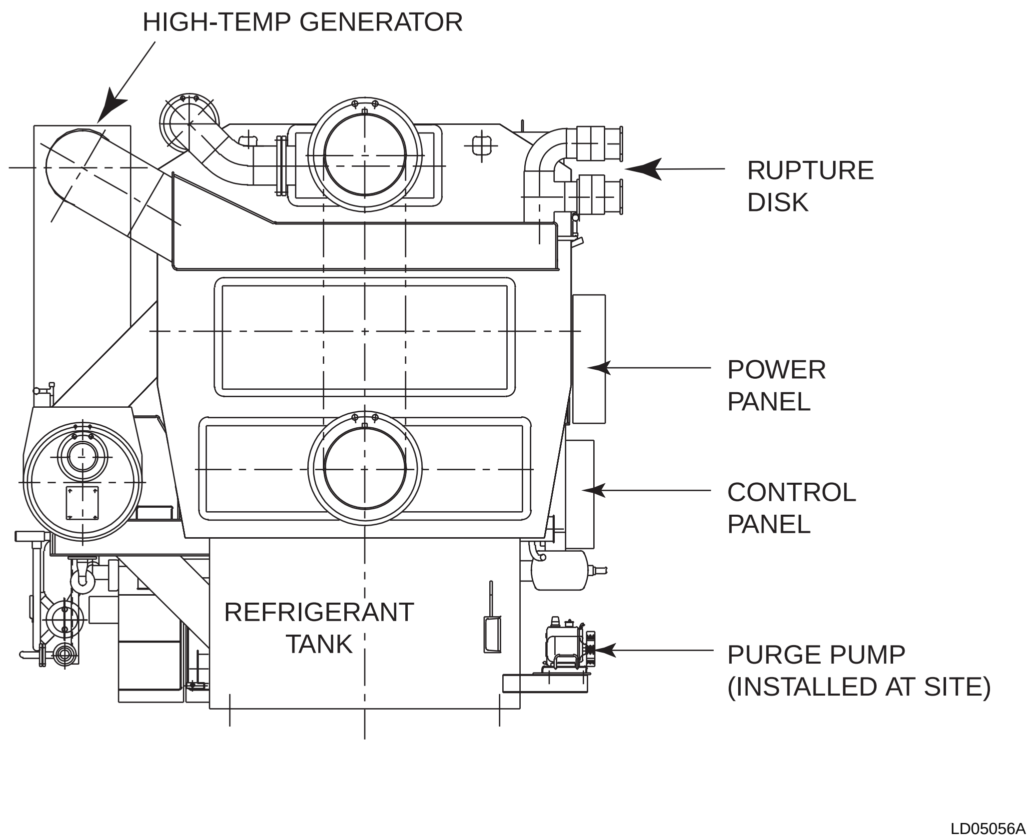

FIG. 82 (CONTINUED) – MODEL YPC-ST-22G VALVE LOCATION DIAGRAM

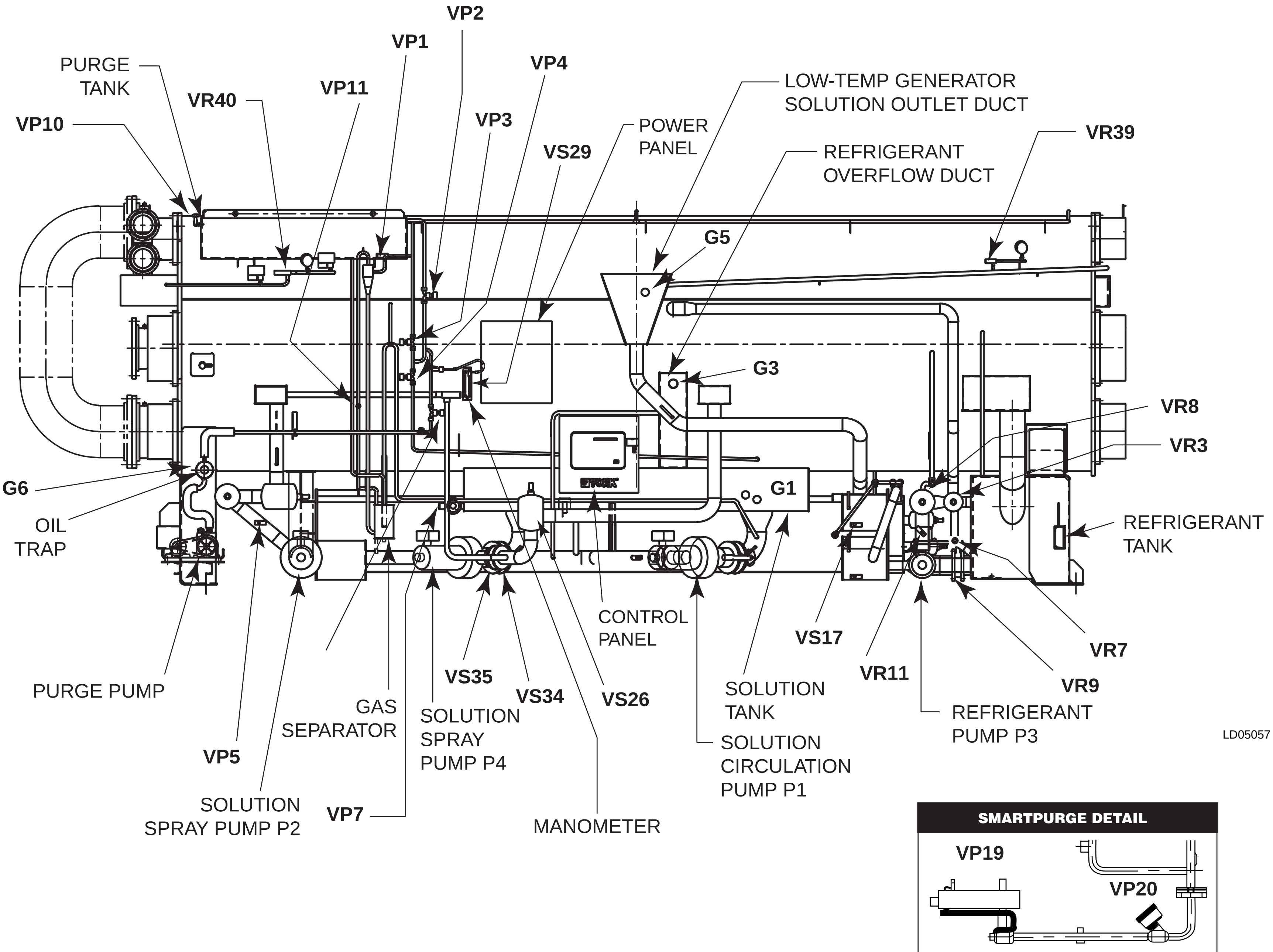

FIG. 83 – MODEL YPC-ST-22G VALVE LOCATION DIAGRAM

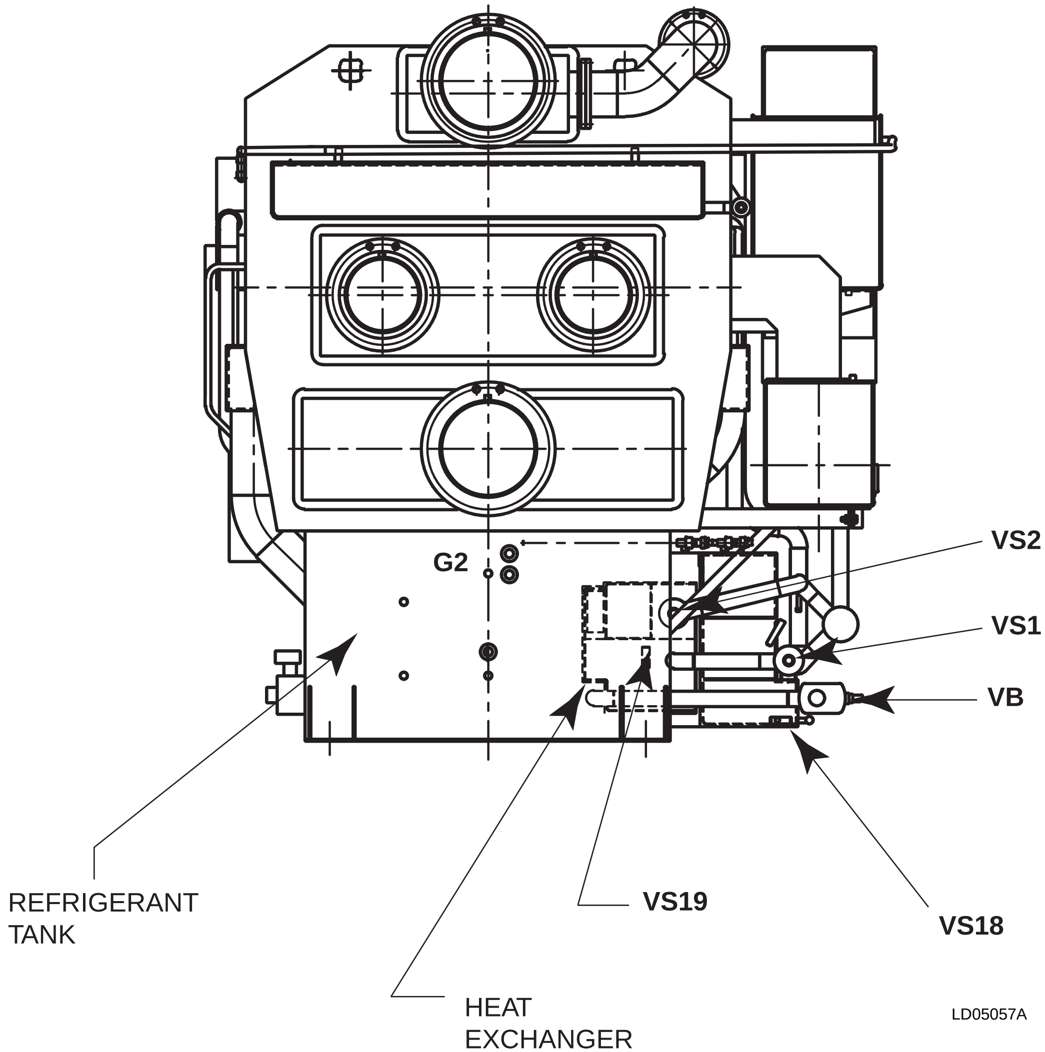

FIG. 83 (CONTINUED) – MODEL YPC-ST-22G VALVE LOCATION DIAGRAM

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APPENDIX C – COMPONENT IDENTIFICATION

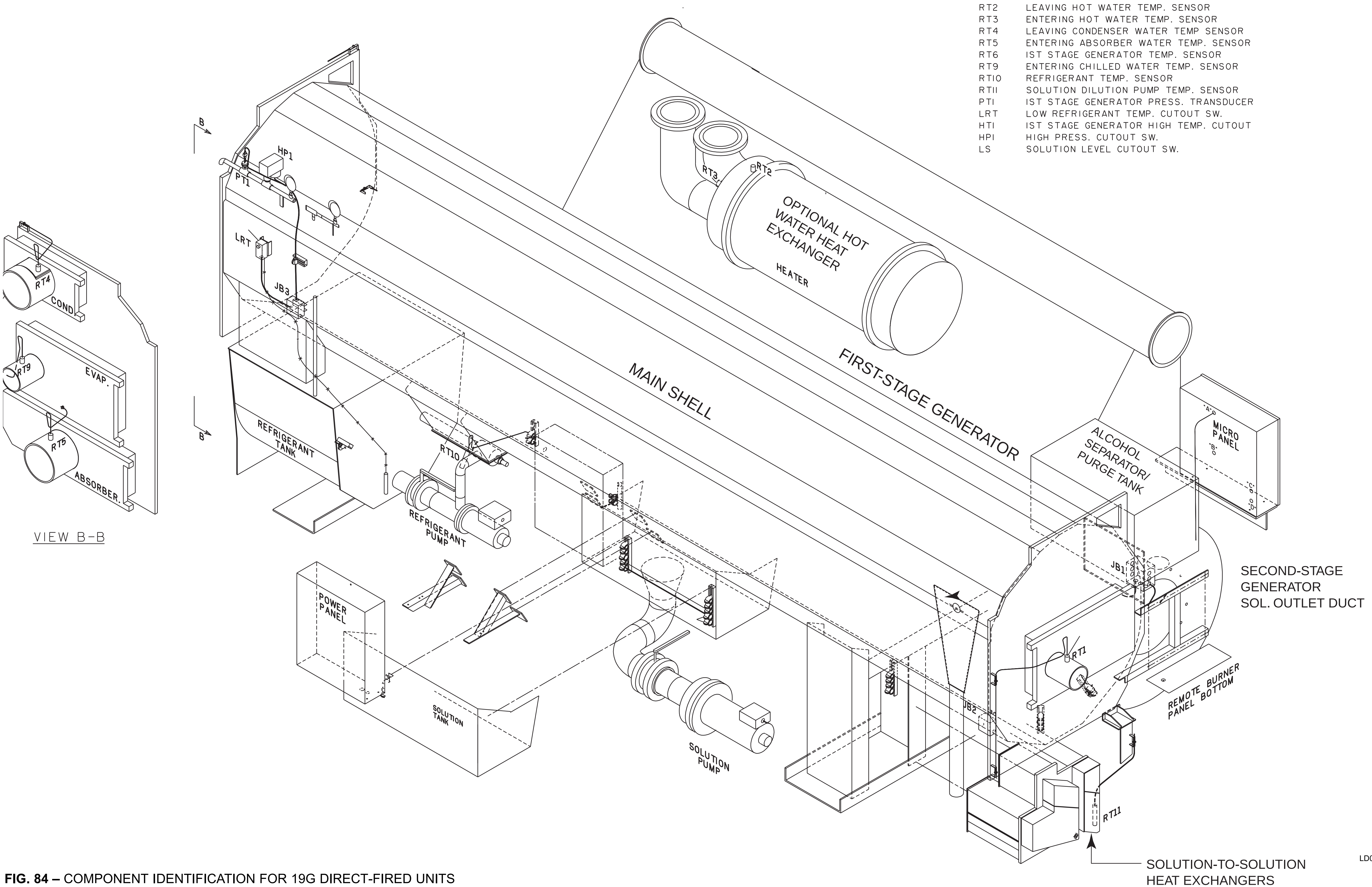


FIG. 84 – COMPONENT IDENTIFICATION FOR 19G DIRECT-FIRED UNITS

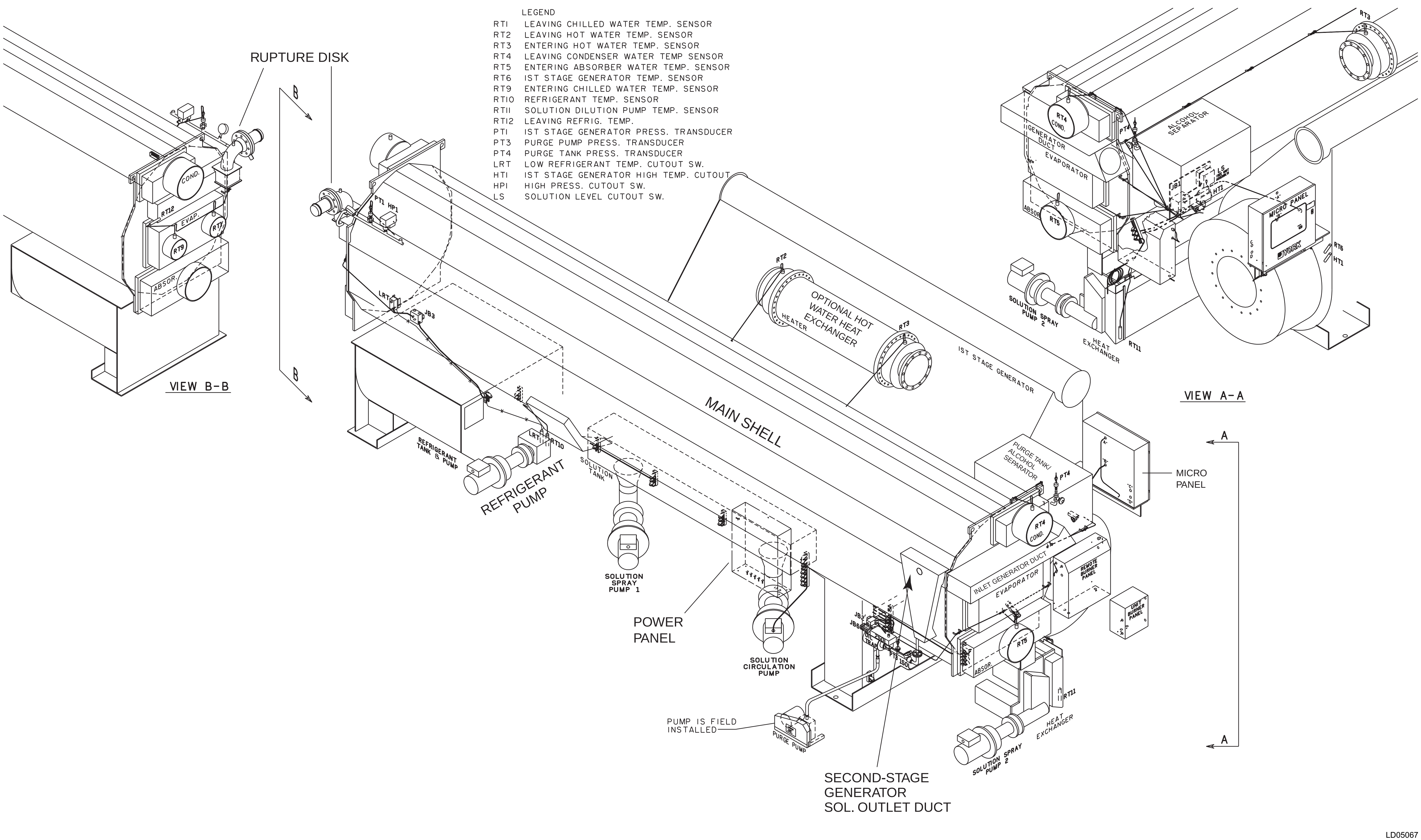


FIG. 84 (CONTINUED) – COMPONENT IDENTIFICATION FOR 19G DIRECT-FIRED MODELS

FORM 155.17-OM1

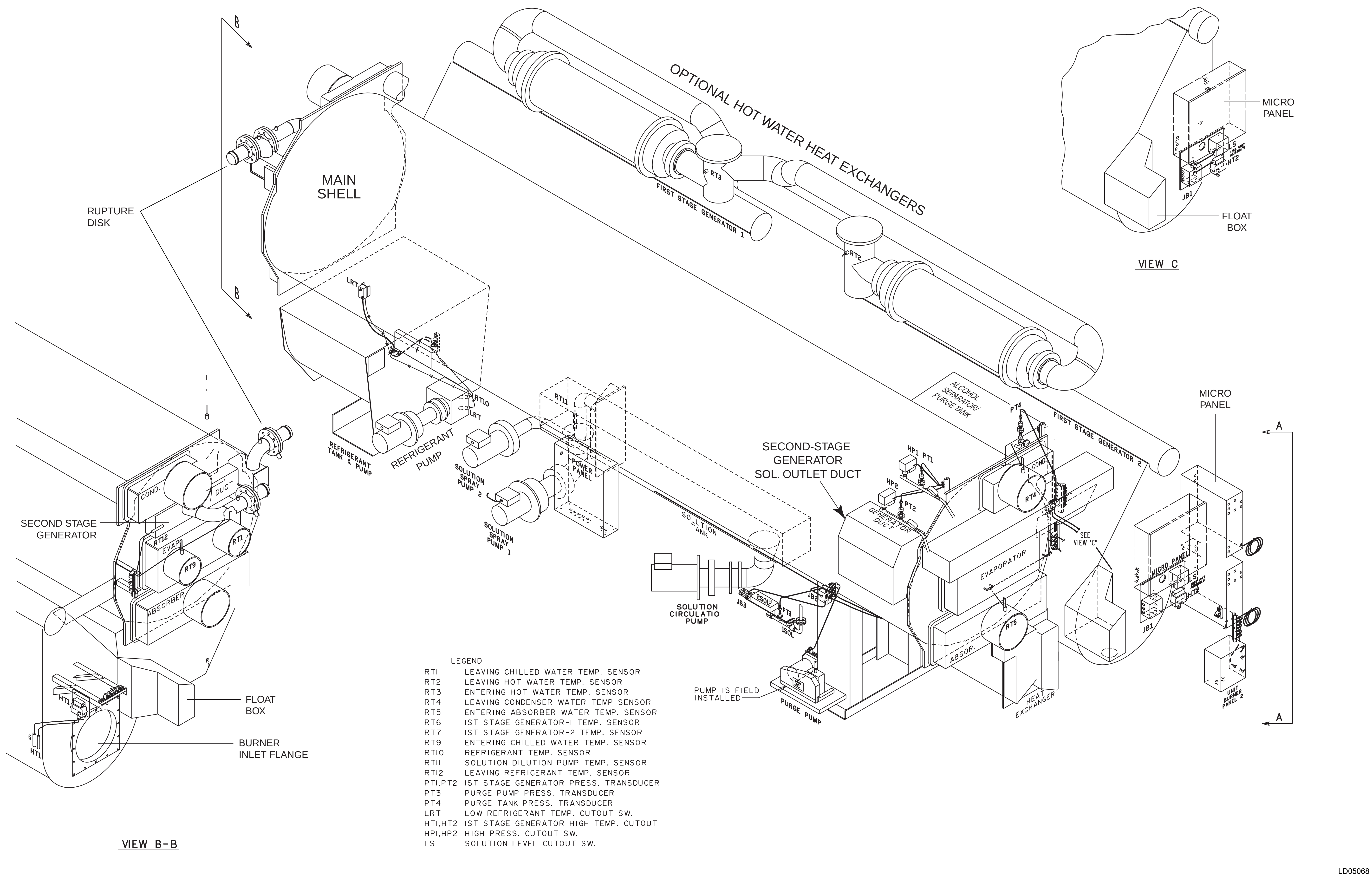
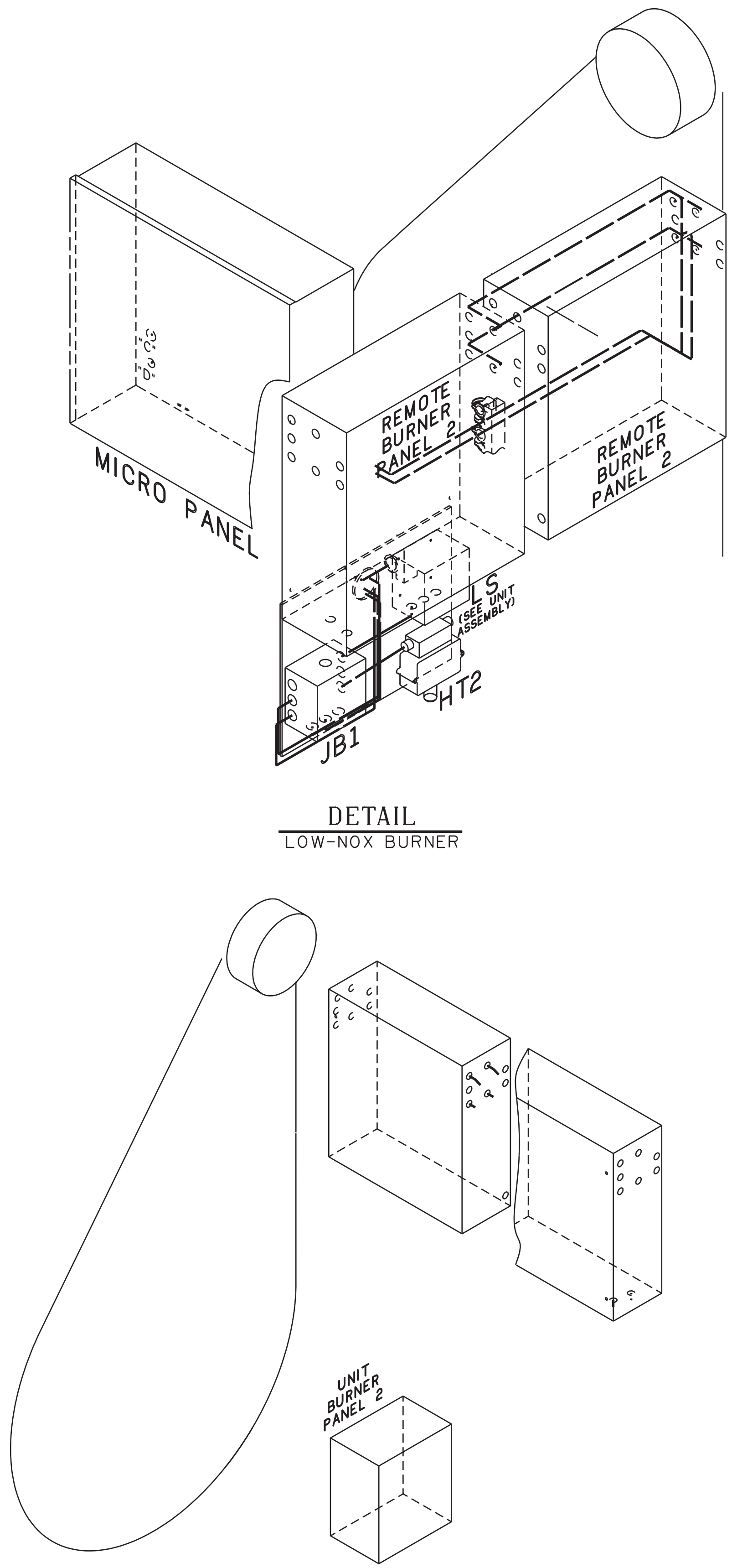


FIG. 85 – COMPONENT IDENTIFICATION FOR 20G DIRECT-FIRED UNITS



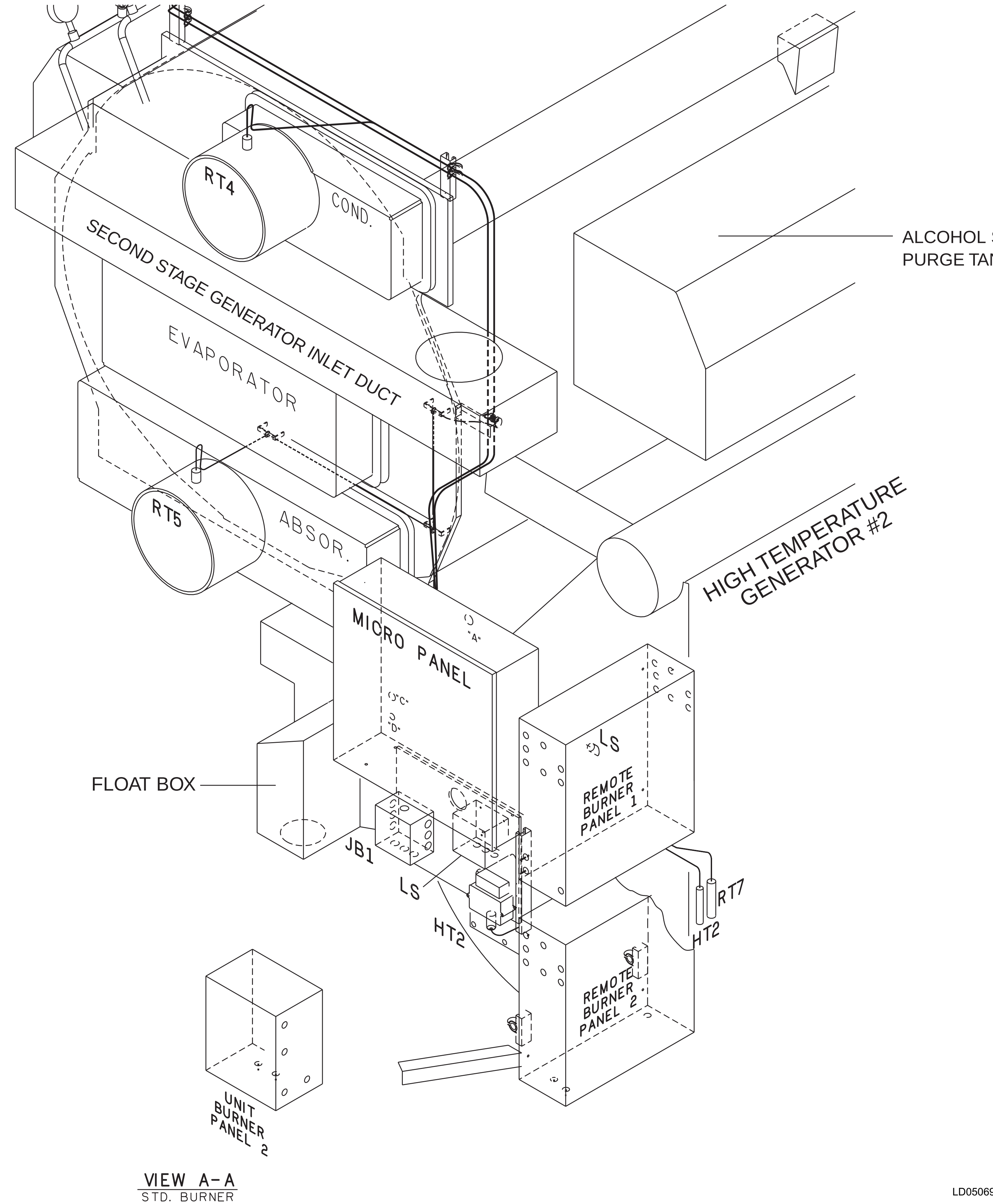


FIG. 85 (CONTINUED) – COMPONENT IDENTIFICATION FOR 20G DIRECT-FIRED UNITS

FORM 155.17-OM1

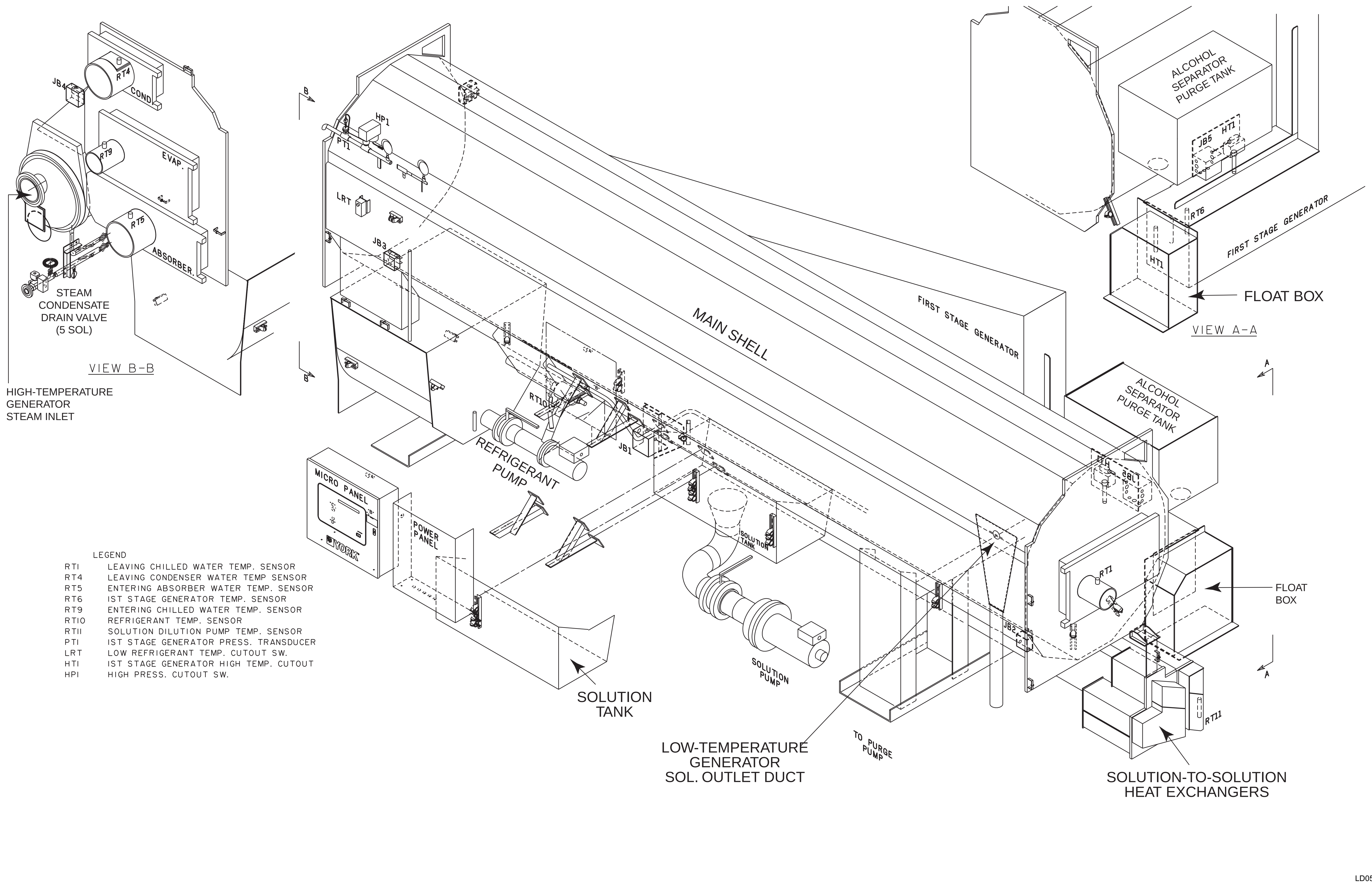


FIG. 86 – COMPONENT IDENTIFICATION FOR 19G STEAM UNITS

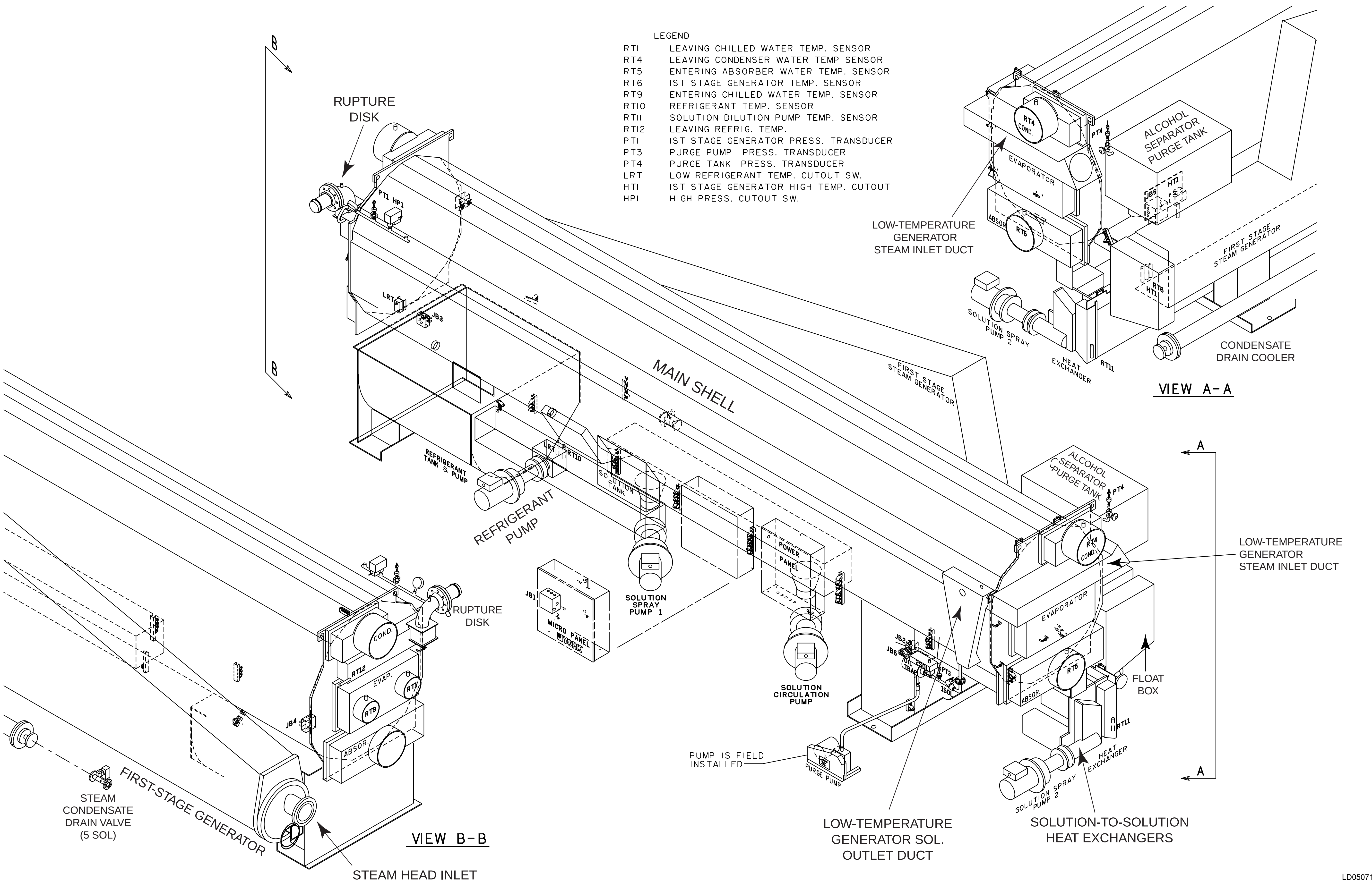


FIG. 87 – COMPONENT IDENTIFICATION FOR 19GL STEAM UNIT

FORM 155.17-OM1

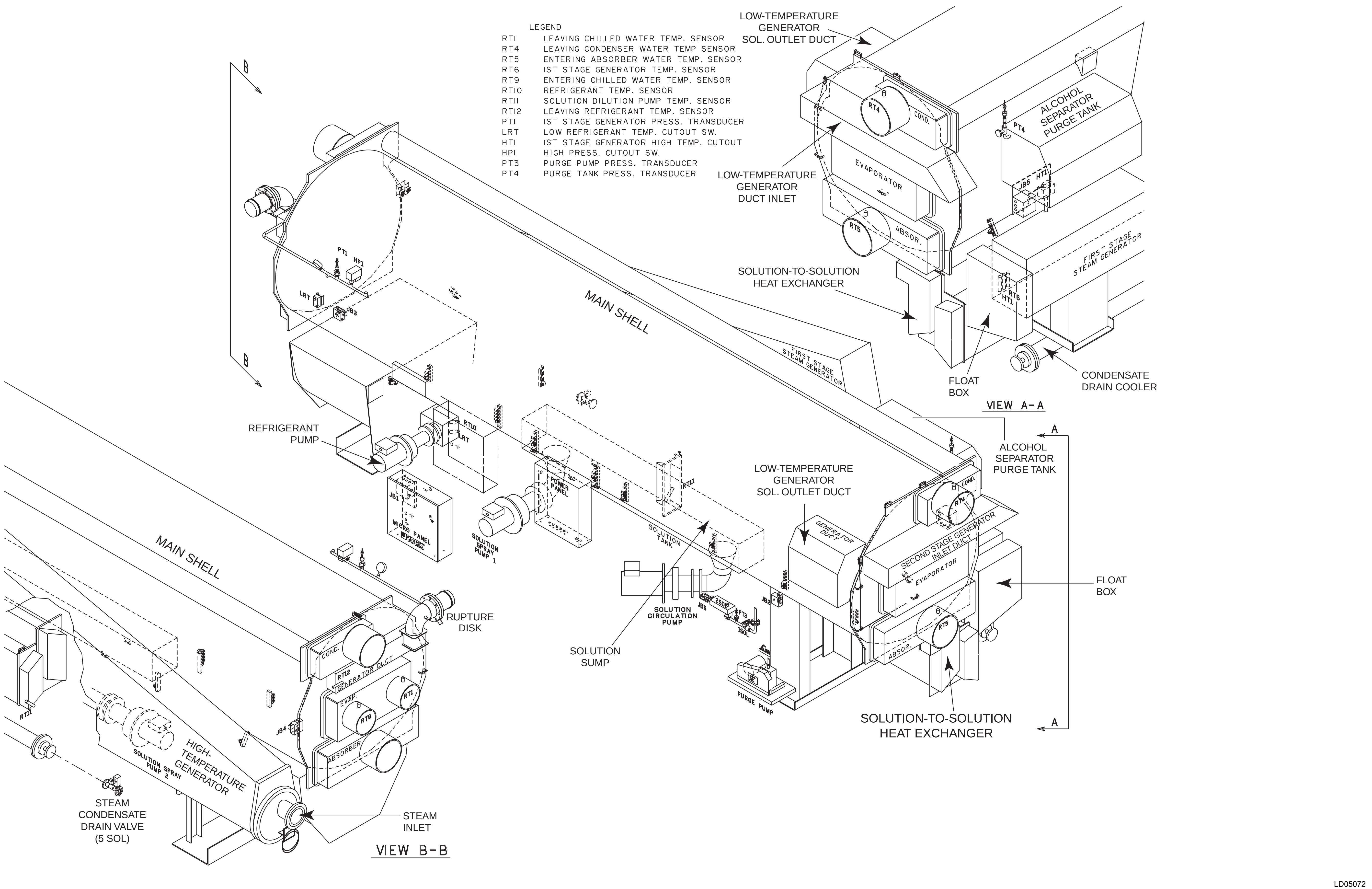


FIG. 88 – COMPONENT IDENTIFICATION FOR 20G STEAM UNITS

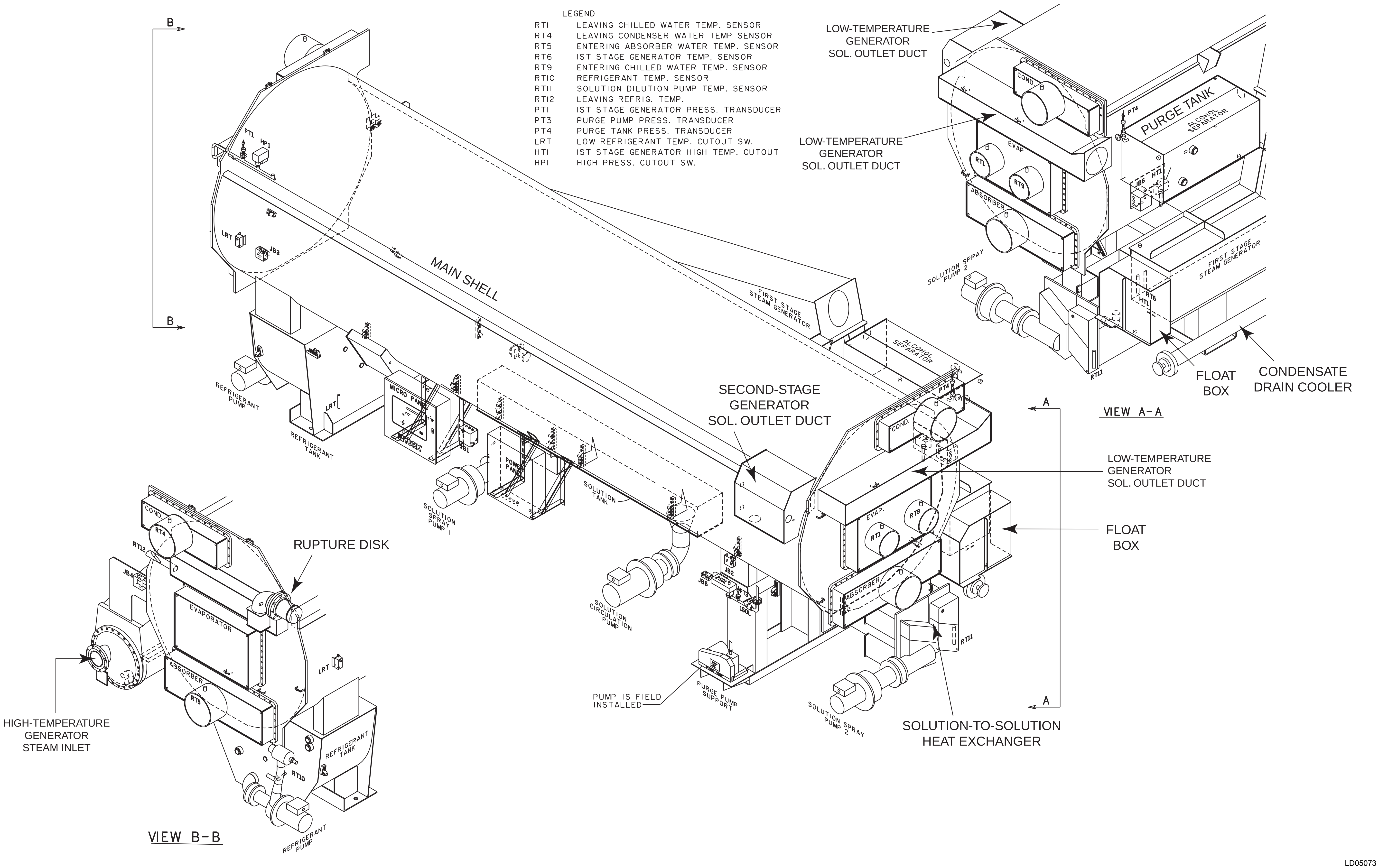


FIG. 89 – COMPONENT IDENTIFICATION FOR 21G STEAM UNITS

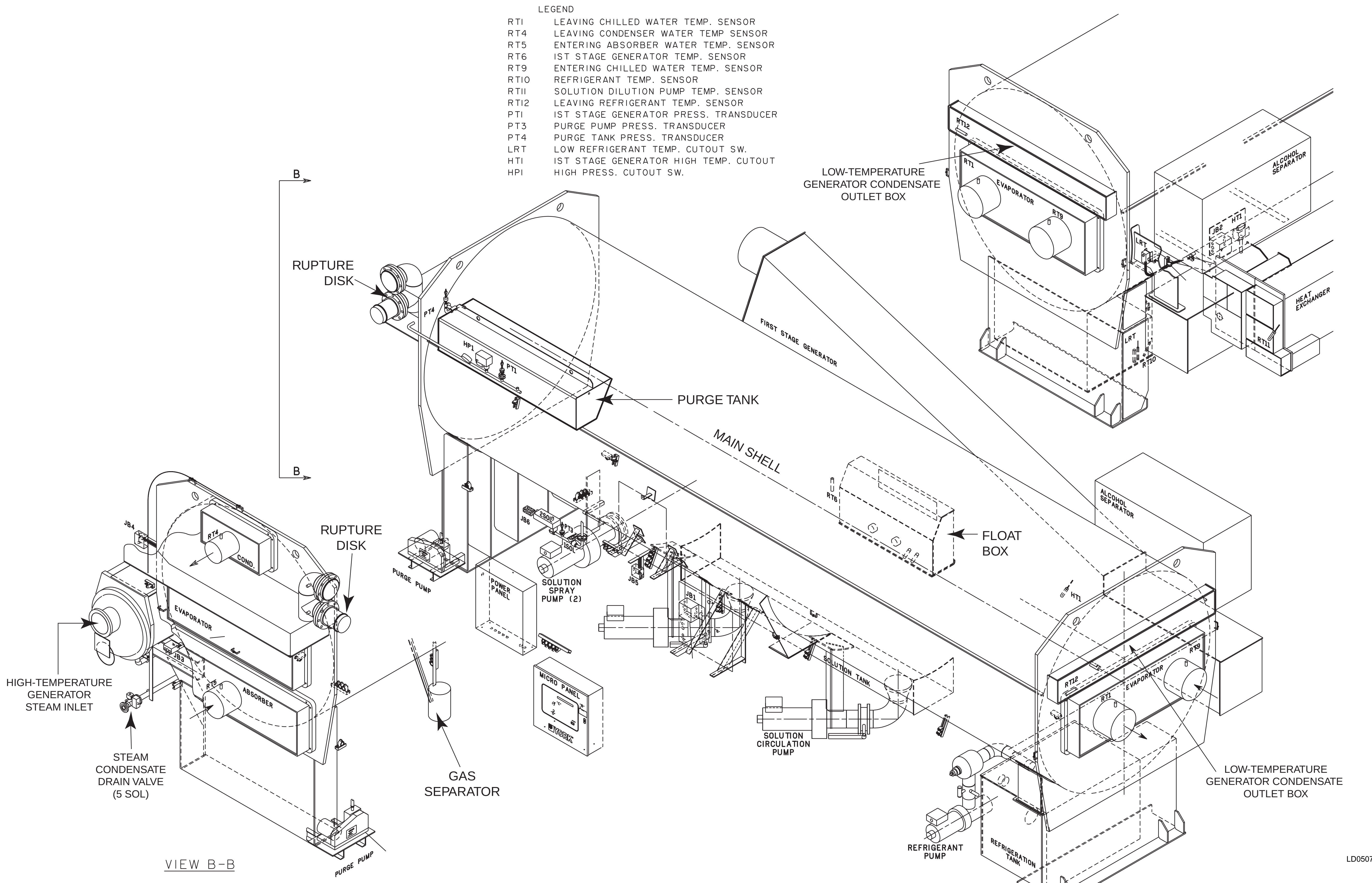


FIG. 90 – COMPONENT IDENTIFICATION FOR 22G STEAM UNIT

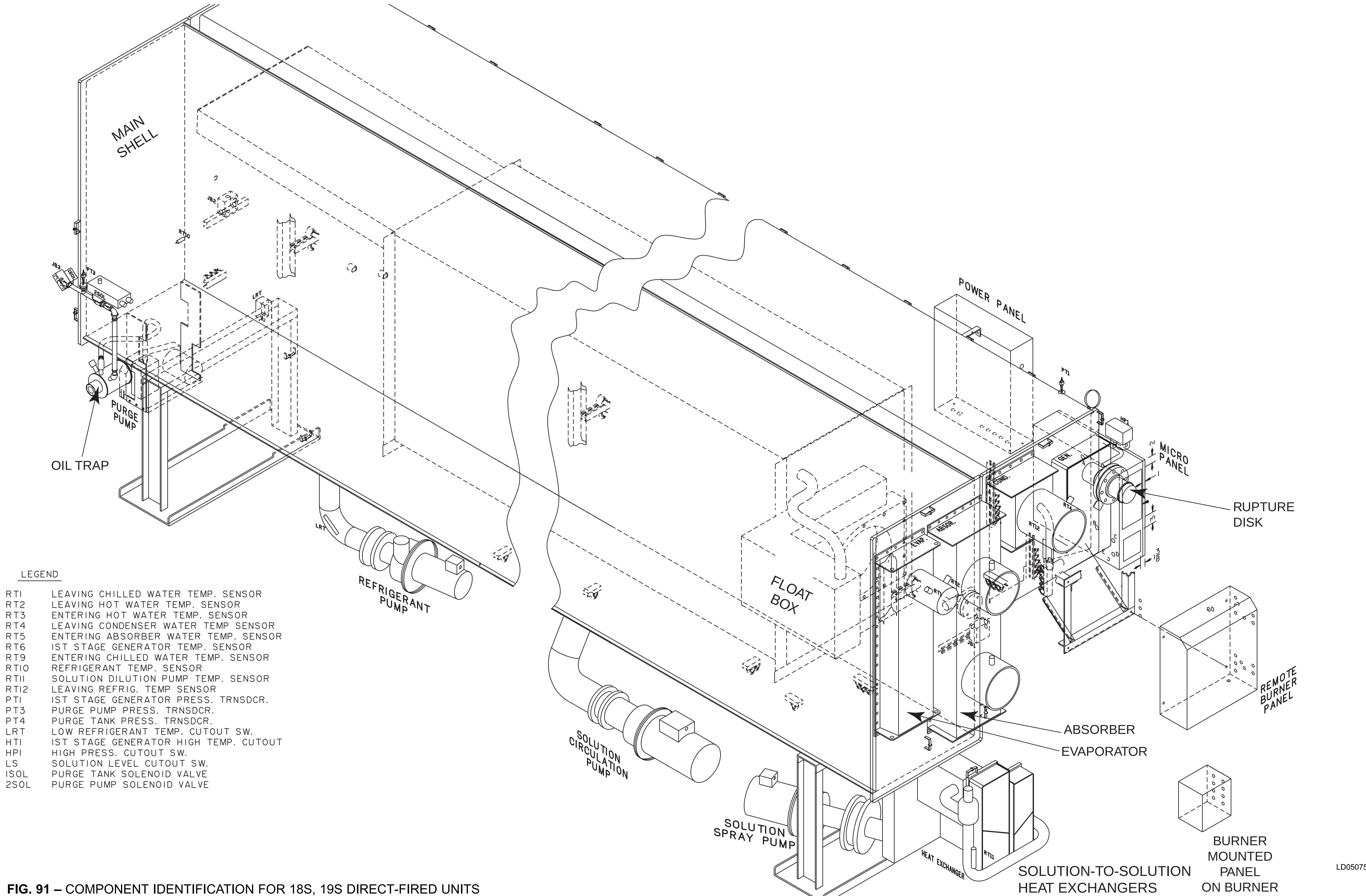


FIG. 91 – COMPONENT IDENTIFICATION FOR 18S, 19S DIRECT-FIRED UNITS

FORM 155.17-OM1

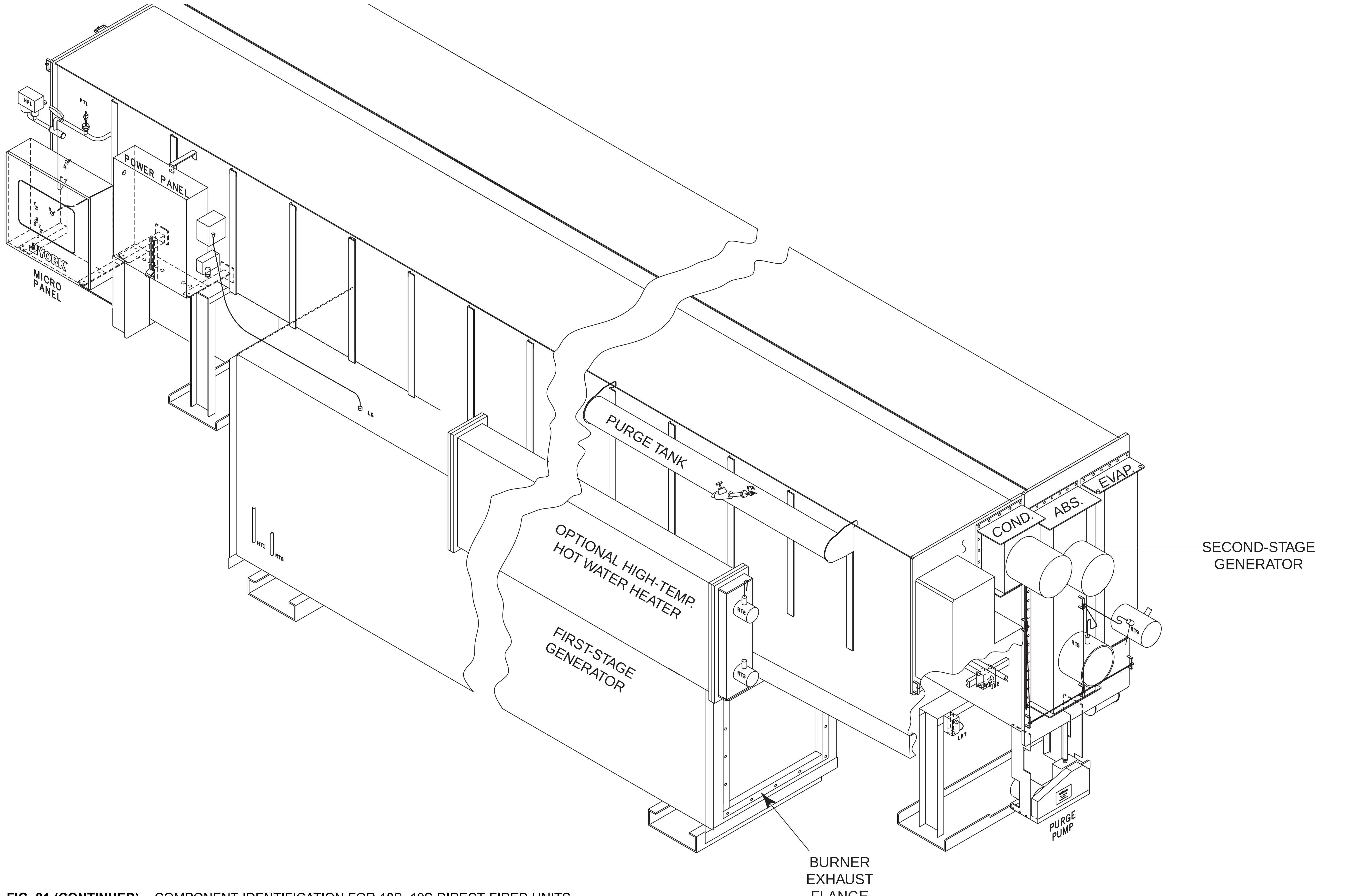


FIG. 91 (CONTINUED) – COMPONENT IDENTIFICATION FOR 18S, 19S DIRECT-FIRED UNITS

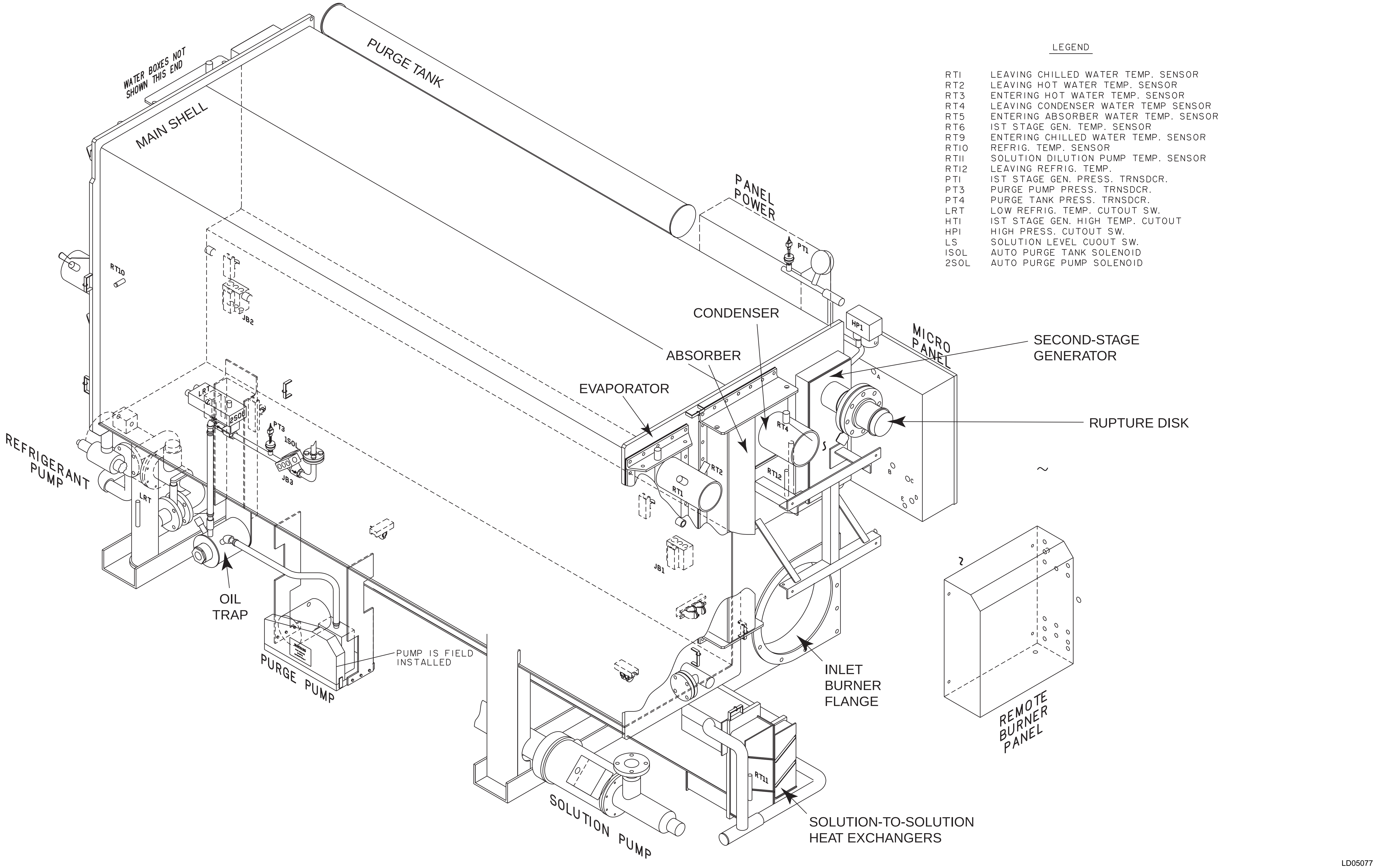


FIG. 92 – COMPONENT IDENTIFICATION FOR 13S, 14S, 15S DIRECT-FIRED UNITS

FORM 155.17-OM1

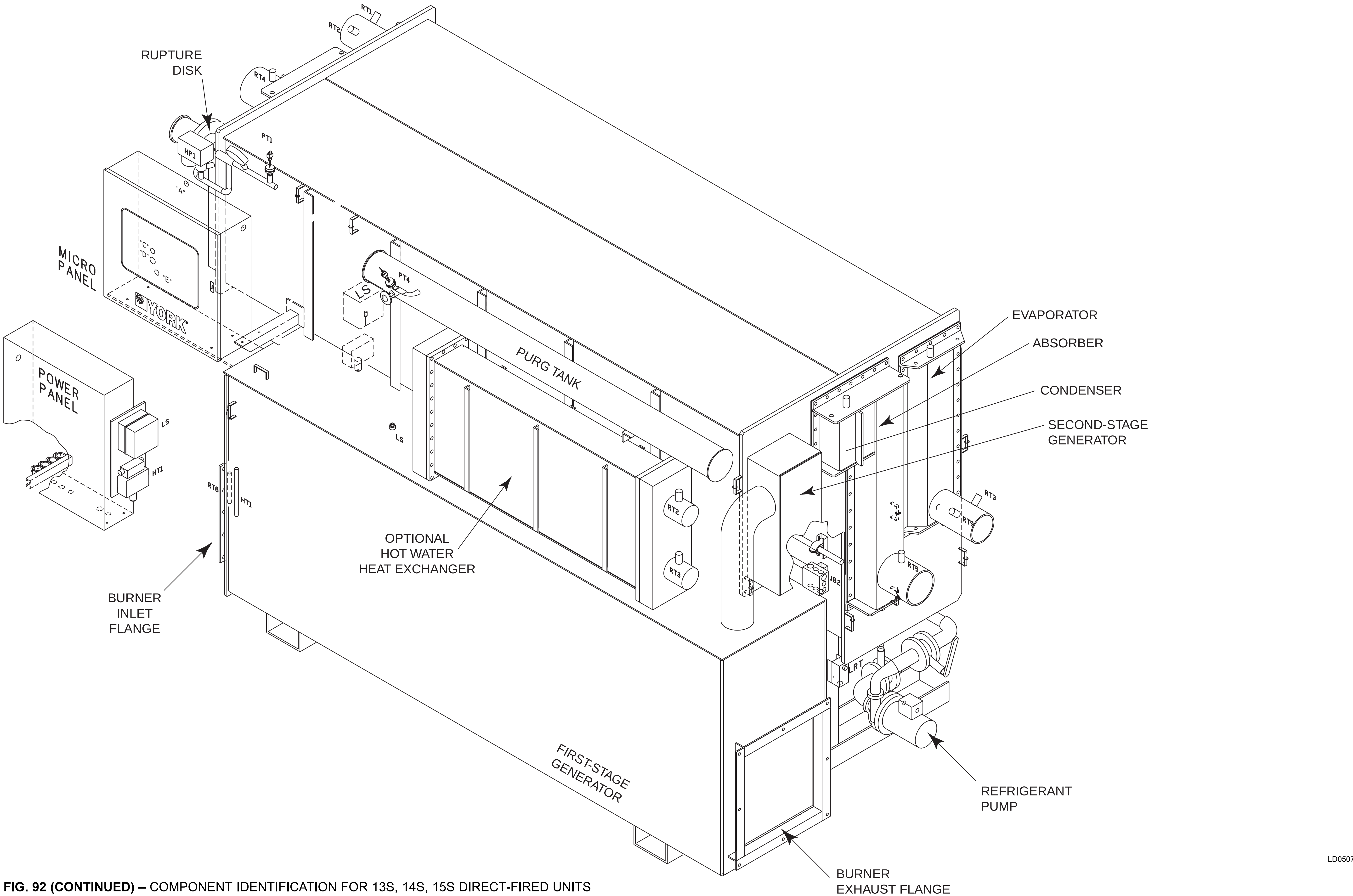


FIG. 92 (CONTINUED) – COMPONENT IDENTIFICATION FOR 13S, 14S, 15S DIRECT-FIRED UNITS

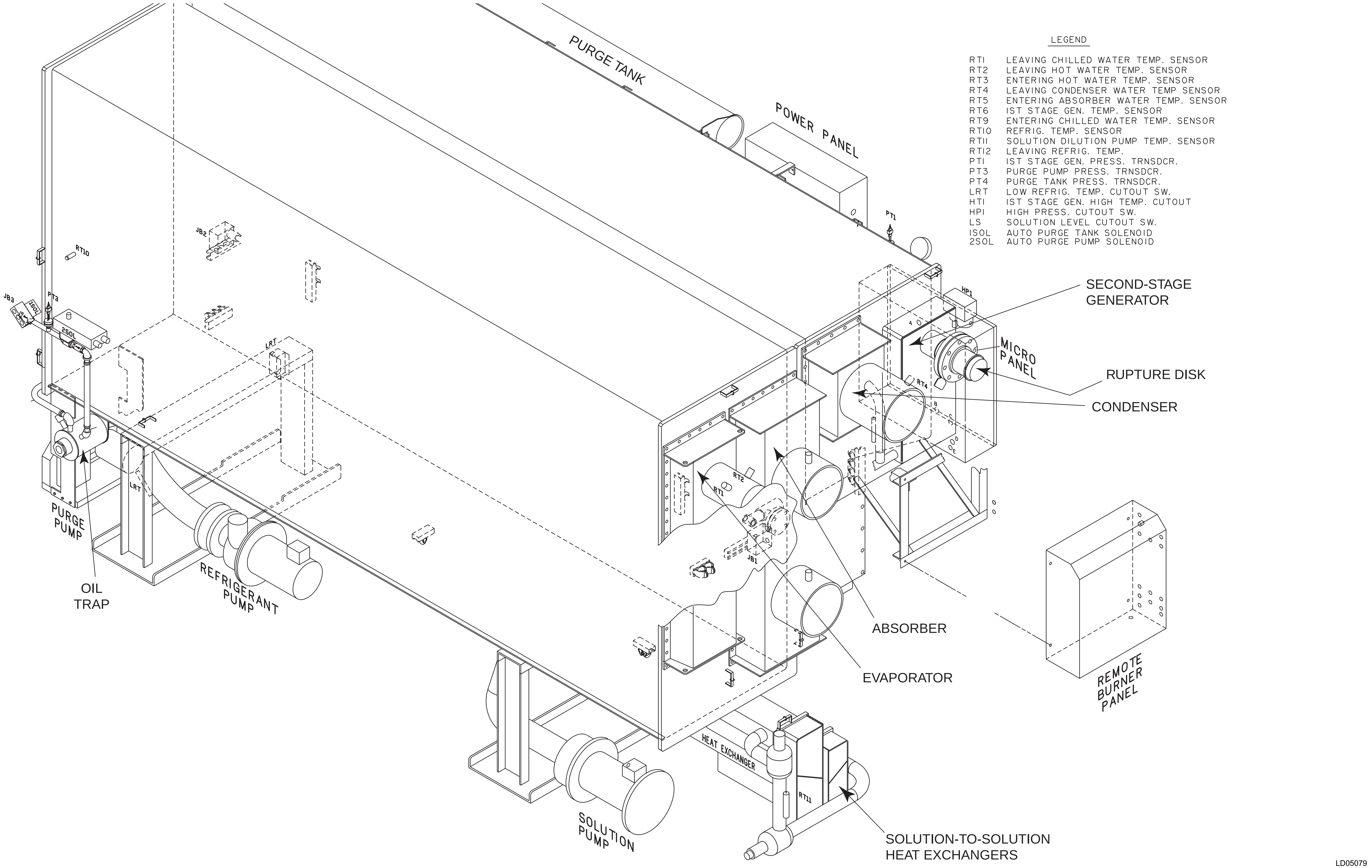


FIG. 93 – COMPONENT IDENTIFICATION FOR 15SL, 16S DIRECT-FIRED UNITS

FORM 155.17-OM1

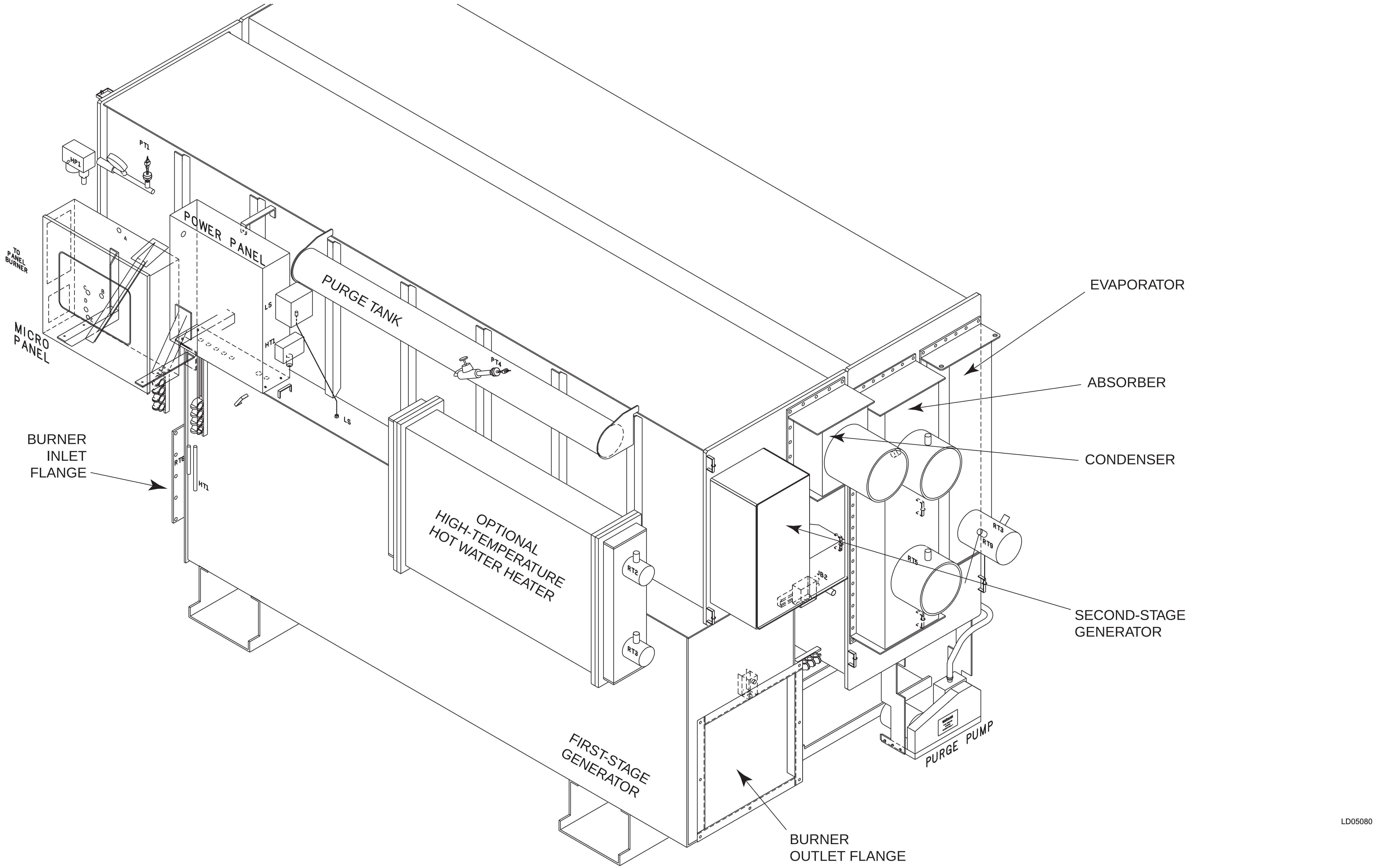


FIG. 93 (CONTINUED) – COMPONENT IDENTIFICATION FOR 15SL, 16S DIRECT-FIRED UNITS

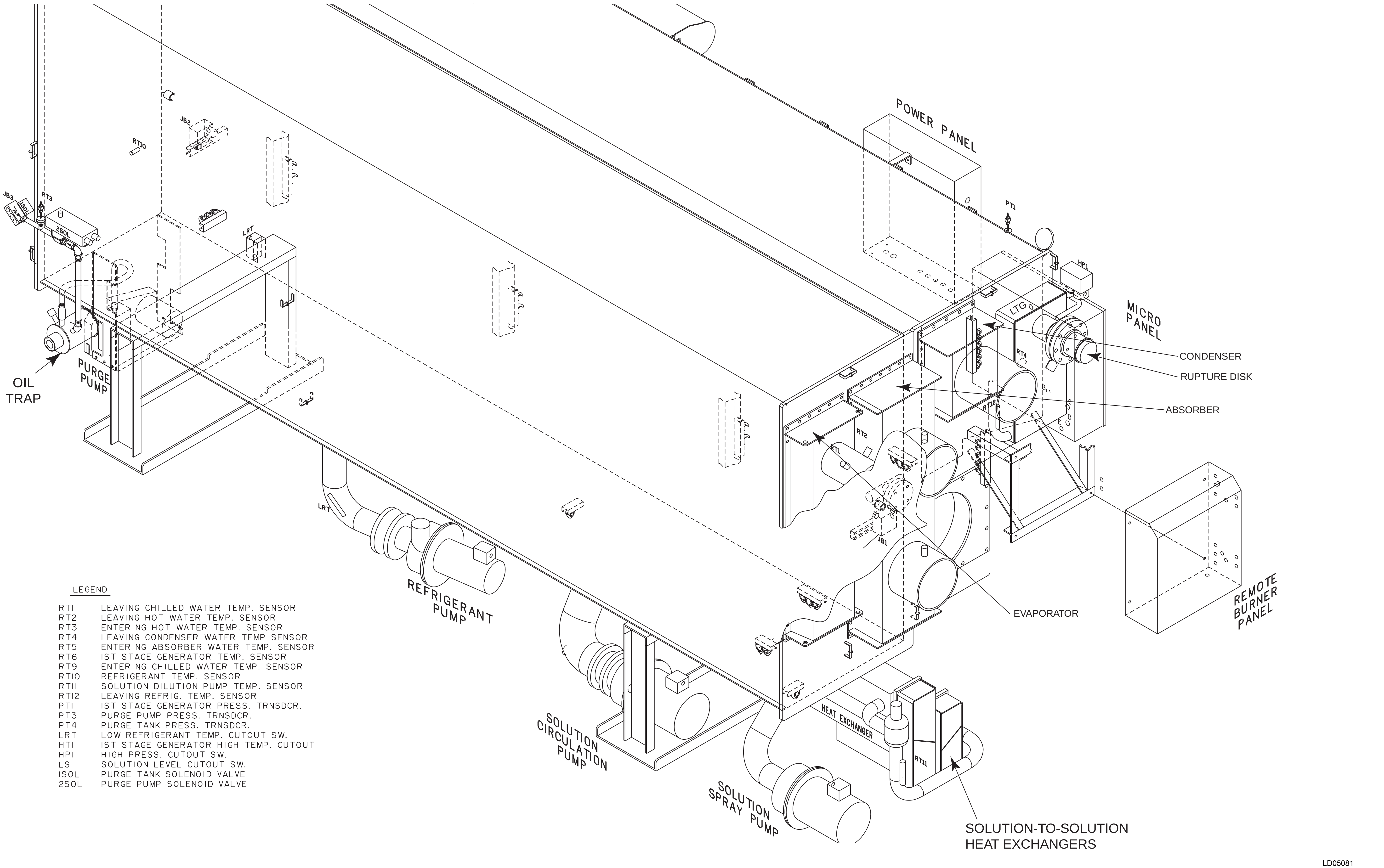


FIG. 94 – COMPONENT IDENTIFICATION FOR 16SL, 17S DIRECT-FIRED UNITS

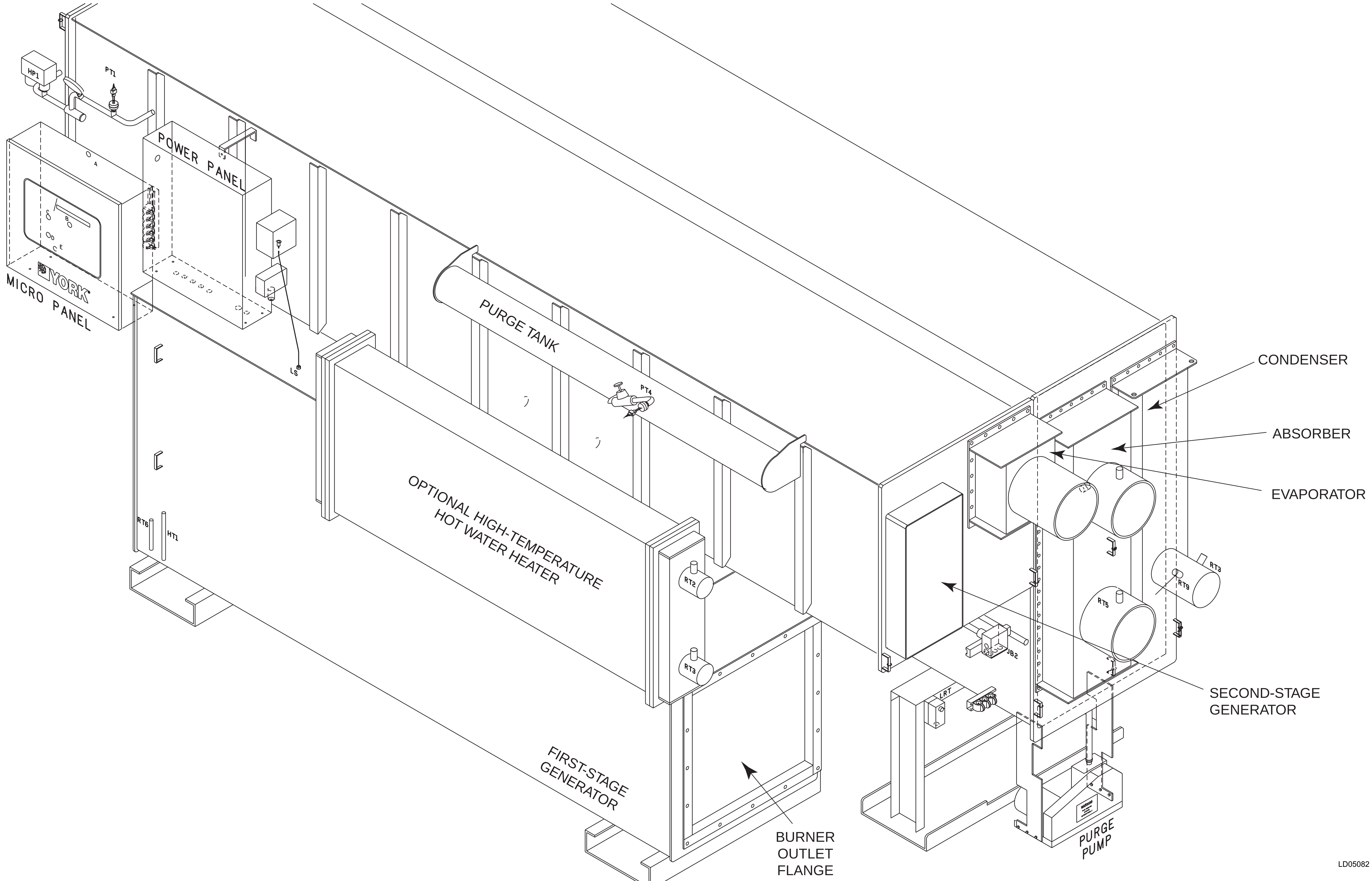


FIG. 94 (CONTINUED) – COMPONENT IDENTIFICATION FOR 16SL, 17S DIRECT-FIRED UNITS

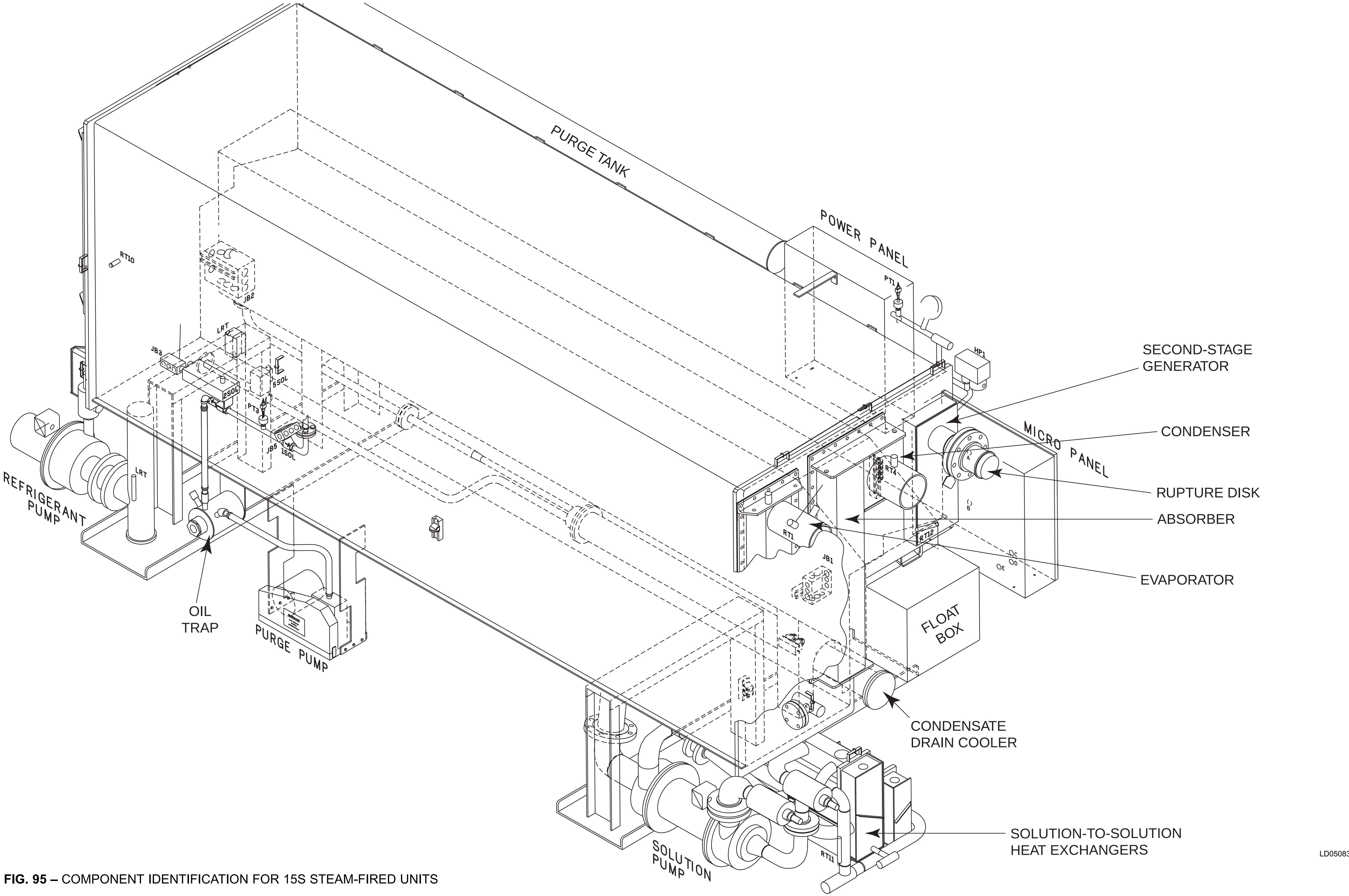


FIG. 95 – COMPONENT IDENTIFICATION FOR 15S STEAM-FIRED UNITS

FORM 155.17-OM1

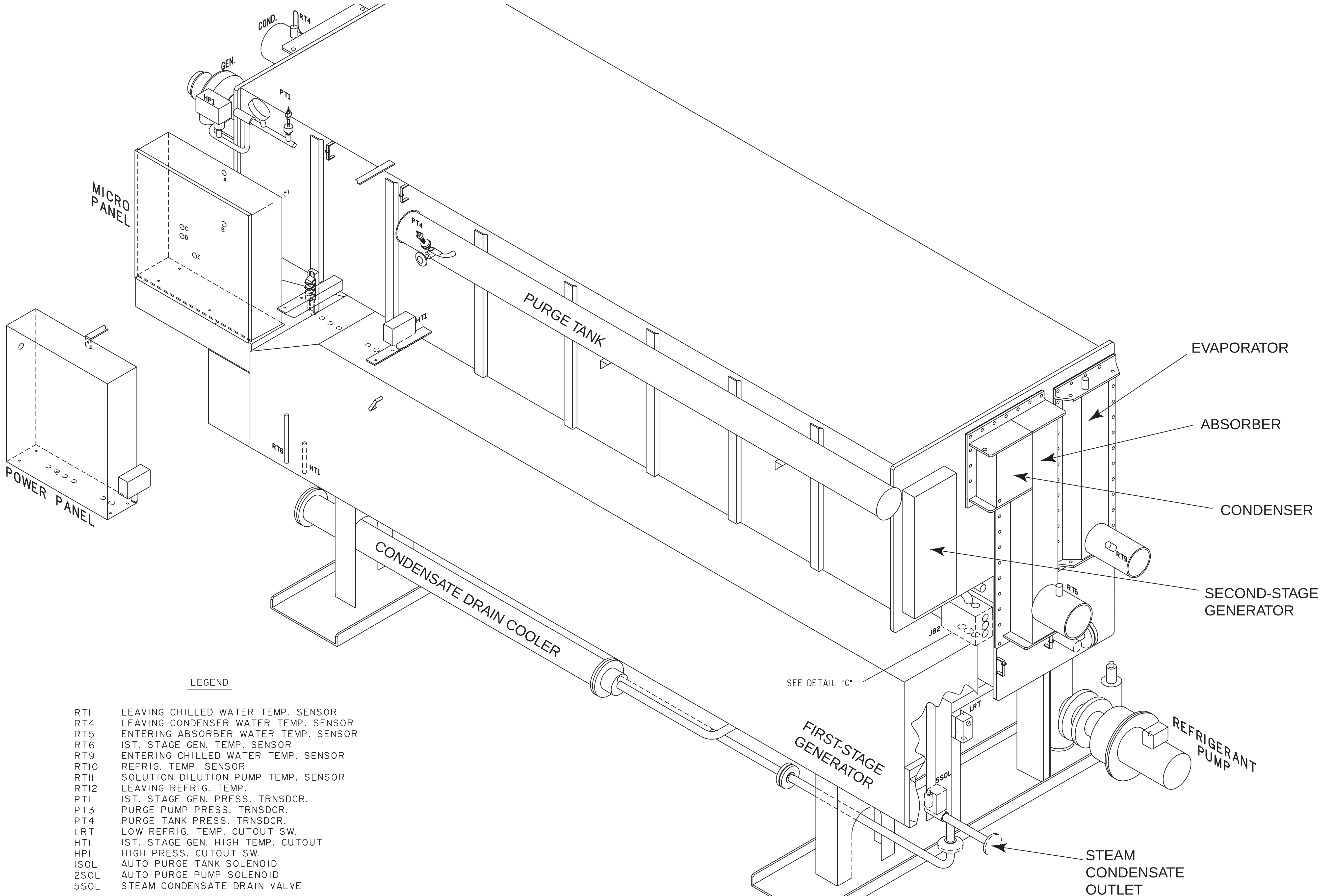


FIG. 95 (CONTINUED) – COMPONENT IDENTIFICATION FOR 15S STEAM FIRED UNITS

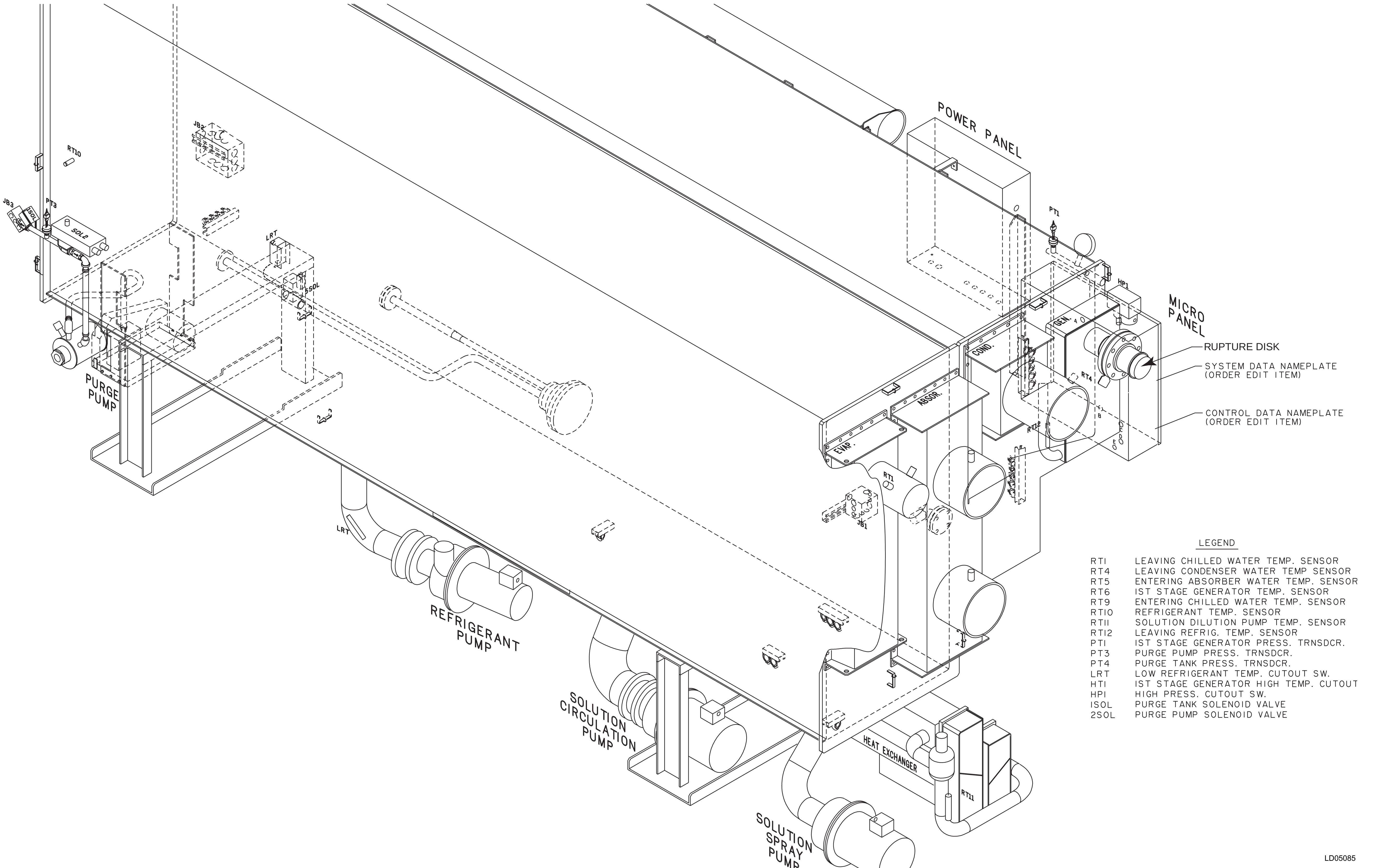


FIG. 96 – COMPONENT IDENTIFICATION FOR 16SL, 17S STEAM-FIRED UNITS

FORM 155.17-OM1

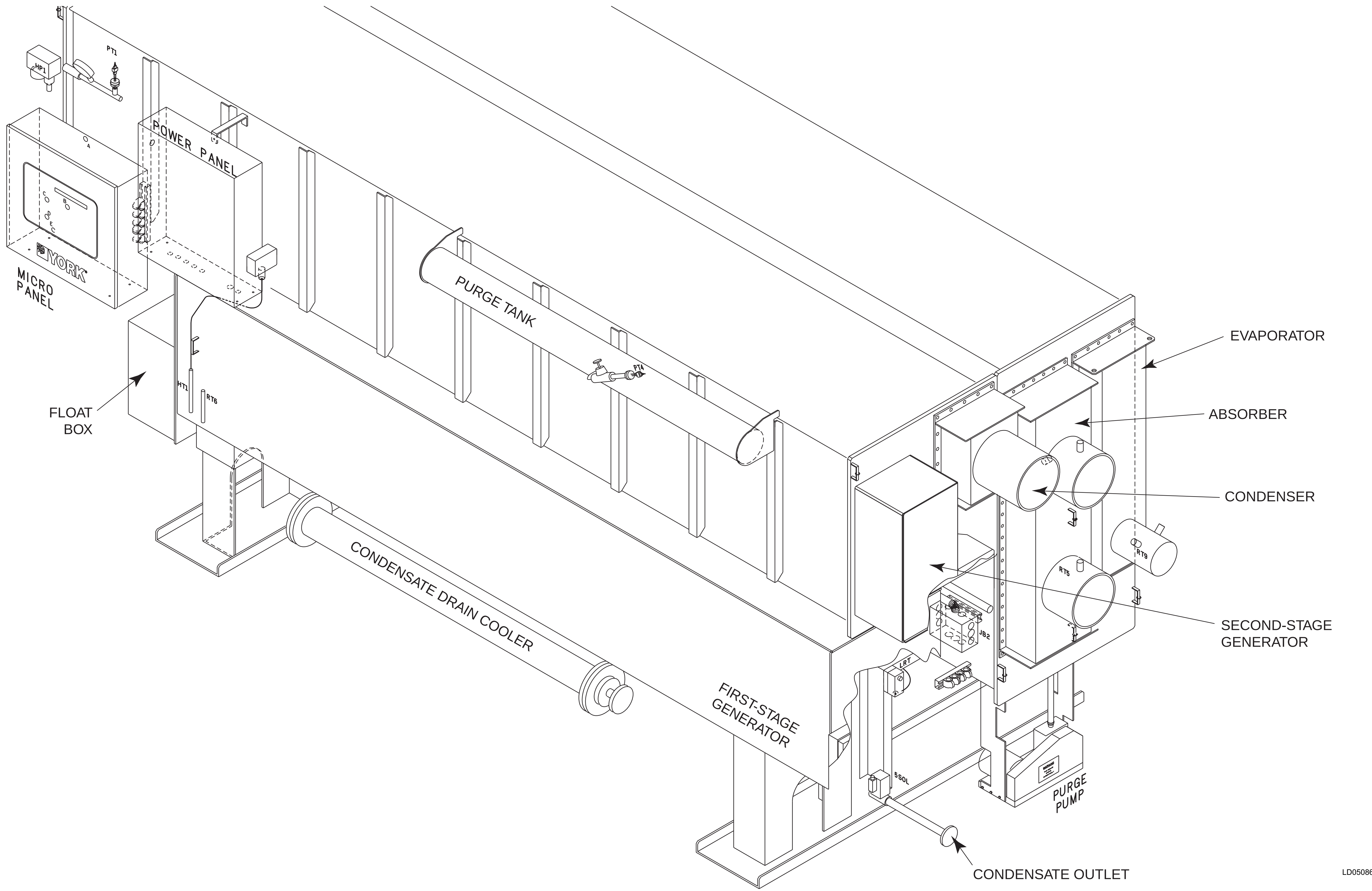


FIG. 96 (CONTINUED) – COMPONENT IDENTIFICATION FOR 16SL, 17S STEAM-FIRED UNITS

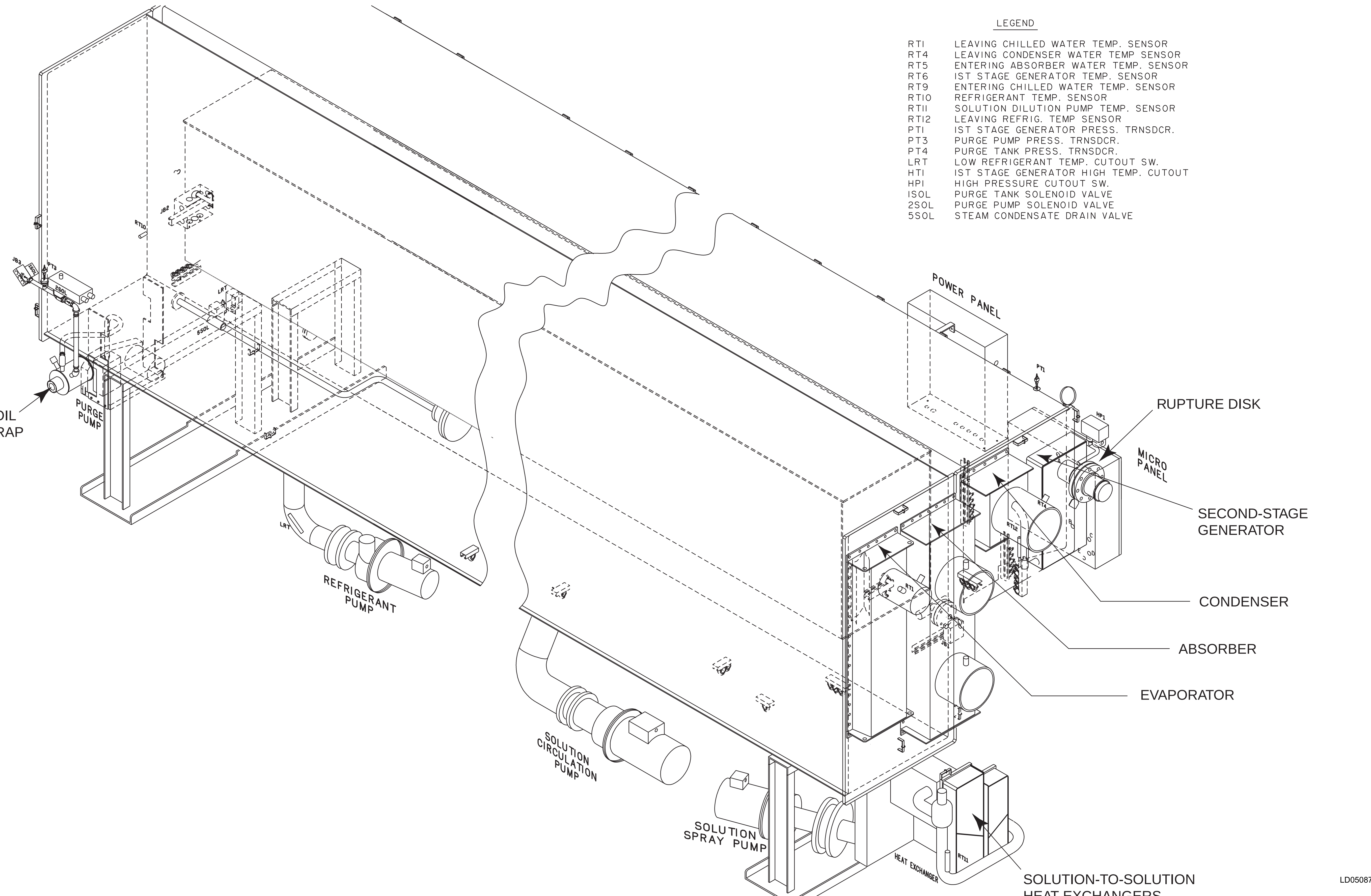


FIG. 96 – COMPONENT IDENTIFICATION FOR 18S, 19S STEAM FIRED UNITS

FORM 155.17-OM1

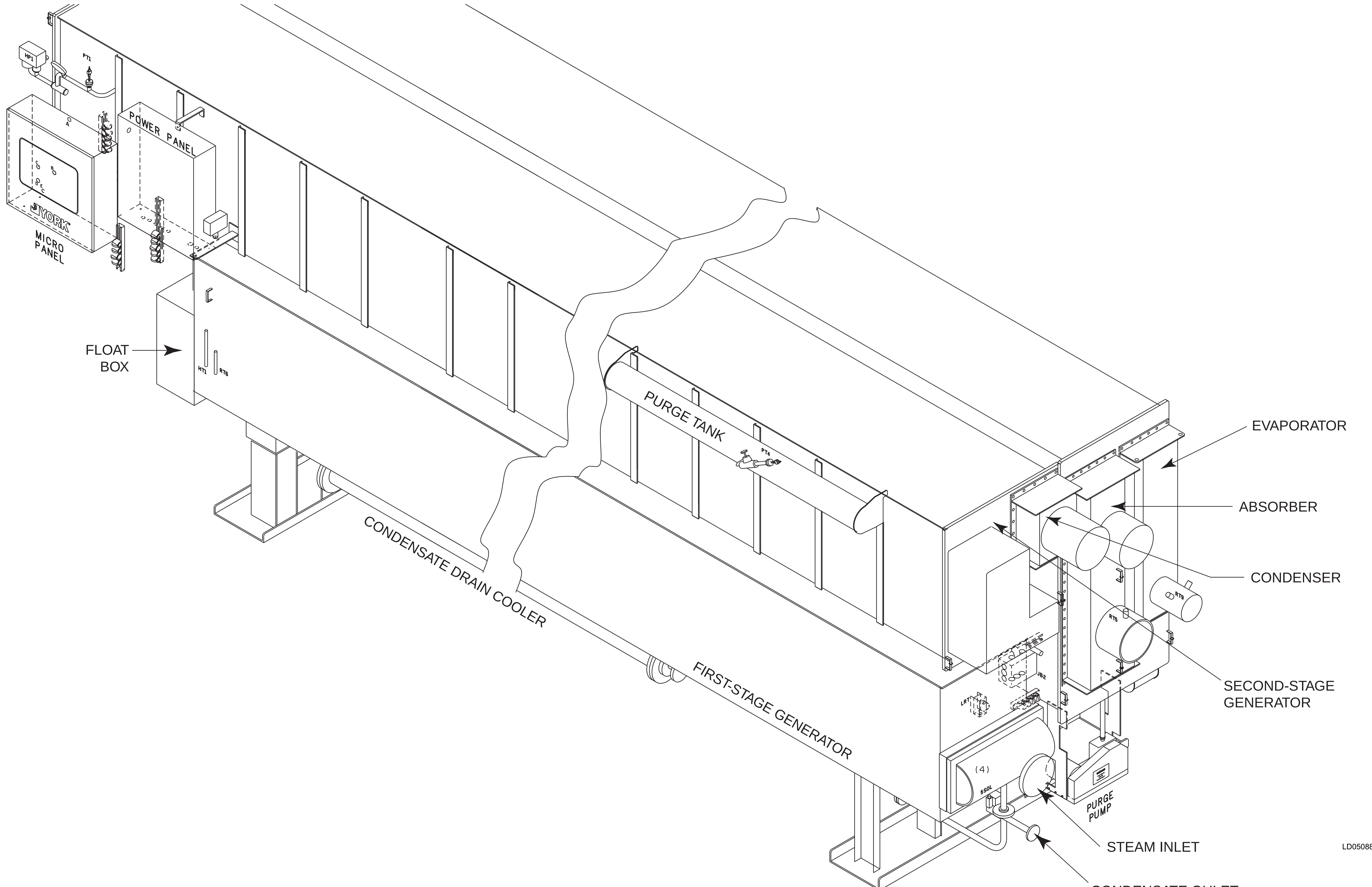


FIG. 97 (CONTINUED) – COMPONENT IDENTIFICATION FOR 18S, 19S STEAM-FIRED UNITS

APPENDIX D – FORMS

WEEKLY RECORD OF OPERATION – CHILLER / HEATER REPORT

OPERATOR						WEEK ENDING ____ / ____ / ____				
OPERATION: COOLING ____ HEATING ____ SIMULTANEOUS ____										
DESCRIPTION			S	M	TU	W	TH	F	S	
1.	TIME INFORMATION RECORDED (am – pm)									
2.	MACHINE ROOM TEMPERATURE (°F)									
3.	AMBIENT TEMPERATURE (°F)									
4.	GAS CONSUMPTION (METER READING)									
5.	GAS FIRING RATE (ft3/hr)									
6.	OIL CONSUMPTION RATE (Gal/m)									
7.	OIL SUPPLY PRESSURE (psi)									
8.	OIL RETURN PRESSURE (psi)									
9.	OIL PUMP INLET PRESSURE (psi)									
10.	EXHAUST GAS TEMPERATURE (°F)									
11.	CHILLED WATER	ENTER TEMPERATURE °F								
12.		LEAVE TEMPERATURE °F								
13.		ENTER PRESSURE psi								
14.		LEAVE PRESSURE psi								
15.	COOLING WATER	ENTER TEMPERATURE °F								
16.		LEAVE TEMPERATURE °F								
17.		ENTER PRESSURE psi								
18.		LEAVE PRESSURE psi								
19.	HOT WATER	ENTER TEMPERATURE °F								
20.		LEAVE TEMPERATURE °F								
21.		ENTER PRESSURE (psi)								
22.		LEAVE PRESSURE (psi)								
23.	HIGH-TEMP GENERATOR PRESSURE (mmHg)									
24.	HIGH-TEMP GENERATOR TEMPERATURE (°F)									
25.	SOLUTION TEMPERATURE (°F)									
26.	BURNER FLAME STABILITY									
27.	ABNORMAL NOISE									
28.	CHECK: GAS/OIL LINKAGE									
29.	FLUE DAMPERS									
30.	EXHAUST GAS – SMOKE OR SOOT									
31.	GAS / OIL LINES FOR LEAKAGE									
32.	IS SOLUTION / REFRIGERANT PUMP NOISE NORMAL?									
33.	NUMBER OF AUTO PURGES (LAST SEVEN DAYS)									

REMARKS: ____

____

____

____

____

____

____

____

SIGNATURE: ____ **DATE:** _______________

YORK ParaFlow™ Inspection Report

FOR USE ON INSPECTION CONTRACT VISITS

Project Name: ID #

Address

Model No. Serial No. YORK Order: Hrs. of Operation

By Date Time AM PM

MACHINE OPERATING MODE: Chilling ☐ Heating ☐ % LOAD TYPE OF VISIT: Every Service Visit / Change/Over (Seasonal) / Performed As Required

D

Chilled Water	Inlet Temp (°F)	
	Outlet Temp (°F)	
	ΔP (psi)	
Condenser Water	Inlet Temp (°F)	
	Outlet Temp (°F)	
	ΔP (psi)	
High Temp Generator	Solution In Temp (°F)	
	Solution Out Temp (°F)	
	Pressure (mm HG)	
	Concentration (%) (Optional)	
Low Temp Generator	Solution In Temp (°F)	
	Solution Out Temp (°F)	
	Refrigerant Out Temp (°F)	
	Concentration (%) (Optional)	
Absorber	Solution Out Temp (°F)	
	Sol. Concentration (%) (Required)	
	Abs. Spray Temp (°F)	
Condenser	Refrigerant Out Temp (°F)	
Evaporator	Refrigerant Temp (°F)	
Steam Models	Stm. Inlet Press. (PSIG)	
	Condensate Press. (PSIG)	
Heat Rec. Models	Gas Ent. Temp (°F)	
	Gas Lvg. Temp (°F)	
Purge Counters (if applicable)	Auto Lifetime	
	Auto 7 Day	
	Manual Lifetime	
	Manual 7 Day	

SERVICES PERFORMED

1. Operational check of all controls ☐
2. Check refrigerant concentration ☐
3. Refrigerant blowdown ☐
4. Refrigerant added ____ gals ☐
5. Refrigerant removed ____ gals ☐
6. Check solution level ☐
7. Solution added ____ gals ☐
8. Solution removed ____ gals ☐
9. Solution sample taken ☐ Yes ☐ No ☐
10. Octyl alcohol added ____ gals. ☐
11. Inhibitor / hydroxide added type ____ lbs ☐
12. Perform air leakage test and indicate length of time (hrs.) Abso ____ cc/min Purge Tank ____ cc/min ____ hrs ☐
13. Check torque on carbon type rupture disk flange ☐
14. Check unit level (once/yr.) ☐
15. Steam units
    a. Inspect traps and control valves ☐
    b. Take condensate sample ☐
16. Heat Recovery units
    a. Check control damper operation ☐
    b. Check bypass damper operation ☐
17. Direct Fired Units
    a. Inspect Burner Components ☐
    b. Stack Temperature ____ °F ____ % O_2 ____ % CO_2 ☐

Sketch Area:

Remarks / Recommendations:

Customer Signature

	EVAPORATOR	REFRIGERANT TANK	ABSORBER	HIGH TEMPERATURE GENERATOR	LOW TEMPERATURE GENERATOR
LIQUID LEVEL	O	O O O	O O Tank; O O O Main Shell	O	O

* If unit has additional sight glasses, sketch in and indicate liquid level

WHITE - District/Factory Service CANARY - District/Factory Service PINK - Customer/District Office GOLDENROD - Service Technician

APPENDIX E – USEFUL CHARTS

SPECIFIC GRAVITY - CONCENTRATION TABLES
AQUEOUS LiBr SOLUTIONS

Refrigerant Table (%LiBr by Weight)

Temperature ˚F

S.G.	40	45	50	55	60	65	70	75	80	85	90	95	100
1.00	—	—	—	—	—	—	0.08	0.18	0.28	0.37	0.47	0.57	0.67
1.01	0.98	1.08	1.17	1.27	1.37	1.47	1.56	1.66	1.76	1.85	1.95	2.05	2.15
1.02	2.43	2.52	2.62	2.72	2.82	2.91	3.01	3.11	3.20	3.30	3.40	3.50	3.59
1.03	3.84	3.94	4.03	4.13	4.23	4.33	4.42	4.52	4.62	4.72	4.81	4.91	5.01
1.04	5.22	5.32	5.42	5.51	5.61	5.71	5.81	5.90	6.00	6.10	6.19	6.29	6.39
1.05	6.57	6.67	6.77	6.87	6.96	7.06	7.16	7.26	7.35	7.45	7.55	7.64	7.74

Solution Tables

Temperature ˚F

S.G	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
1.350	37.27	37.5	37.75	37.98	38.21	38.44	38.67	38.90	39.13	39.35	39.58	39.80	40.02	40.24	40.46	40.68	40.90	41.11	41.33
1.360	38.03	38.26	38.50	38.73	38.96	39.19	39.42	39.64	39.87	40.09	40.31	40.53	40.75	40.97	41.19	41.41	41.62	41.83	42.05
1.370	38.78	39.01	39.24	39.47	39.70	39.93	40.15	40.38	40.60	40.82	41.04	41.26	41.48	41.69	41.91	42.12	42.34	42.55	42.76
1.380	39.52	39.75	39.98	40.20	40.43	40.66	40.88	41.10	41.32	41.54	41.76	41.98	42.20	42.41	42.62	42.83	43.04	43.25	43.46
1.390	40.25	40.48	40.70	40.93	41.16	41.38	41.60	41.82	42.04	42.26	42.48	42.69	42.90	43.12	43.33	43.54	43.75	43.95	44.16
1.400	40.97	41.20	41.42	41.65	41.87	42.09	42.31	42.53	42.75	42.97	43.18	43.39	43.61	43.82	44.03	44.23	44.44	44.64	44.85
1.410	41.69	41.91	42.14	42.36	42.58	42.80	43.02	43.24	43.45	43.67	43.88	44.09	44.30	44.51	44.72	44.92	45.12	45.33	45.53
1.420	42.39	42.62	42.84	43.06	43.28	43.50	43.72	43.93	44.15	44.36	44.57	44.78	44.99	45.19	45.40	45.60	45.80	46.00	46.20
1.430	43.10	43.32	43.54	43.76	43.98	44.19	44.41	44.62	44.83	45.04	45.25	45.46	45.67	45.87	46.07	46.27	46.47	46.67	46.87
1.440	43.79	44.01	44.23	44.45	44.66	44.88	45.09	45.30	45.51	45.72	45.93	46.13	46.34	46.54	46.74	46.94	47.14	47.33	47.53
1.450	44.47	44.69	44.91	45.13	45.34	45.55	45.76	45.97	46.18	46.39	46.59	46.80	47.00	47.20	47.40	47.60	47.79	47.99	48.18
1.460	45.15	45.37	45.58	45.80	46.01	46.22	46.43	46.6	446.85	47.05	47.25	47.46	47.66	47.85	48.05	48.25	48.44	48.63	48.82
1.470	45.82	46.03	46.25	46.46	46.67	46.88	47.09	47.30	47.50	47.70	47.91	48.11	48.30	48.50	48.70	48.89	49.08	49.27	49.46
1.480	46.48	46.69	46.91	47.12	47.33	47.54	47.74	47.95	48.15	48.35	48.55	48.75	48.94	49.14	49.33	49.52	49.71	49.90	50.09
1.490	47.13	47.35	47.56	47.77	47.97	48.18	48.38	48.59	48.79	48.99	49.19	49.38	49.58	49.77	49.96	50.15	50.34	50.53	50.71
1.500	47.78	47.99	48.20	48.41	48.61	48.82	49.02	49.22	49.42	49.62	49.82	50.01	50.20	50.39	50.58	50.77	50.96	51.14	51.33
1.510	48.42	48.63	48.84	49.04	49.25	49.45	49.65	49.85	50.05	50.24	50.44	50.63	50.82	51.01	51.20	51.38	51.57	51.75	51.93
1.520	49.05	49.26	49.46	49.67	49.87	50.07	50.27	50.47	50.66	50.86	51.05	51.24	51.43	51.62	51.80	51.99	52.17	52.35	52.53
1.530	49.67	49.88	50.08	50.28	50.49	50.68	50.88	51.08	51.27	51.46	51.66	51.84	52.03	52.22	52.40	52.59	52.77	52.95	53.12
1.540	50.29	50.49	50.69	50.89	51.09	51.29	51.49	51.68	51.87	52.06	52.25	52.44	52.63	52.81	52.99	53.18	53.36	53.53	53.71
1.550	50.89	51.10	51.30	51.50	51.69	51.89	52.08	52.28	52.47	52.66	52.84	53.03	53.21	53.40	53.58	53.76	53.94	54.11	54.29
1.560	51.49	51.69	51.89	52.09	52.29	52.48	52.67	52.86	53.05	53.24	53.43	53.61	53.79	53.97	54.15	54.33	54.51	54.68	54.86
1.570	52.09	52.28	52.48	52.68	52.87	53.06	53.25	53.44	53.6	353.82	54.00	54.18	54.37	54.55	54.72	54.90	55.07	55.25	55.42
1.580	52.67	52.87	53.06	53.26	53.45	53.64	53.83	54.02	54.20	54.39	54.57	54.75	54.93	55.11	55.28	55.46	55.63	55.80	55.97
1.590	53.25	53.44	53.64	53.83	54.02	54.21	54.39	54.58	54.77	54.95	55.13	55.31	55.49	55.66	55.84	56.01	56.18	56.35	56.52
1.600	53.81	54.01	54.20	54.39	54.58	54.77	54.95	55.14	55.32	55.50	55.68	55.86	56.04	56.21	56.38	56.55	56.72	56.89	57.06
1.610	54.37	54.57	54.76	54.95	55.13	55.32	55.50	55.69	55.87	56.05	56.23	56.40	56.58	56.75	56.92	57.09	57.26	57.43	57.59
1.620	54.93	55.12	55.31	55.49	55.68	55.86	56.05	56.23	56.41	56.59	56.76	56.94	57.11	57.28	57.45	57.62	57.79	57.95	58.12
1.630	55.47	55.66	55.85	56.03	56.22	56.40	56.58	56.76	56.94	57.12	57.29	57.46	57.64	57.81	57.97	58.14	58.31	58.47	58.63
1.640	56.01	56.20	56.38	56.57	56.75	56.93	57.11	57.29	57.46	57.64	57.81	57.98	58.15	58.32	58.49	58.66	58.82	58.98	59.14
1.650	56.54	56.72	56.91	57.09	57.27	57.45	57.63	57.81	57.98	58.15	58.33	58.50	58.67	58.83	59.00	59.16	59.32	59.49	59.65
1.660	57.06	57.25	57.43	57.61	57.79	57.97	58.14	58.32	58.49	58.66	58.83	59.00	59.17	59.33	59.50	59.66	59.82	59.98	60.14
1.670	57.58	57.76	57.94	58.12	58.29	58.47	58.65	58.82	58.99	59.16	59.33	59.50	59.66	59.83	59.99	60.15	60.31	60.47	60.63
1.680	58.08	58.26	58.44	58.62	58.79	58.97	59.14	59.31	59.48	59.65	59.82	59.99	60.15	60.31	60.48	60.64	60.79	60.95	61.11
1.690	58.58	58.76	58.94	59.11	59.29	59.46	59.63	59.80	59.97	60.14	60.30	60.47	60.63	60.79	60.95	61.11	61.27	61.43	61.58
1.700	59.07	59.25	59.42	59.60	59.77	59.94	60.11	60.28	60.45	60.61	60.78	60.94	61.10	61.26	61.42	61.58	61.74	61.89	62.05
1.710	59.55	59.73	59.90	60.08	60.25	60.42	60.59	60.75	60.92	61.08	61.25	61.41	61.57	61.73	61.89	62.04	62.20	62.35	62.50
1.720		60.20	60.38	60.55	60.72	60.88	61.05	61.22	61.38	61.54	61.71	61.87	62.03	62.18	62.34	62.50	62.65	62.80	62.95
1.730		60.67	60.84	61.01	61.18	61.34	61.51	61.67	61.84	62.00	62.16	62.32	62.48	62.63	62.79	62.94	63.09	63.25	63.40
1.740		61.13	61.30	61.46	61.63	61.80	61.96	62.12	62.28	62.44	62.60	62.76	62.92	63.07	63.23	63.38	63.53	63.68	63.83
1.750			61.74	61.91	62.08	62.24	62.40	62.56	62.72	62.88	63.04	63.20	63.35	63.51	63.66	63.81	63.96	64.11	64.26
1.760				62.35	62.51	62.68	62.84	63.00	63.16	63.31	63.47	63.62	63.78	63.93	64.08	64.23	64.38	64.53	64.68
1.770				62.78	62.94	63.10	63.26	63.42	63.58	63.74	63.89	64.04	64.20	64.35	64.50	64.65	64.80	64.95	65.09
1.780					63.37	63.52	63.68	63.84	64.00	64.15	64.30	64.46	64.61	64.76	64.91	65.06	65.21	65.35	65.50
1.790					63.78	63.94	64.09	64.25	64.40	64.56	64.71	64.86	65.01	65.16	65.31	65.46	65.60	65.75	65.89
1.800						64.34	64.50	64.65	64.81	64.96	65.11	65.26	65.41	65.56	65.70	65.85	66.00	66.14	66.28
1.810							64.89	65.05	65.20	65.35	65.50	65.65	65.80	65.94	66.09	66.24	66.38	66.52	66.67
1.820								65.43	65.58	65.73	65.88	66.03	66.18	66.32	66.47	66.61	66.76	66.90	67.04
1.830	**CRYSTALLIZATION AREA**								65.96	66.11	66.26	66.41	66.55	66.70	66.84	66.98	67.13	67.27	67.41
1.840										66.48	66.63	66.77	66.92	67.06	67.20	67.35	67.49	67.63	67.77
1.850											66.99	67.13	67.27	67.42	67.56	67.70	67.84	67.98	68.12

FIG. 98 – SPECIFIC GRAVITY - CONCENTRATION TABLES, AQUEOUS LiBr SOLUTIONS

FORM 155.17-OM1

YORK INTERNATIONAL CORPORATION

ParaFlow and IsoFlow

Absorption Liquid Chillers

Useful Conversion Formulas

To convert °C (Centigrade) to °F (Fahrenheit) or F to °C:

$°C = \frac{°F + 40}{1.8} - 40$ $°F = (°C + 40) \times 1.8 - 40$

1 atm (atmosphere at sea level) = 14.696 psia = 0 psig = 760 mmHg = 29.92 in Hg

1 mm Hg = 1000 microns = 0.3937 inch Hg = .01934 psi

1 in Hg = 25.4 mm Hg = .491 psi

1 psi = 2.036 in Hg = 51.7 mm Hg = 2.31 ft H_2O

1 ft H_2O = .433 psi

1 lb = .4536 Kg = 453.6 gms

1 liter = .2641 U.S. gal = 1.057 U.S. quarts

1 U.S. gallon = 3.785 liters

1 inch = 25.4 mm

1 ton refrigeration (12,000 Btu/hr) = 3.52 kW

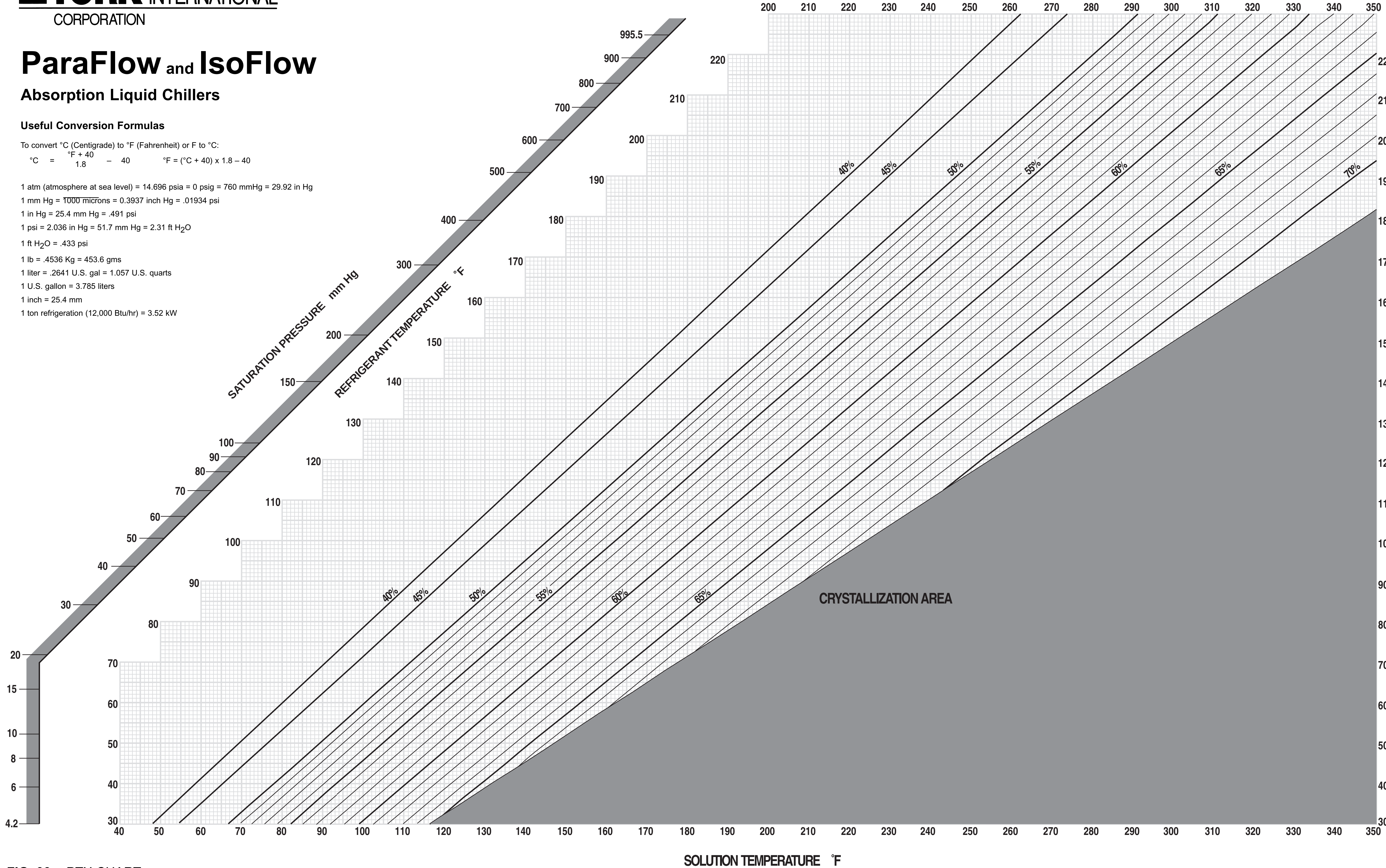


FIG. 99 – PTX CHART

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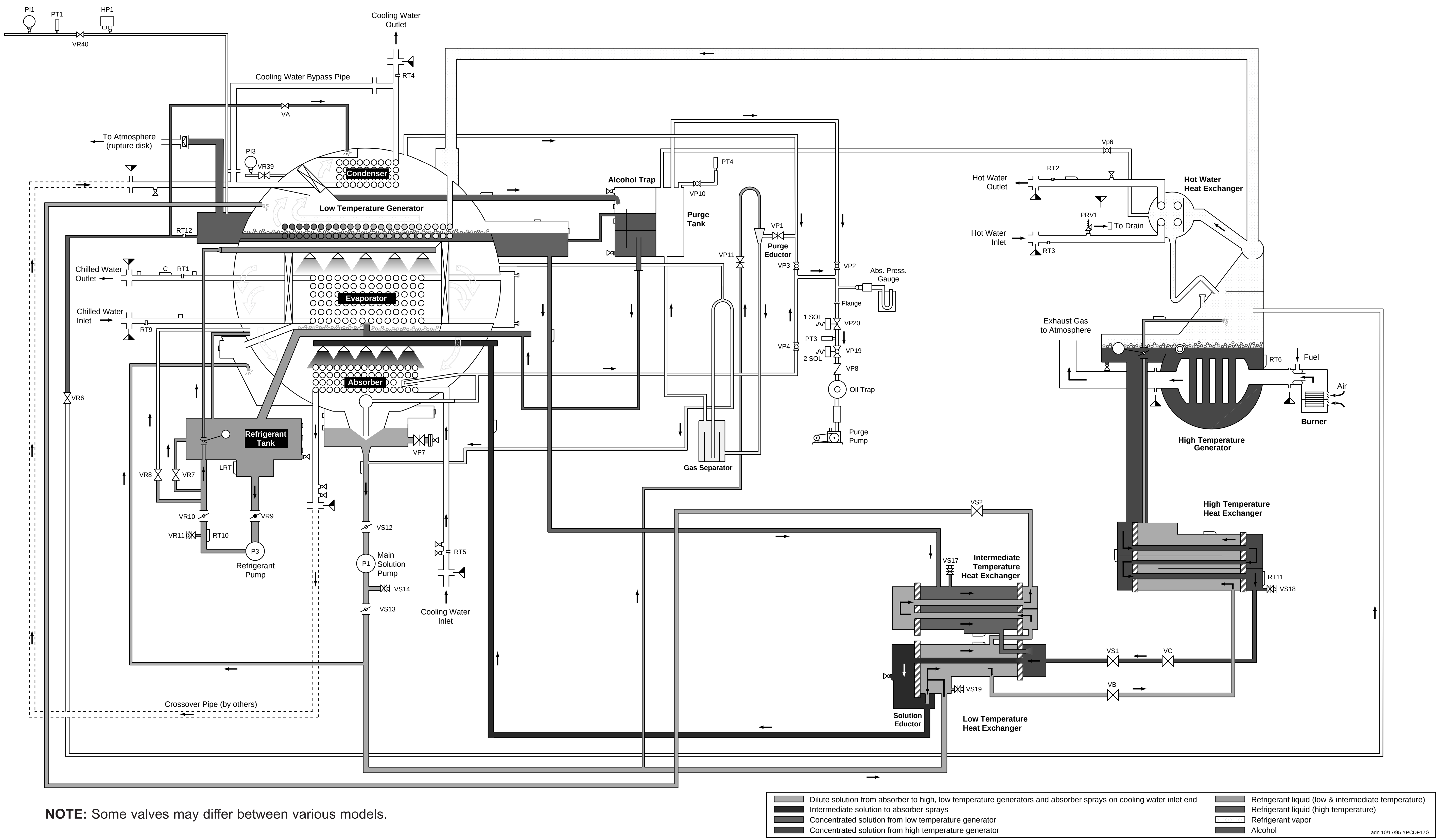
FORM 155.17-OM1

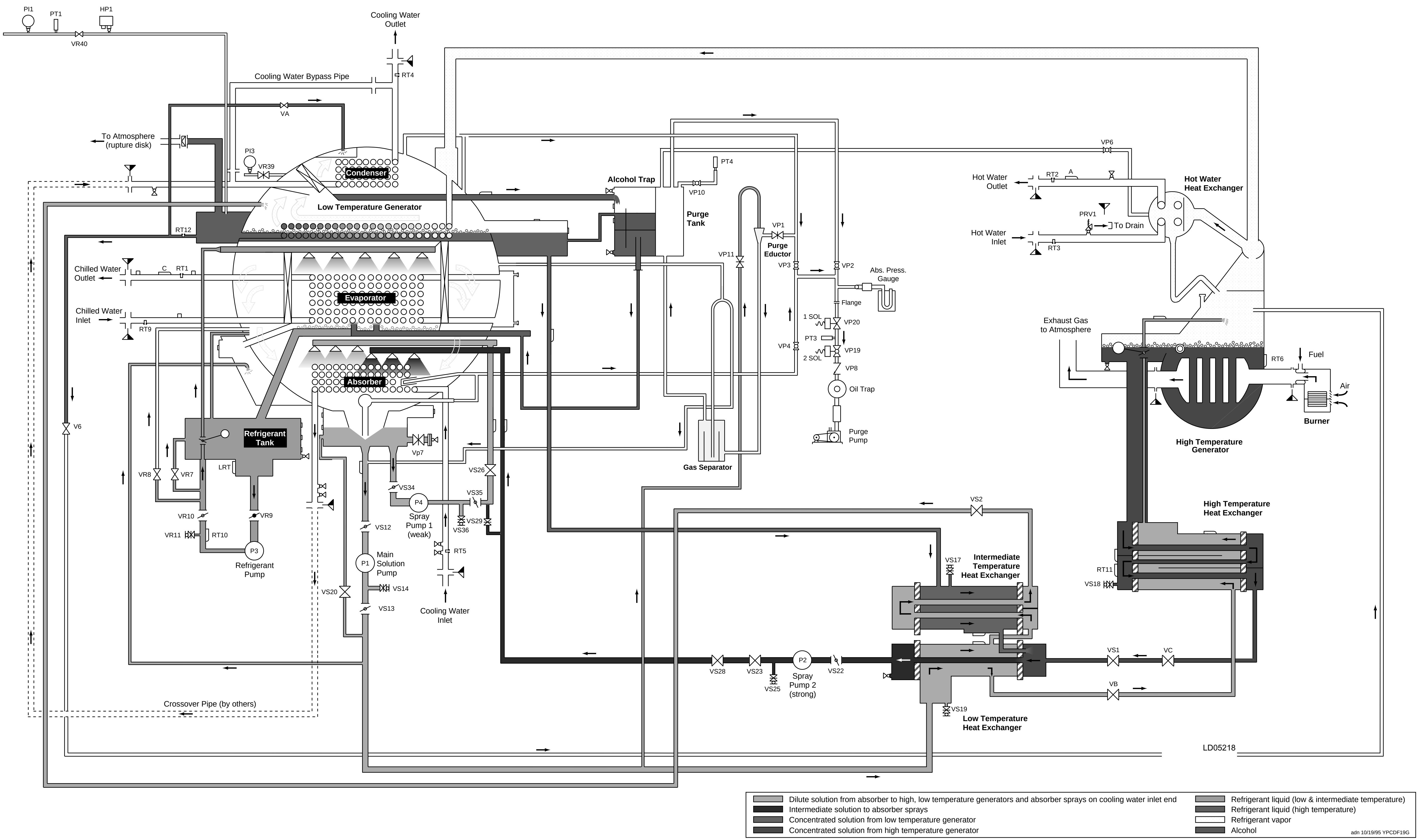
APPENDIX F – FLOW SCHEMATICS



NOTE: Some valves may differ between various models.

LD05217

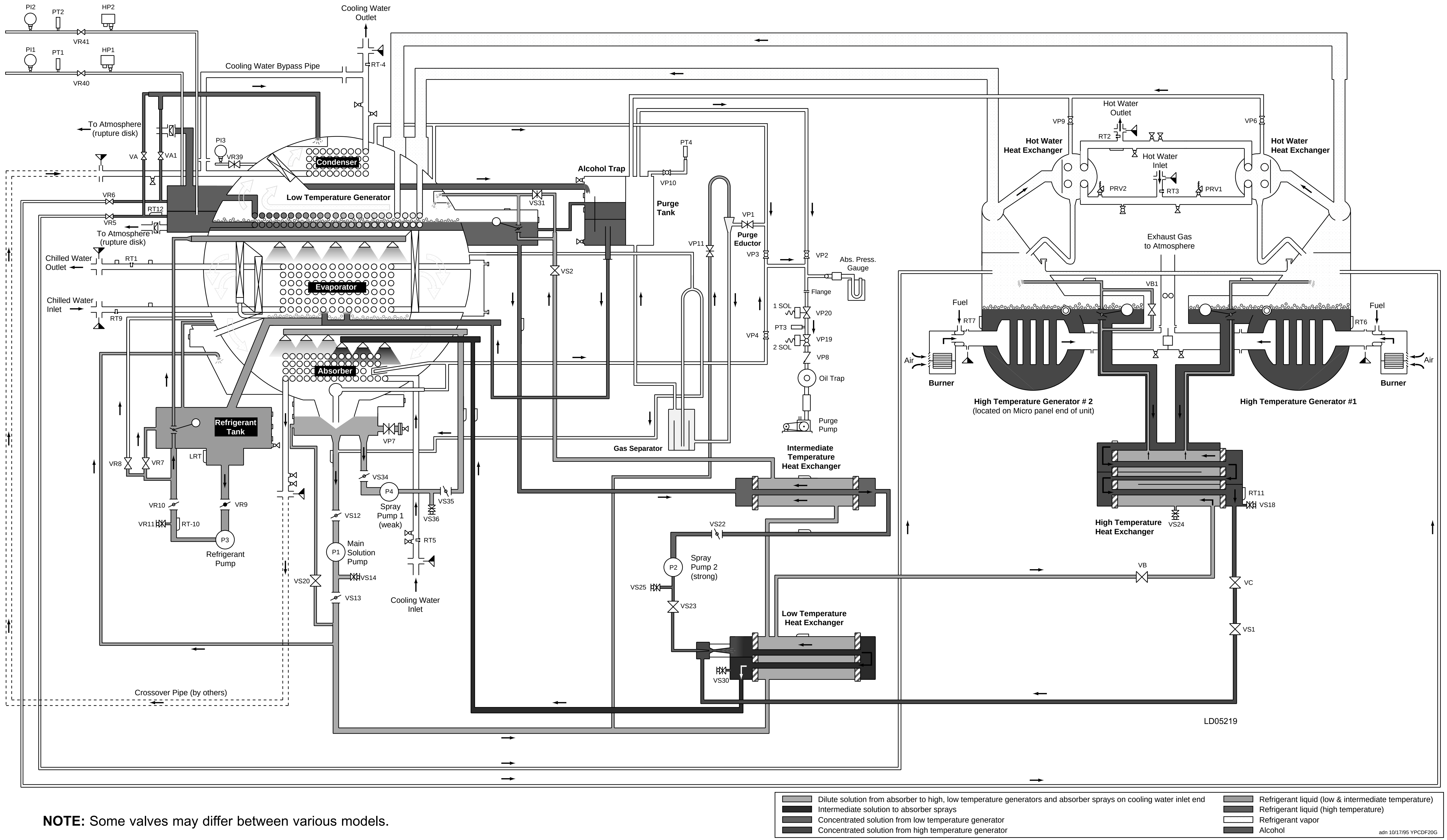
FIG. 100 – FLOW DIAGRAM, MODEL YPC-DF-16G-19G (COOLING MODE)



NOTE: Some valves may differ between various models.

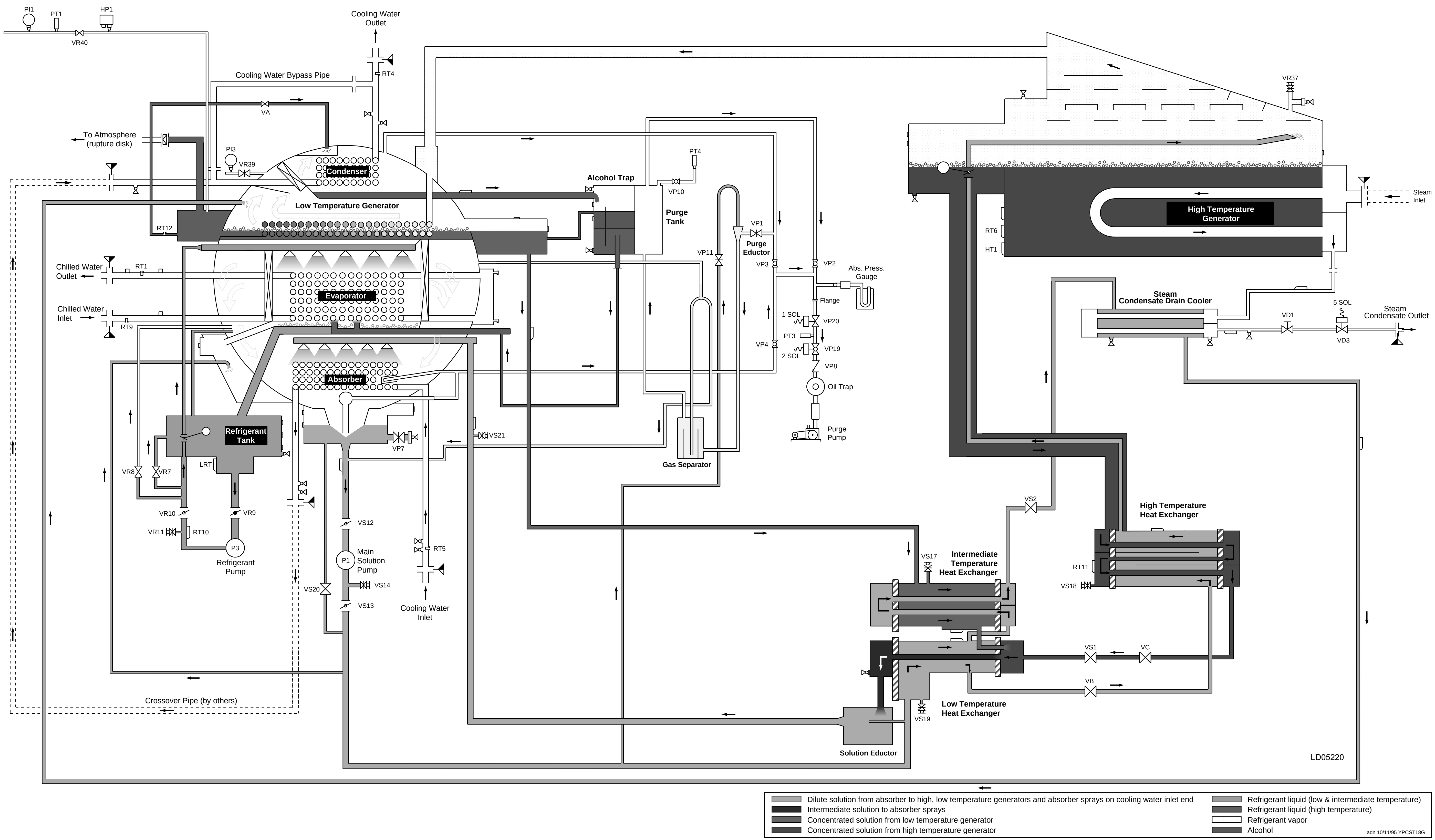
FIG. 101 – FLOW DIAGRAM, MODEL YPC-DF-19GL (COOLING MODE)

FORM 155.17-OM1



NOTE: Some valves may differ between various models.

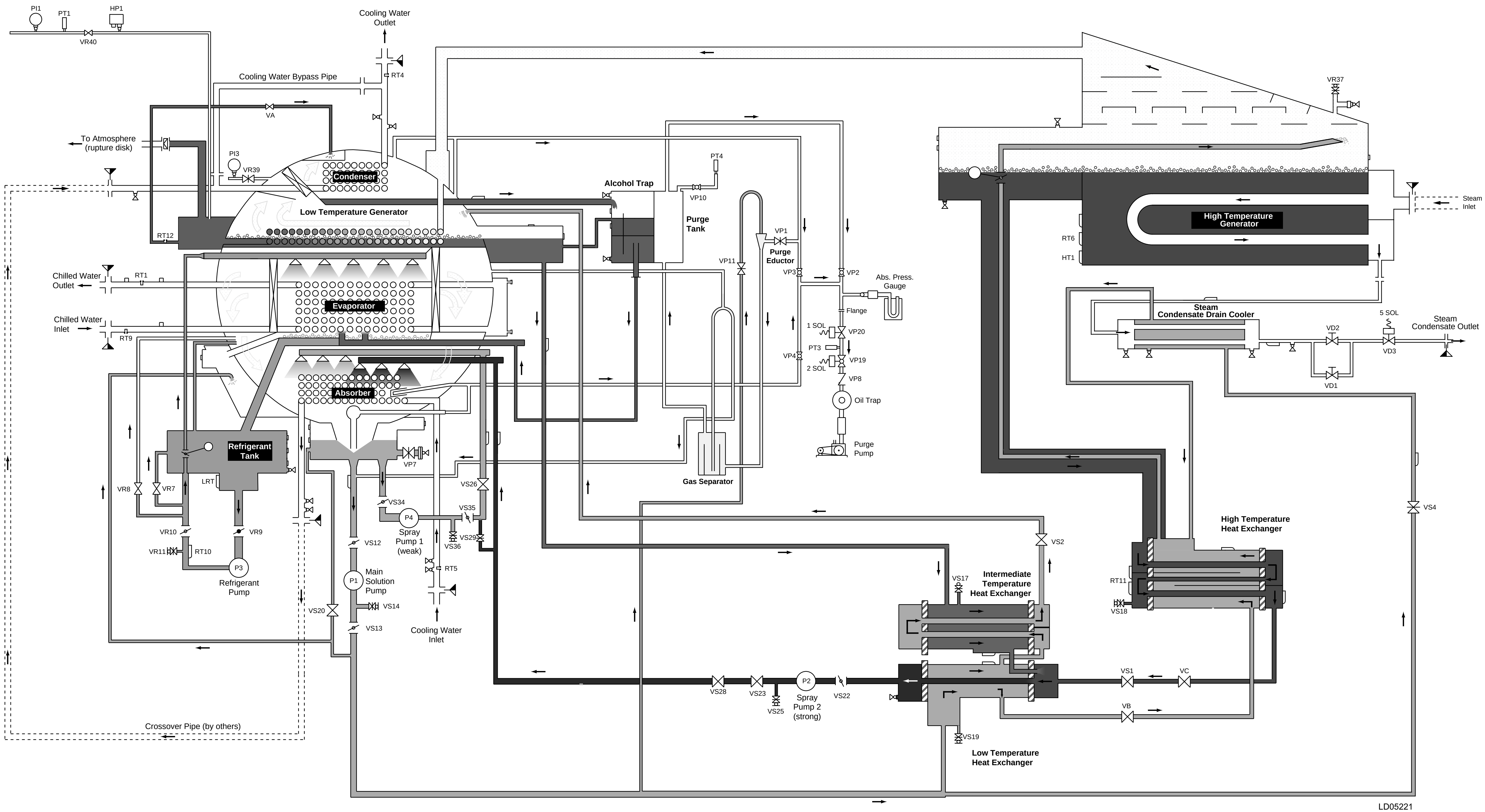
FIG. 102 – FLOW DIAGRAM, MODEL YPC-DF-20G (COOLING MODE)



NOTE: Some valves may differ between various models.

FIG. 103 – FLOW DIAGRAM, MODEL YPC-ST-18G

 FORM 155.17-OM1

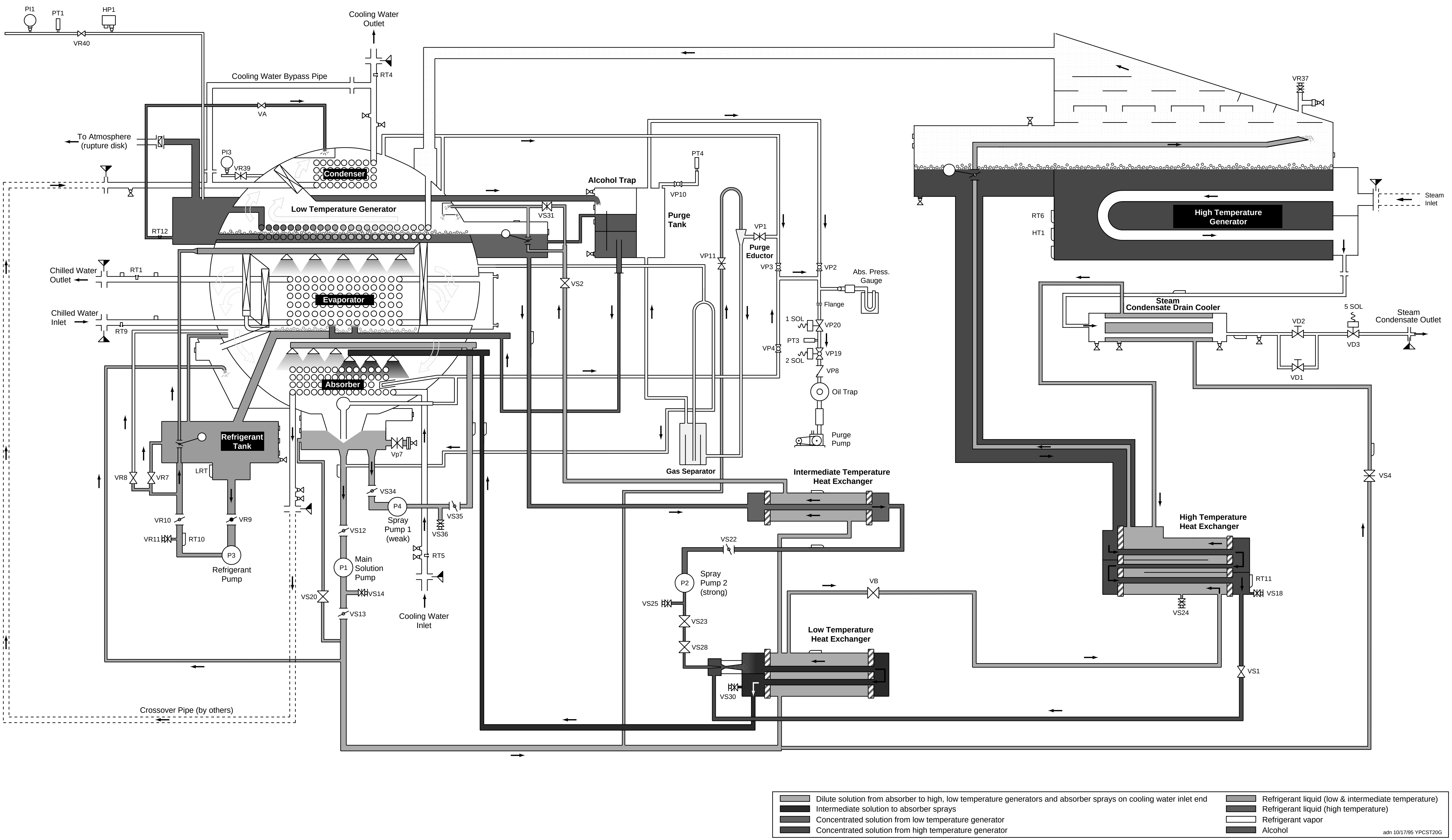


NOTE: Some valves may differ between various models.

- Dilute solution from absorber to high, low temperature generators and absorber sprays on cooling water inlet end
- Intermediate solution to absorber sprays
- Concentrated solution from low temperature generator
- Concentrated solution from high temperature generator
- Refrigerant liquid (low & intermediate temperature)
- Refrigerant liquid (high temperature)
- Refrigerant vapor
- Alcohol

adn 10/12/95 YPCST19G

FIG. 104 – FLOW DIAGRAM, MODEL YPC-ST-19GL



NOTE: Some valves may differ between various models.

LD05222

FIG. 105 – FLOW DIAGRAM, MODEL YPC-ST-20G

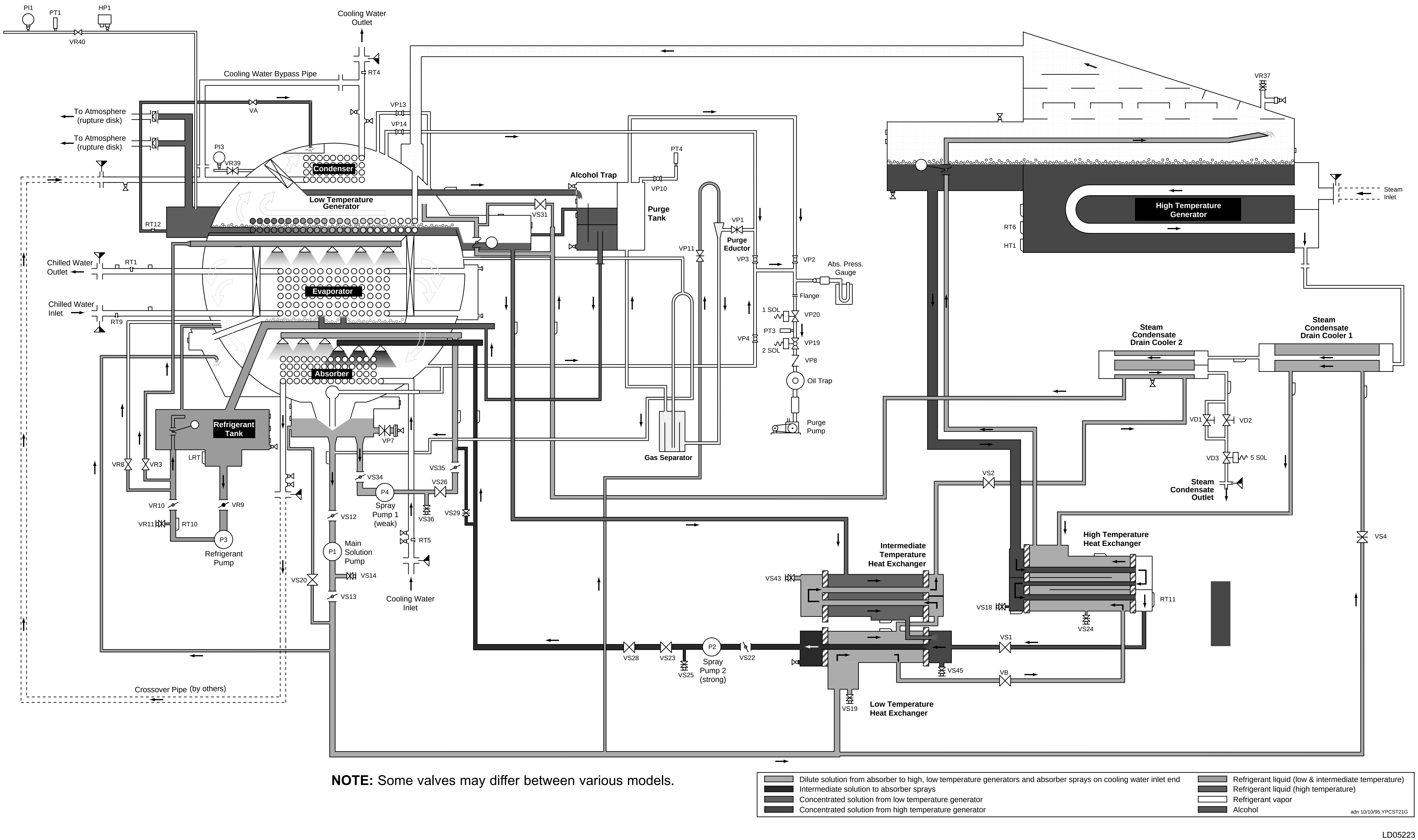
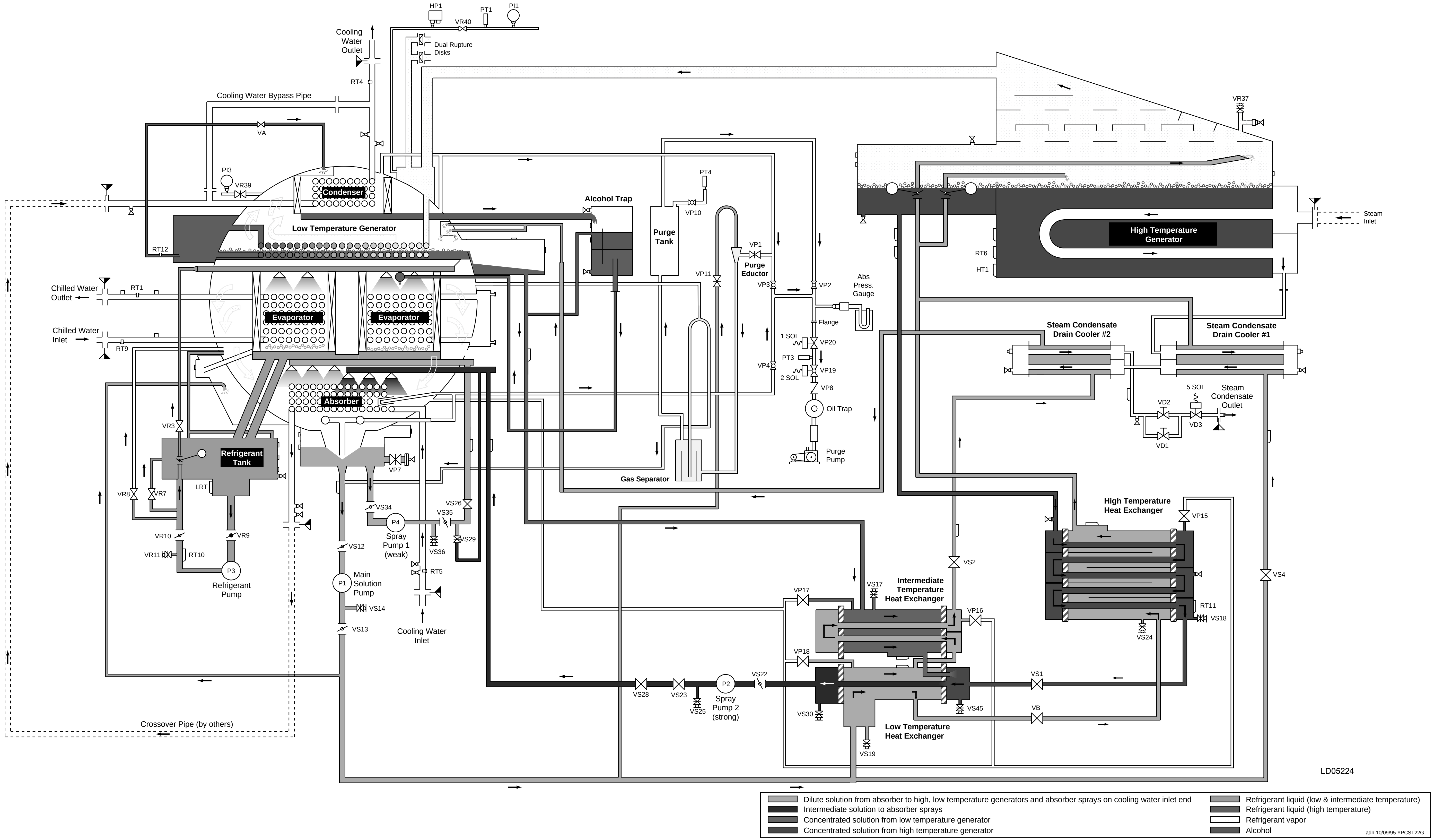


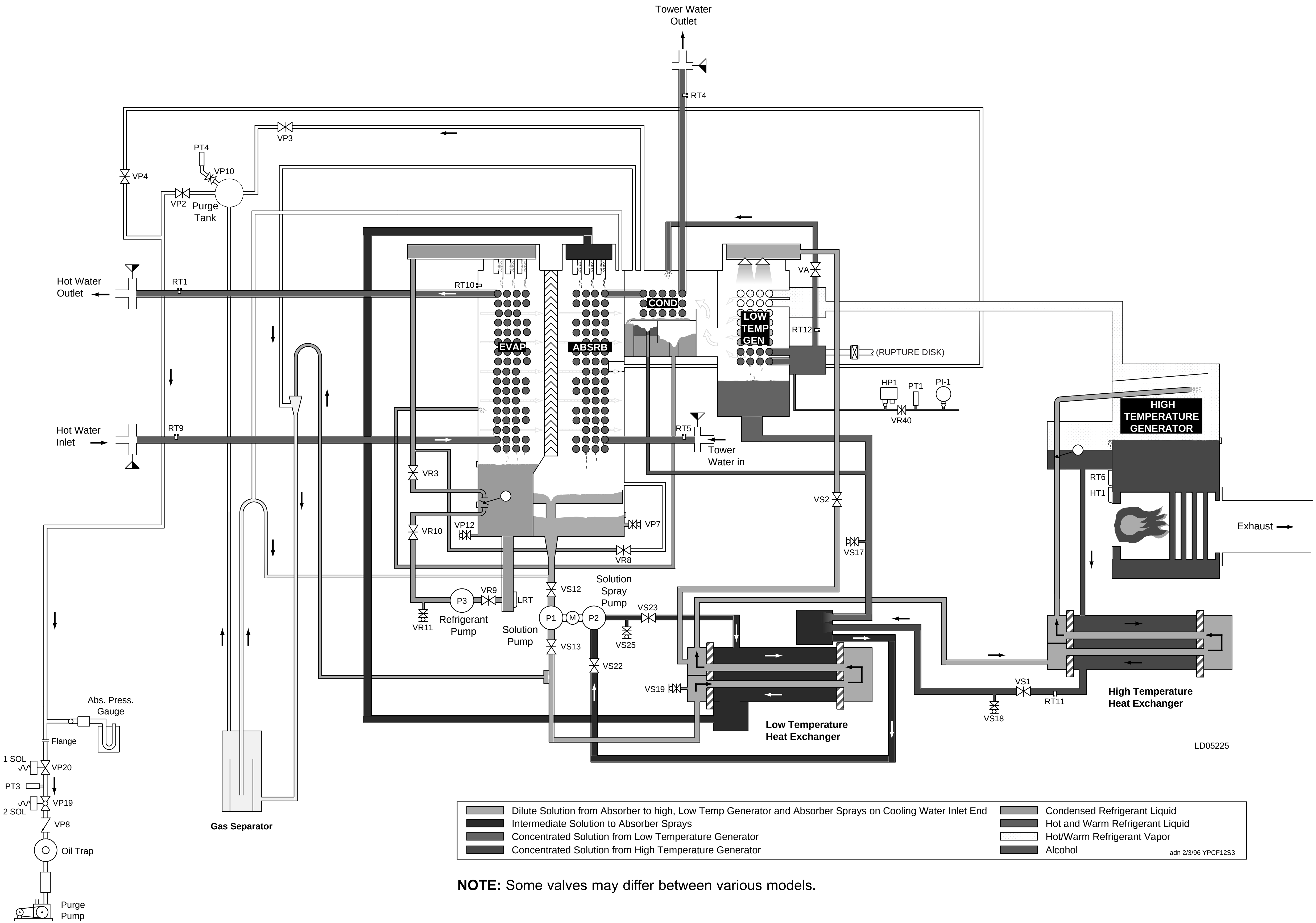
FIG. 106 – FLOW DIAGRAM, MODEL YPC-ST-21G



NOTE: Some valves may differ between various models.

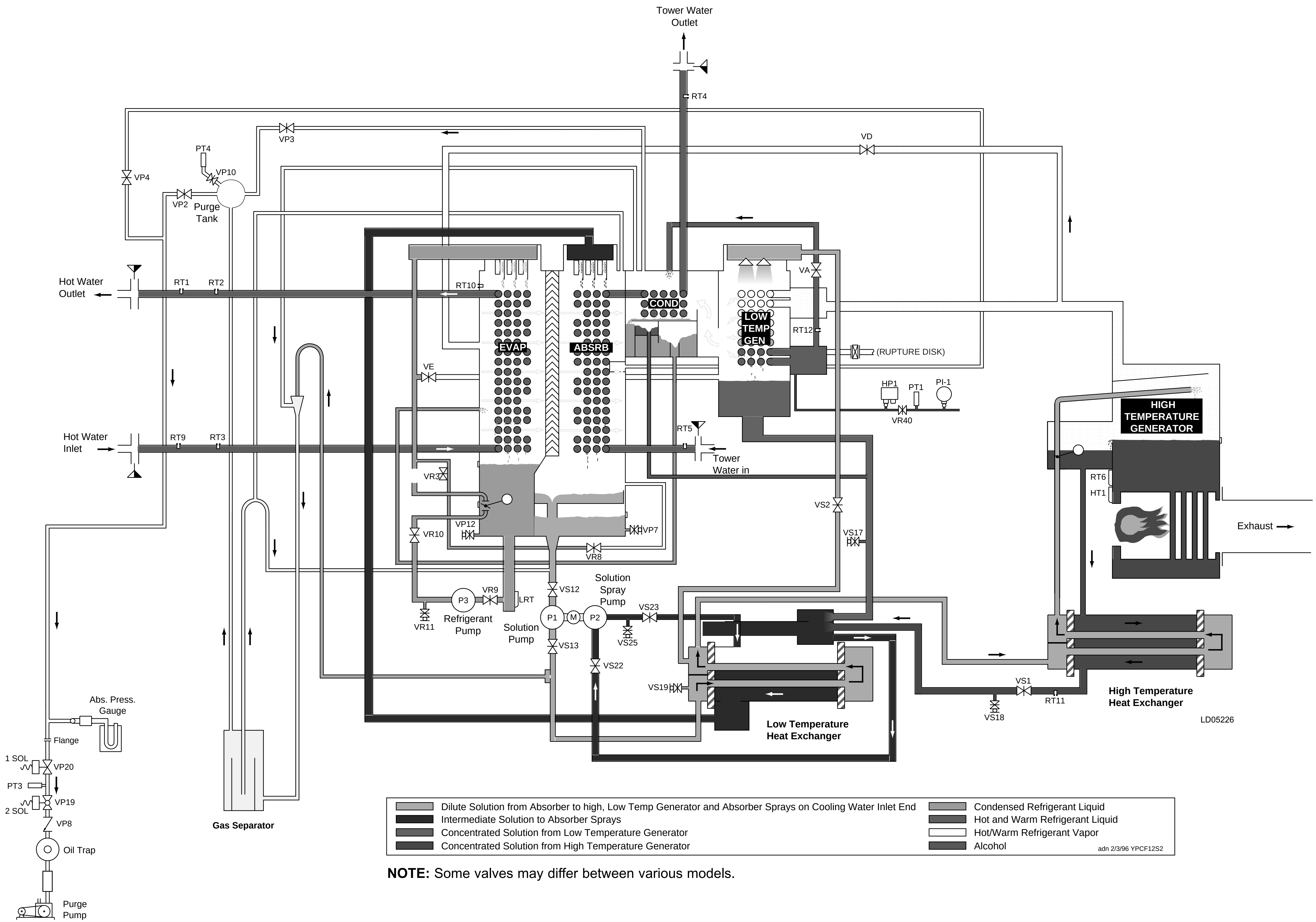
FIG. 107 – FLOW DIAGRAM, MODEL YPC-ST-22G

FORM 155.17-OM1



NOTE: Some valves may differ between various models.

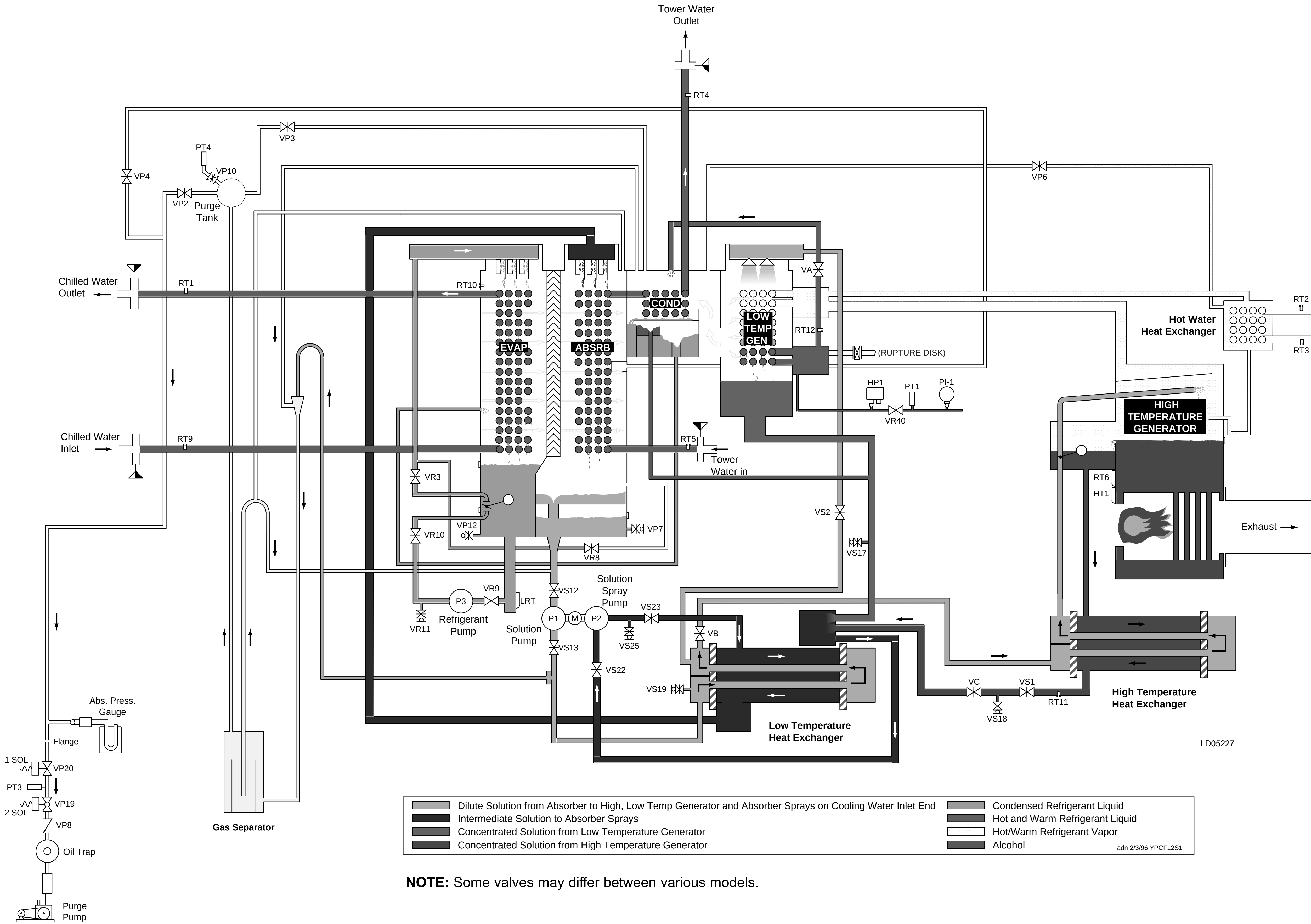
FIG. 108 – FLOW DIAGRAM, MODEL YPC-DF-12SC-15S (COOLING ONLY)



NOTE: Some valves may differ between various models.

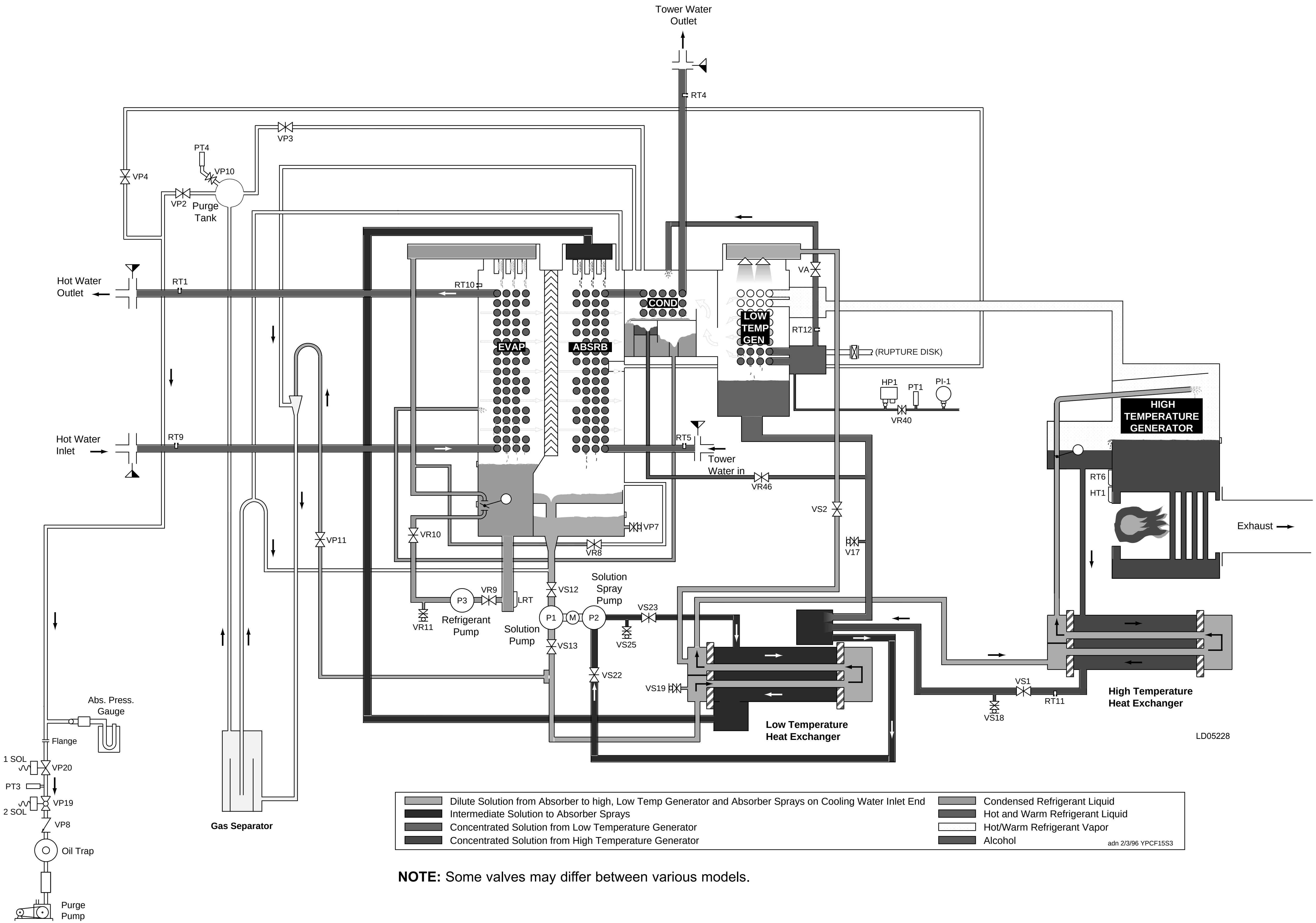
FIG. 109 – FLOW DIAGRAM, MODEL YPC-DF-12SC-15S (STD. HEATING OPTION - COOLING MODE)

FORM 155.17-OM1



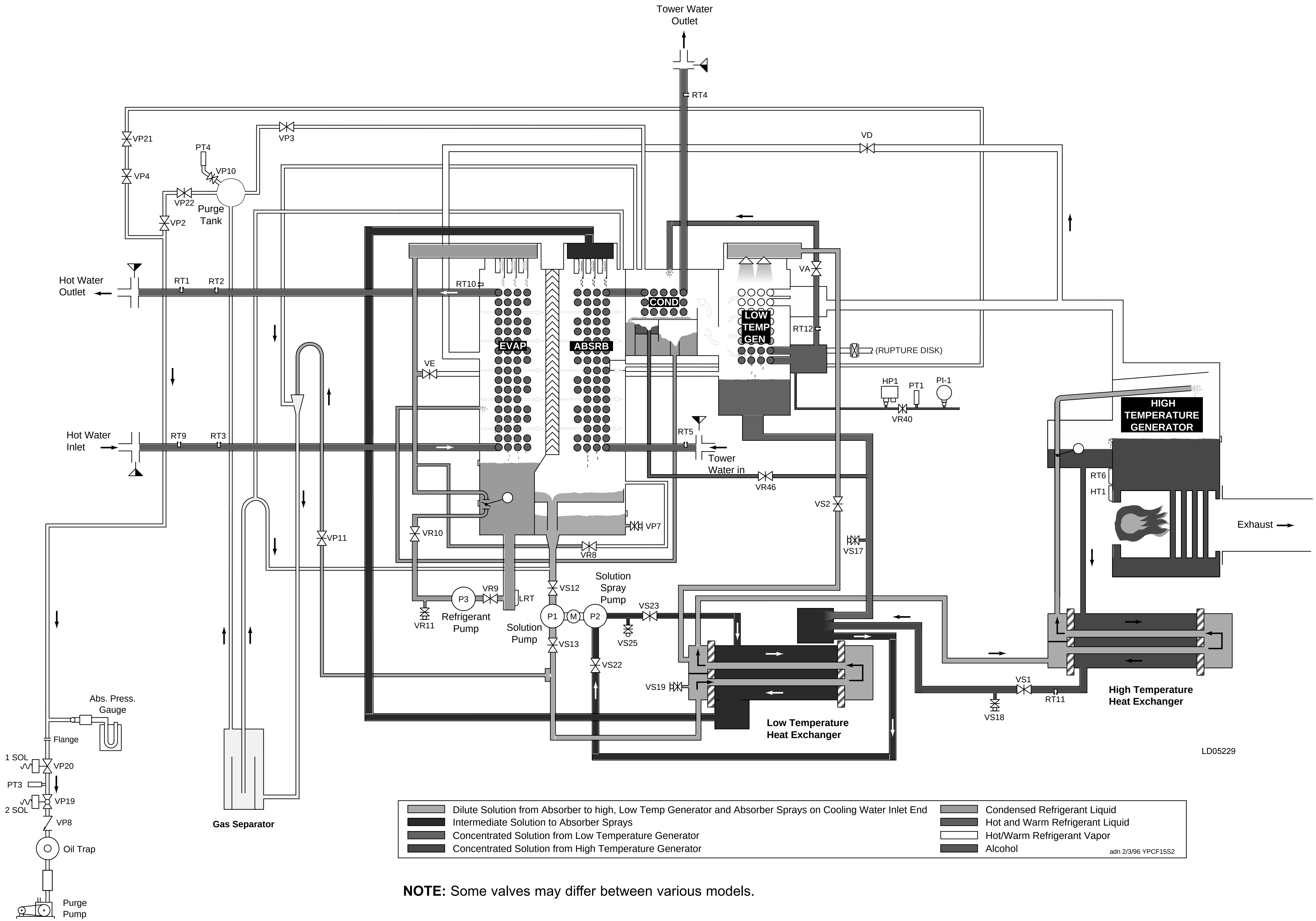
NOTE: Some valves may differ between various models.

FIG. 110 – FLOW DIAGRAM, MODEL YPC-DF-12SC-15S (HIGH TEMPERATURE HEATING OPTION)



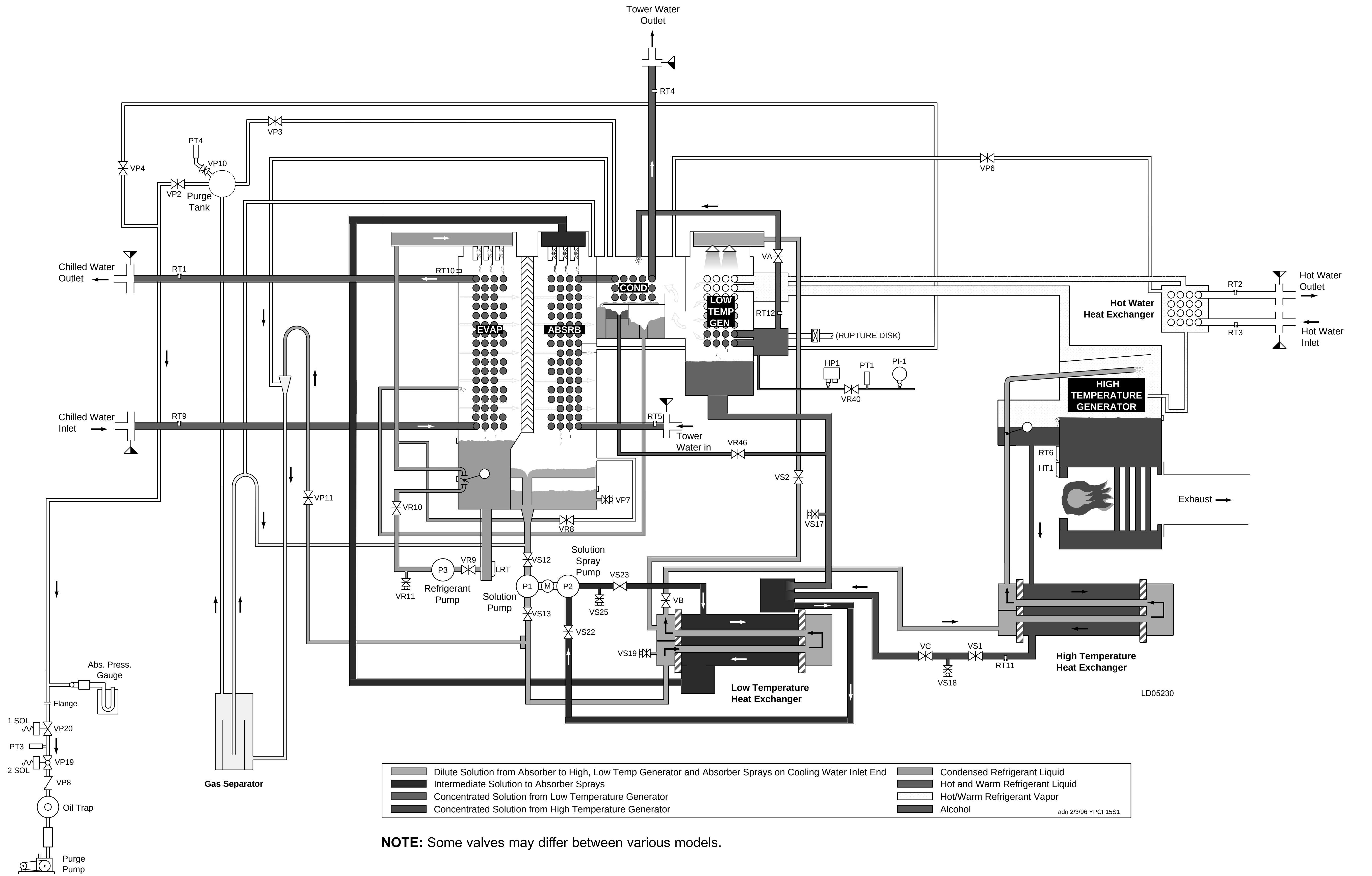
NOTE: Some valves may differ between various models.

FIG. 111 – FLOW DIAGRAM, MODEL YPC-DF-15SL-16S (COOLING ONLY)



NOTE: Some valves may differ between various models.

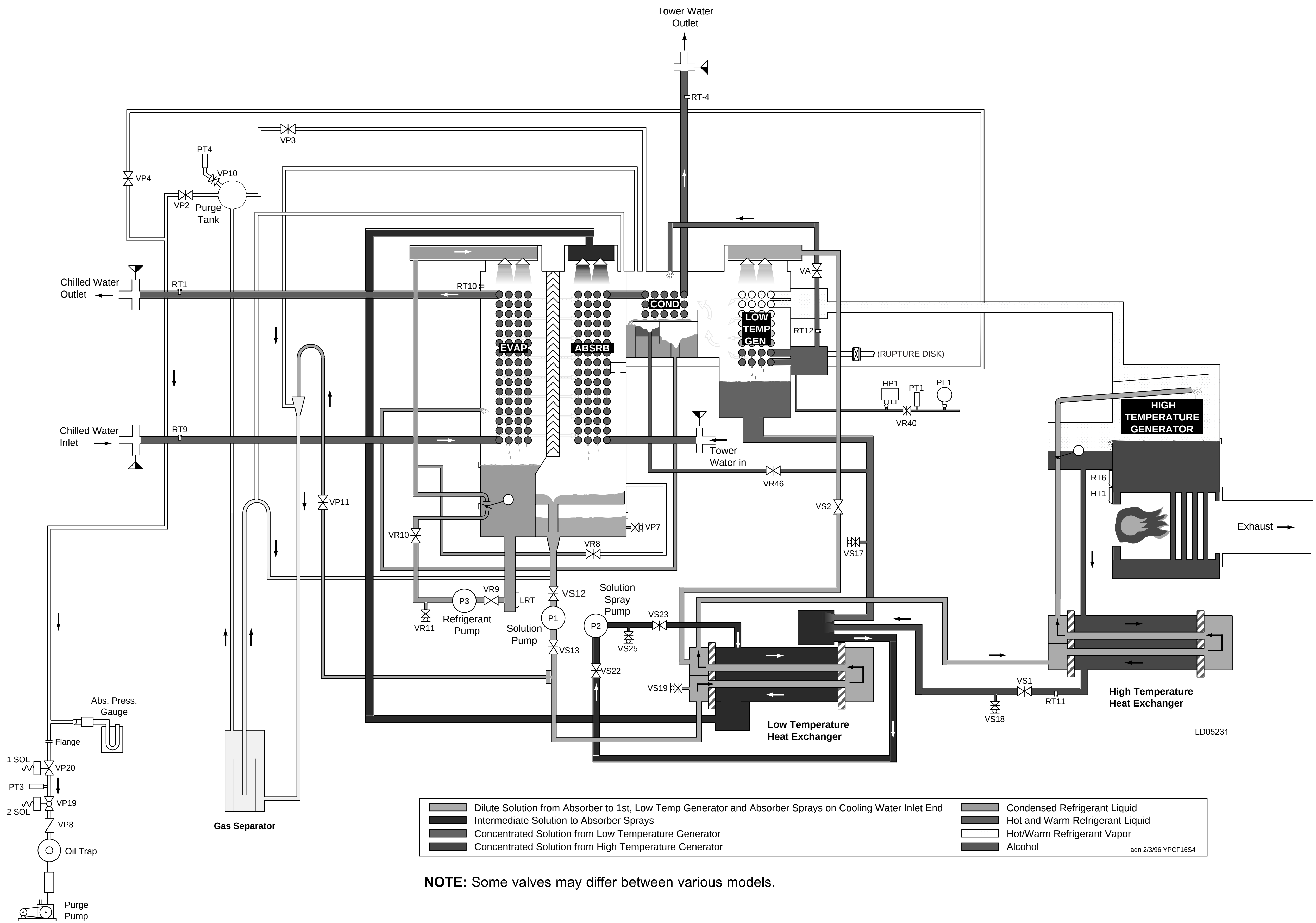
FIG. 112 – FLOW DIAGRAM, MODEL YPC-DF-15SL-16S (STD. HEATING OPTION - COOLING MODE)



NOTE: Some valves may differ between various models.

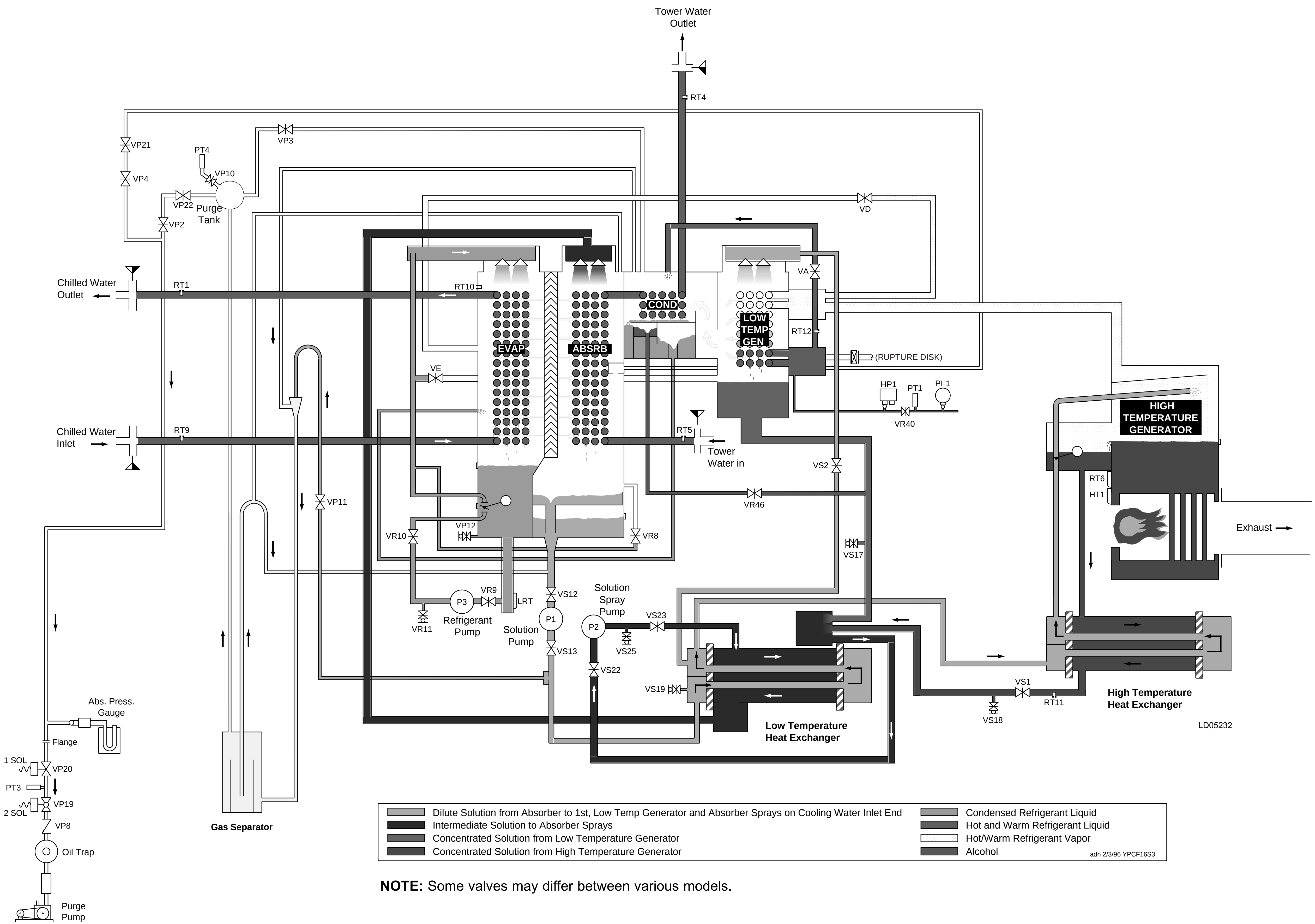
FIG. 113 – FLOW DIAGRAM, MODEL YPC-DF-15SL-16S (HIGH TEMPERATURE HEATING OPTION)

FORM 155.17-OM1



NOTE: Some valves may differ between various models.

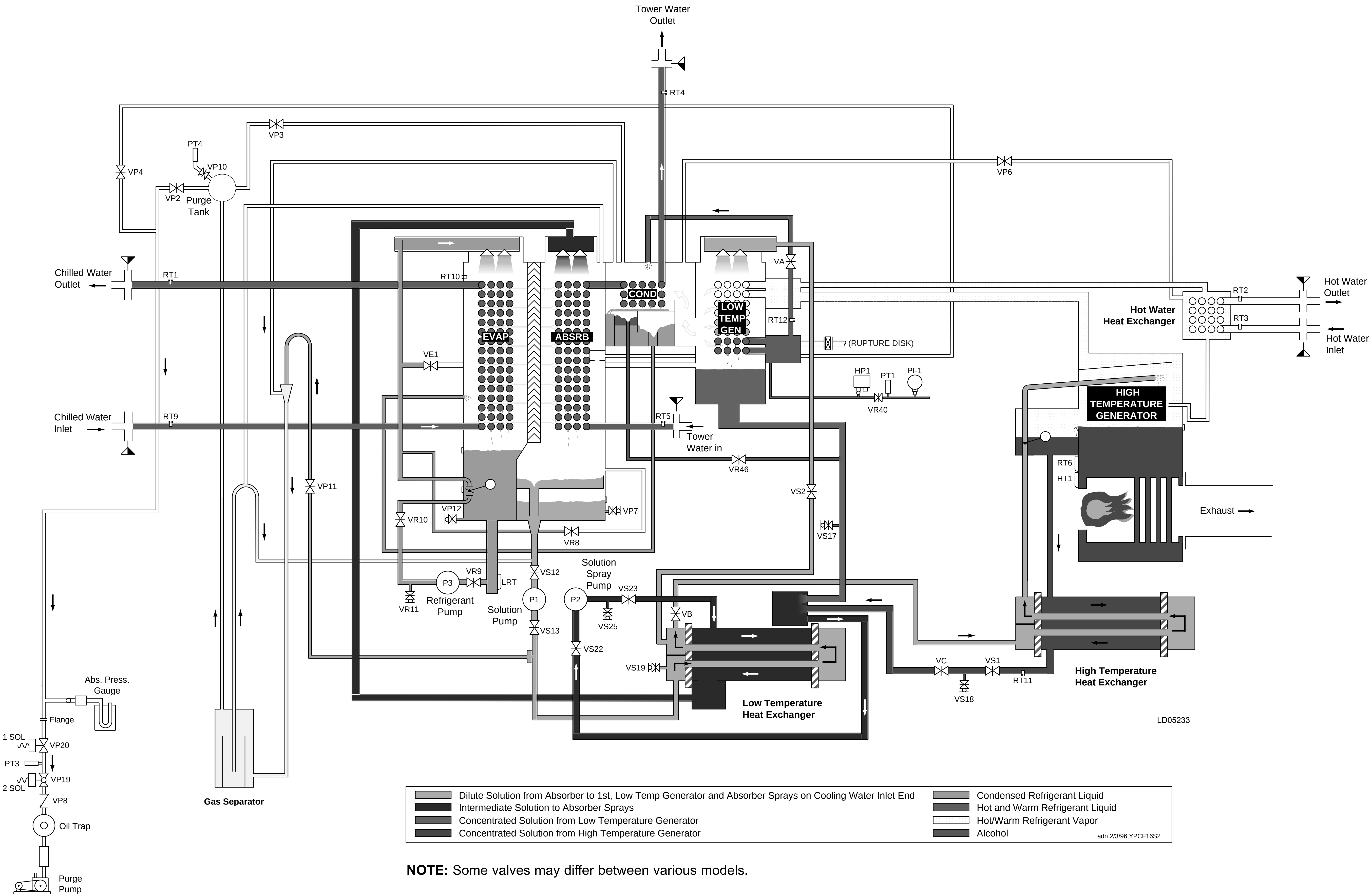
FIG. 114 – FLOW DIAGRAM, MODEL YPC-DF-16SL-19S (COOLING ONLY)



NOTE: Some valves may differ between various models.

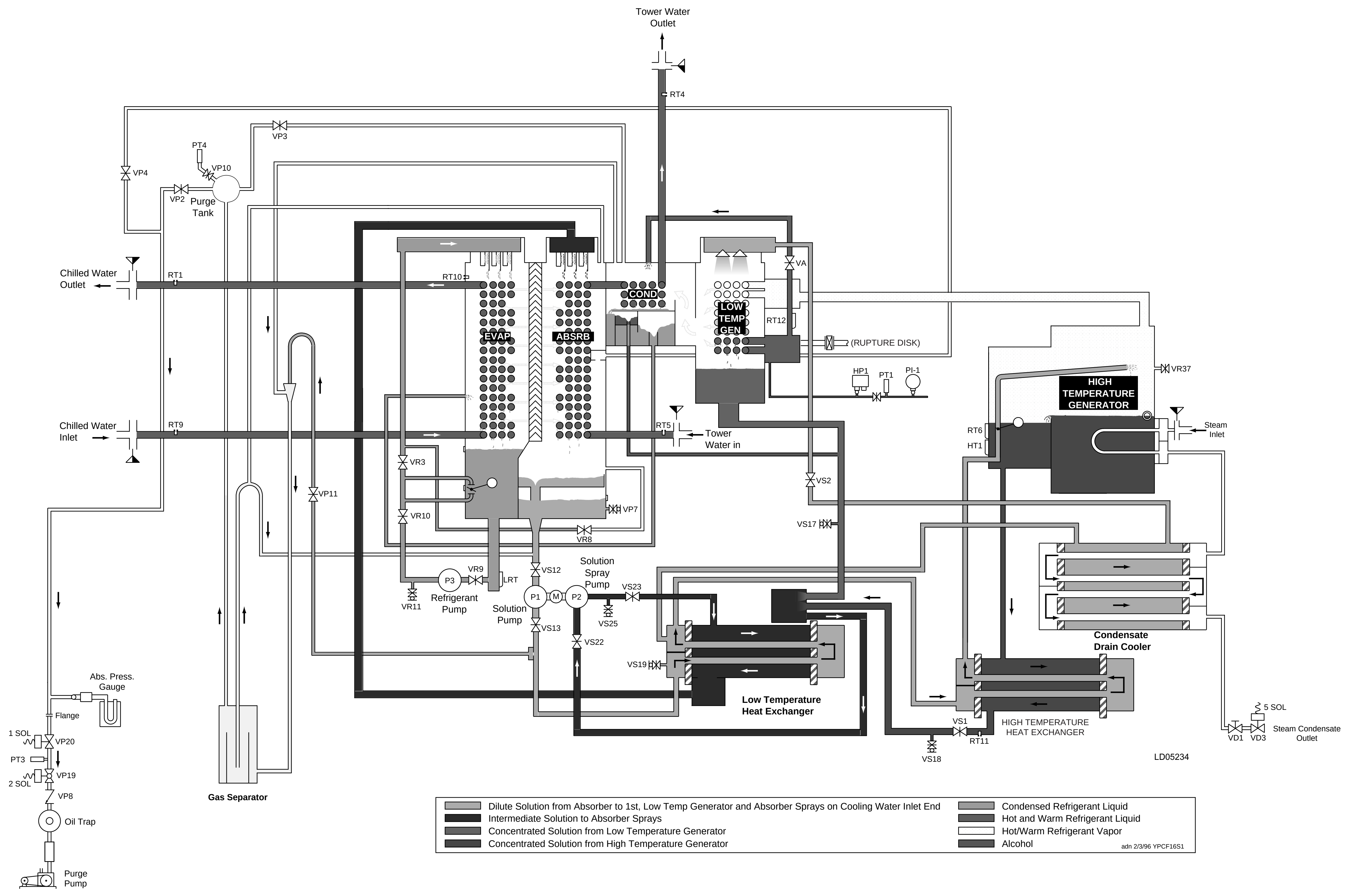
FIG. 115 – FLOW DIAGRAM, MODEL YPC-DF-16SL-19S (STANDARD HEATING OPTION)

FORM 155.17-OM1



NOTE: Some valves may differ between various models.

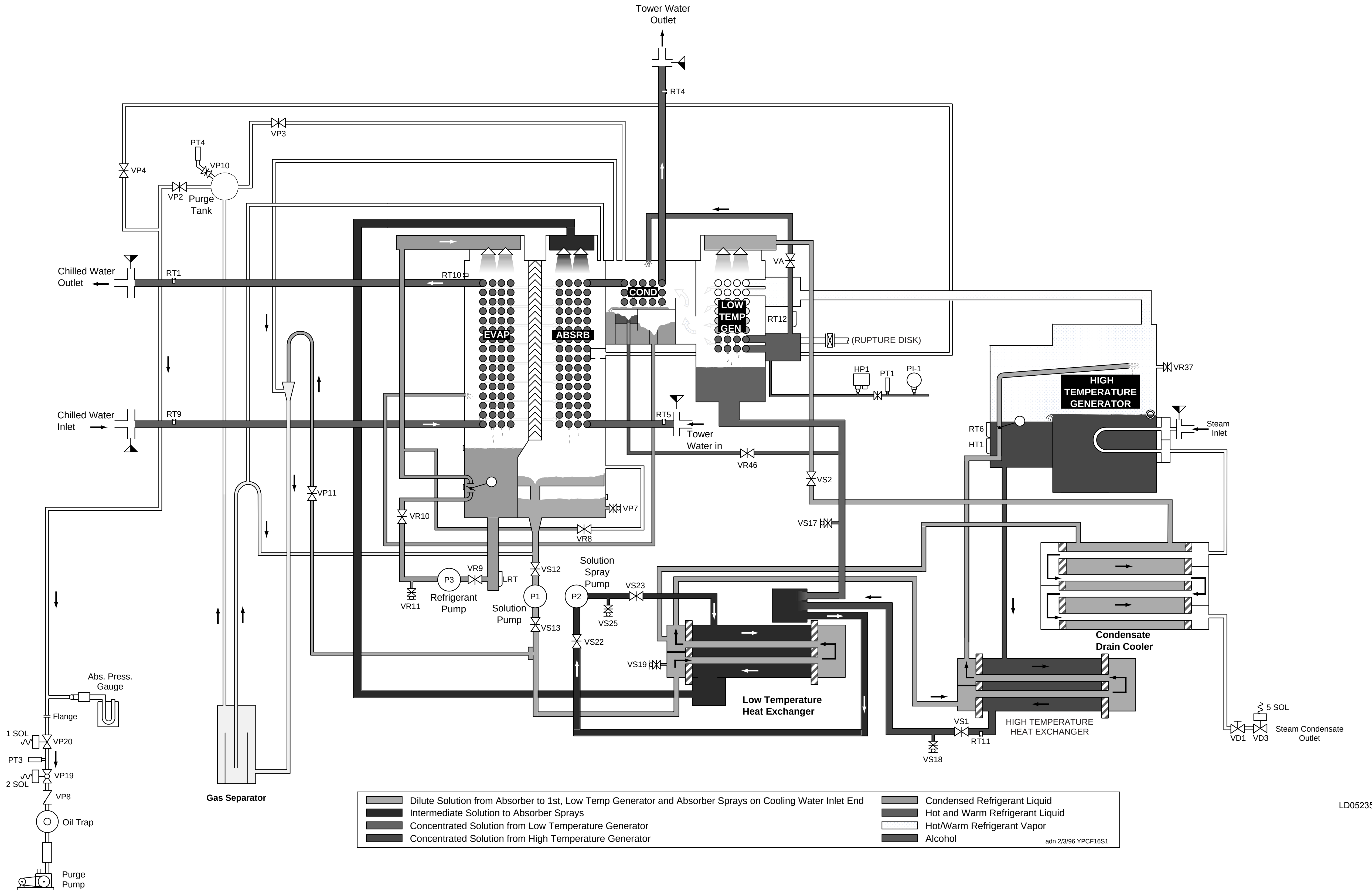
FIG. 116 – FLOW DIAGRAM, MODEL YPC-DF-16SL-19S (HIGH TEMPERATURE HEATING OPTION)



NOTE: Some valves may differ between various models.

FIG. 117 – FLOW DIAGRAM, MODEL YPC-ST-14SC (COOLING ONLY)

FORM 155.17-OM1



NOTE: Some valves may differ between various models.

FIG. 118 – FLOW DIAGRAM, MODEL YPC-ST-16SL-19S (COOLING ONLY)

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