CRYOGENIC LINE ROUTING:

REFRIGERATOR

TO

VLPC CRYOSTATS & SOLENOID

D-ZERO ENGINEERING NOTE # 3823.115- EN-413

October 4, 1994

Russ Rucinski
RD/DØ Mech.

Approved :

A handwritten signature in dark ink, appearing to read 'Russ Rucinski', is written over a horizontal line. The signature is stylized with large, sweeping loops.

INTRODUCTION

This engineering note documents the proposed cryogenic line routing from the liquid helium (LHe) refrigeration plant to the detector solenoid and VLPC cryostats. Many figures are included to aid in understanding the route. As an appendix, I include some general comments relevant to the topic. Also listed are a number of routing options that were considered before the proposed route was finalized.

REFRIGERATOR AREA

The refrigerator is to be located at the 3rd floor highbay, south side, just west of the receiving ramp. The heat exchanger is to be hung off the south wall under the cat walk. The transfer lines for both the solenoid and VLPC cryostats start as distinct valve boxes located near the south eastern corner of the higher portion of cleanroom roof. All cryogenic services are connected to the valve boxes by standard u-tubes. The preliminary building side piping and refrigerator layout appears on "DAB Refrigerator Layout", d-zero drawing number 3823.111-ME-317163. See figure 1. This drawing as well as all drawings referenced in this EN are kept electronically on the "XDCS" drawing control system.

The current thinking differs a little with the layout shown in figure 1. The heat exchanger and transfer lines will actually be underneath the foot print of the sidewalk not beyond as shown. The transfer lines from the valve boxes/"feed cans" run directly south to a location under the heat exchanger, not west as shown in figure 1. Figure 2, the start of a more accurate layout shows some of these features. Figure 3, a crude line drawing of the route gives some rough dimensional information.

SOLENOID 'BUILDING SIDE' ROUTE

The solenoid transfer line runs south across the top of the lower clean room roof. Once under the sidewalk and heat exchanger it turns and runs west. The solenoid transfer line vacuum jacket will be a 10" pipe (10 3/4" OD). The transfer line tees off just west of the cleanroom at the same elevation as the control dewar. The feed can vacuum jacket will be a 20" pipe (20" OD). The jumpers go north from the feed can to the control dewar. The collision hall run goes south to the wall at approximately the same elevation. It then runs west where it penetrates through a specially notched shield block. Once in the collision hall, it turns north and extends to the feed can. A man platform will be mounted off the shield block to allow u-tube

installation. Access to the man platform will be made from the air conditioning platform situated below.

SOLENOID 'DETECTOR SIDE' ROUTE

U-tubes will connect the feed can to the vendor supplied control dewar. The location of the control dewar and detector side routing of the transfer line is detailed on the "Solenoid package nominal placement drawing" d-zero drawing number 3823.111-ME-317048. See figure 4.

VLPC 'BUILDING SIDE' ROUTE

The building side portion of the VLPC transfer line follows the same path as the solenoid transfer line. The VLPC transfer line vacuum jacket will be a 6" pipe (6 5/8" OD) for the majority of it's length. The feed cans for the VLPC sit at a lower elevation. The feed can vacuum jacket will be a 12" pipe (12 3/4" OD). The span for the VLPC U-tubes is shorter and within the span of the solenoid U-tubes. The building side feed can is positioned south enough to allow the closed detector to pass by. The detector side feed can is located on the solenoid control dewar platform but at an elevation such that the ball valves at the top of the female bayonets are about 12" above the platform surface, see figure 5.

VLPC 'DETECTOR SIDE' ROUTE

Figure 6 is a line drawing showing the VLPC piping on the detector. The platform piping runs from the bottom of the feed can to a location just north of the cryobridge where it runs vertically down to the platform base level. The vertical piping is located as far west as possible so that it does not inhibit access to the only entrance for the east CF truss. The CF truss stairs will need to be modified to miss the vertical pipe. An angle attached to the cryobridge at the sidewalk elevation will need to be removed. It elbows north through a square cutout in the platform. Figures 7 and 8 detail this area. Just into the central east portion the piping enters a valve box. This valve box contains four control valves to control the helium and nitrogen for the two VLPC cryostats. The piping exits the valve box at approximately the floor level. It runs west through a small opening into the central section of the platform, see figure 9. The entrance into the central platform section is made at the extreme south east corner. The exact routing within the central platform section is uncertain. Most likely the two VLPC cryostats will be positioned in the center aisle of the platform running length-wise in an east-west direction. If this is the case, the VLPC piping will run along the south

wall of the central platform section and then turn north to the cryostats at the centerline of the detector.

VACUUM SERVICES

Turbomolecular vacuum pumps are located below the detector side VLPC feed can and solenoid control dewar. The turbo pumps are backed by either the UV or IV header. The existing UV header runs up the north side of the cryobridge and is tied into just below the vacuum pump platform.

The IV header runs up the south side of the cryobridge and is not accessible along the cryobridge run. Therefore, the IV header will be tied into below the cryobridge in the south east platform corner known as the cryo-corner. The existing IV header elbow at the platform level will be replaced by a tee. The thru run of the tee runs north to the space north of the cryobridge. The IV extension pipe then elbows west and then up to a position just outside the northwest corner of the cryobridge vertical beam. The IV pipe runs vertically along the cryobridge until just below where the UV tie in is made. There it runs west and under the vacuum pump platform.

Figure 1 : Preliminary DAB Refrigerator Layout of 3/94

REV	DESCRIPTION	DATE	BY
1	ISSUED FOR INFO	03/94	ME

PARTS LIST			
QTY	DESCRIPTION	UOM	DATE
1	0001	0001	03/94
1	0002	0002	03/94
1	0003	0003	03/94
1	0004	0004	03/94
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1	0006	0006	03/94
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1	0100	0100	03/94

FEDERAL NATIONAL ACCELERATOR LABORATORY	
UNIVERSITY OF MICHIGAN	
DAB Refrigerator Layout	
REV	DESCRIPTION
1	ISSUED FOR INFO
DATE	03/94
BY	ME

Figure 2: Refrigerator Layout as of 12/94

ENGINEERING NOTE

SECTION

RD/CRYO

PROJECT

CRYO UTILITIES
VLP & SOLENOID

SERIAL-CATEGORY

3823.115

PAGE

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SUBJECT

LINE DRAWING OF SOLENOID
BUILDING SIDE X-FER LINE

NAME

RUSS RUCINSKI

DATE

10-19-94

REVISION DATE

12-8-94

12-8-94 REV. CHANGE ROUTING SUCH THAT
OVERALL LENGTH CHANGED FROM
125 FT. 2" TO 122 FT. 2"

$$L_{TOTAL} = 1466 \text{ IN.} = 122 \text{ FT.}, 2 \text{ IN.}$$

★ ESTIMATED
IN FEED CAN

Figure 3: Line Drawing of Solenoid 'building side' piping route

Figure 5: Solenoid control dewar & VLPC bayonet can, 'detector side'

FERMILAB

ENGINEERING NOTE

SECTION

RD/DD

PROJECT

CRYO UTILITIES

SERIAL-CATEGORY

3823.115

P.

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SUBJECT

LINE DRAWING OF VLPC PLATFORM
PIPING

NAME

RUSS RUCINSKI

DATE

12-8-94

REVISION DATE

NOTE: X,Y,Z COORDINATES ARE RELATIVE TO THE
INTERACTION POINT @ (X,Y,Z) = (0,0,0).

Figure 6: Line Drawing of VLPC 'detector side' piping route

Figure 7: Plan view of VLPC pipe passing north through platform

LAYOUT OF VLPC PIPE
THROUGH HOLE IN PLATFORM

Figure 8: Elevational view of VLPC pipe passing north through platform

APPENDIX**GENERAL COMMENTS**

1.) The Solenoid control dewar location is locked in per the nominal placement drawing . A clear space has been defined for the control dewar and associated solenoid platform piping. This drawing, 3823.111-ME-317041, has been released to vendor's bidding on the solenoid.

2.) The transfer lines for the VLPC and Solenoid are to be separate to maintain their independence in operation and installation.

3.) The Solenoid currently has the following u-tubes/services:

- 1 - LHe supply
- 1 - He return, steady state
- 1 - He return, cooldown/quench recovery
- 2 - LN2 supply, shield/intercept
- 2 - N2 returns, shield/intercept
- = 7 cryogenic u-tubes

- 2 - GHe vapor returns
- 2 - Water cooled bus

4.) The VLPC currently has the following u-tubes/services:

- 1 - LHe supply, east
- 1 - LHe supply, west
- 1 - He return, east
- 1 - He return, west
- 1 - LN2 supply
- 1 - N2 return
- = 6 cryogenic u-tubes

5.) The cryogenic flow diagram is being developed as d-zero drawing 3823.115-ME-317223, "Solenoid and VLPC cryogenic flow diagram".

OPTIONAL ROUTES INVESTIGATED**OPTION A.**

The Solenoid transfer line runs across the top of the lower clean room roof. A feed can hangs off just west of the cleanroom at the same elevation as the control dewar. The jumpers go north from the feed can to the control dewar. The collision hall run goes south to the wall at approximately the same elevation. It then runs west where it penetrates through a specially notched shield block. Once in the collision hall, it turns north and extends to the feed can.

The VLPC transfer line follows the same path as the Solenoid transfer line. The feed cans for the VLPC sit at a lower elevation. The span for the VLPC U-tubes is shorter and within the span of the Solenoid U-tubes. The feed can must be south enough to allow the closed detector to pass by. The platform piping runs from the feed can to a location just north of the cryobridge where it runs vertically down to the platform base level. The piping must not inhibit access to the only entrance for the east CF truss. The CF truss stairs may need to be modified. An angle at the sidewalk level will need to be removed. It elbows north through a hole into the central east portion. It then elbows down & west to pass through a hole into the south east corner of the central section of the platform.

Choice A1: The transfer line runs through a 10 x 24 hole currently occupied by two air circulation muffin fans to get to the central section of the platform.

Choice A2: The transfer line runs through a small mouse hole at the south corner/base of the beam to get to the central section of the platform.

Choice A3: The transfer line stays at the elevation of the north-south hole in the central east portion of the platform. It then elbows west through the trapezoidal man access hole into the central section of the platform.

Choice A4: The transfer line stays at the elevation of the north-south hole in the central east portion of the platform. It then elbows west through one of the 10 3/4" muffin fan holes into the central section of the platform.

Choice A5: The transfer line runs north below the rectangular hole in the platform. It inhibits jack removal train style when in the collision hall position.

Choice A6: Run the IV header up the north side of the cryobridge to provide backing to the turbo(s) on the vacuum pump platform. The piping must not inhibit access to the only entrance for the east CF truss. The other choice is to have a separate mechanical pump on the platform and no tie in to the IV.

OPTION B.

The Solenoid transfer line and feed can locations are the same as described in Option A. The u-tubes between feed can and control dewar are a little shorter in width since the feed can is 1 to 2 feet more to the north than in Option A.

The VLPC transfer line runs across the lower cleanroom roof. It then jogs north 1-2 feet. It then drops vertically to the pit floor. It runs under the calorimeter cryopiping that is hung off the south wall under the sidewalk. There are two or three sections of building duct work that will need to be modified to make space for the transfer line. A feed can tees off this line in the assembly hall. The collision hall feed can is at the end of the transfer line. The feed can is located with a bottom elevation at the pit floor. An expansion box may need to be located in the SW assembly hall pit to take care of thermal contraction. Due to vertical height requirements at the location of the feed can, normal u-tubes may not work. Some type of flex hose/bayonet connection or moveable feed can might be required. No obvious location for a turbo pump and backing pump comes to mind at this time.

Choice B1: The feed can is located just east of the spill trough hole in the floor. The corresponding platform feed can is located at the southern most edge of the south central platform section. The east half of the spill trough on the platform is modified to accept the feed can and a transfer line that runs north. The transfer line runs at the platform floor level until it elbows up and through the center rectangular hole into the central platform section.

Choice B2: Same as B1 except the transfer line stays at the platform floor level into the central section. It occupies space in-between the set of four platform lifting cylinders. This inhibits changing a cylinder in certain positions by pulling out the set of four train style. An alternative jack repair plan would need to be worked out.

Choice B3: The feed can is located at the south west corner of the platform. The existing TRD bubbler racks and controls will be gone in the upgrade. A small feed can and turbo could be located on the south west corner of the platform. The transfer line would then be routed to the central section of the platform. The options for the path are symmetrically identical to choices A1 through A5.

Choice B4: Feed can in south west corner as in B3. Run transfer line north just past the cryo bridge beam. Then run east into the south central section. Elbow up and north through one of the rectangular holes into the central section of the platform.

OPTION C.

Run the VLPC transfer line through the spill trough. The feedcan is in the middle of the spill trough in both the collision hall and assembly hall locations.

DECISION

Based on the Pro's and Con's of all the routing options, Routing option A was chosen. Choice A2 was taken for the platform level route. Choice A6, to run the IV header up to the vacuum pump platform also was chosen.

ROUTING OPTION	PRO	CON
A	The building side solenoid transfer line is a clean route.	The combined solenoid & VLPC u-tubes in one 2.5' x 12' area is very congested.
	It is not much more work to hang two lines in the same location.	The VLPC lines and IV lines to the north of the cryo bridge reduce access to the east CF truss.
	There is a nice location for a turbo pump for the VLPC platform side vacuum jacket.	The east CF truss access stairs will need to be cut and modified.
	The two turbos can back up each other with simple piping and valving.	Both the Control dewar and Vacuum pumping platform will be crowded.
	No duplication of running IV line, hangers, electric to turbos, instrumentation wiring paths etc.	An angle attached to the cryo bridge at the sidewalk grating level will need to be cut out.
A1	The transfer line is low (ankle level) and out of the way.	Adds the need to have several elbows if you follow the "wall" to opening.
	The transfer line is low when it enters the central platform section.	Field welding on floor level sections is difficult.
	Added elbows may help flexibility of transfer line.	Someone may object to removing a circulation fan.
		Added elbows make fabrication of transfer line more difficult.
A2	Keeps the transfer line out of valuable real estate.	Low corner area makes welding in place impossible. Need Pre-fab pieces.
	Added elbows may help flexibility of transfer line.	Added elbows make fabrication of transfer line more difficult.
	Transfer line ends up in a nice location in central platform section.	
	Does not require removal of a circulation fan.	
A3	Would eliminate need for elevation change in east central platform section.	Transfer line will eat into real estate unless it follows the wall. At gut level.
	Reduced possibility of interference in the cross over from the east central to central platform section.	Reduces man access space in the trapezoid hole.
	Easy to make any field welds.	
	Does not require removal of a circulation fan.	
A4	Would eliminate a need to change elevation of VLPC transfer line once in the east central platform section.	Puts the transfer line at either waist level or chest level depending on which hole you hit.
	Would keep the transfer line higher up where it is easier to make field welds.	Elbow to west location is 54" to the north and 39" to the east of the "walls" of the east central platform section.
	Could make an easy transition to run pipe up high in central section of platform.	Someone may object to removing a circulation fan.
A5	Elevation is the same as the 10" 24" hole so that pipe can be neatly elbowed to hole and is out of the way.	Inhibits planned jack removal in event of failure. Alternative method or plan for jack failure would need to be developed.
		May require a section of pipe that can be removed in the event of jack failure.

ROUTING OPTION	PRO	CON
A6	Backing pump for Turbo which may require periodic maintenance is out of the collision hall.	The IV header pipe extension will have to follow a complicated path with many jogs to avoid interference.
	Do not have oil vapors from mechanical pumps venting into the detector area, possibly upsetting VESDA.	
	Less equipment located on Vacuum platform.	
B	The control dewar and vacuum pump platforms for the Solenoid have more room.	Need to run transfer line through building ductwork that we don't own.
	The building piping to platform piping u-tubes are at pit floor level. No platform required.	The bridge to get the SEC on the sidewalk will restrict access to where the pipes need to be installed.
	The building side piping route is pretty clean and straight.	Location for a VLPC vacuum jacket turbo pump is not obvious.
		Hard to make any field joints in installation since the piping runs in a back corner.
		Long straight run not good for thermal contraction.
		Feed can needs to be under sidewalk to clear platform. This makes normal u-tube jumpers difficult to use.
B1	Would provide a nice clean shot accross the platform to the central platform section.	The bridge to get the SEC on the sidewalk mounts on either side of the Assy hall spill trough hole. Need to be too far away from feedcan to be practical.
		Need to cut open the spill trough. Safety issues?
B2	Would provide the cleanest shot accross the platform to the central platform section. No elbows.	The bridge to get the SEC on the sidewalk mounts on either side of the Assy hall spill trough hole. Need to be too far away from feedcan to be practical.
		Need to cut open the spill trough. Safety issues?
		Inhibits planned jack removal in event of failure. Alternative method or plan for jack failure would need to be developed.
B3	Feed cans and u-tubes/ flex connections are in an uncongested location.	The turbo would require either it's own local mechanical backing pump or a long IV pipe tied in and run along the west side of the cryobridge.
	West side of platform has more open real estate than east side.	This is the longest transfer line option. More time and cost to build. Bigger heat leak, but small next to VLPC's.
	Easy access to feed cans and vacuum pumps.	
B4	Keeps the platform transfer line out of the way.	
	Nice and neat.	
C	Building side feed can in a nice spot.	Very difficult if not impossible to run through trough.
	We own the real estate.	Real safety issues are involved with installation.
		Adds an extra 45 feet to length of pipe to collision hall.

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