If you are using a printed copy of this procedure, and not the on-screen version, then you MUST make sure the dates at the bottom of the printed copy and the on-screen version match. The on-screen version of the Collider-Accelerator Department Procedure is the Official Version. Hard copies of all signed, official, C-A Operating Procedures are available by contacting the ESSHQ Procedures Coordinator, Bldg. 911A

C-A OPERATIONS PROCEDURES MANUAL

8.4 Procedure for Operating S.C. Magnet (Oxford Instr.) for Polarized H^- Ion Source at LINAC

Text Pages 2 through 6

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Collider-Accelerator Department Chairman Date

V. LoDestro

8.4 Procedure for Operating S.C. Magnet (Oxford Instr.) for Polarized H^- Ion Source at LINAC

This procedure is based on manufacturer (Oxford Instr.) manual for SCS.
SCS operators should refer to the Manufacturer manual for the detail information.

1. Purpose

To provide instructions for system operators to ensure safe operation of the superconducting magnet.

2. Responsibilities

2.1 The LINAC Group is responsible for the installation, maintenance, and operation of the SC magnet.

2.2 The LINAC Supervisor is responsible for assigning qualified operator to conduct this procedure.

3. Prerequisites

3.1 Qualified and trained operators in ODH and in Cryogenics.

3.2 The minimum number of persons required to conduct this procedure is TWO.

4. Precautions

4.1 Use protective gloves and eyeglasses. Cold helium gas venting from the service port area can cause severe frostbite on exposed skin.

4.2 Adequate ventilation in the room is required to prevent asphyxiation from the helium gas venting.

4.3 Low oxygen alarm must be installed and in function in the operation room.

5. Procedure

5.1 Prepare instruments and equipment according to following list

5.1.1 Vacuum pumps and hoses.

5.1.2 LN2 dewar (~200 liters).

5.1.3 LN2 transfer lines (vacuum jacketed or Teflon hoses).

5.1.4 GHe pressure bottles.

5.1.5 LHe dewar (~200 liters).

5.1.6 LHe vacuum jacketed transfer lines.

5.1.7 LHe level meter.

5.1.8 Polarized power supply.

5.1.9 Electrical power leads.

5.2 Pump thermal insulation space

5.2.1 Set-up pumping system according to Fig. 1.

5.2.2 Pump thermal insulation space through the Vacuum Gate Valve.

5.2.3 Target vacuum: $<1x10^{-4}$ torr.

5.2.4 Check leak rate: $<1x10^{-8}$ torr-l/s.

5.3 LN2 pre-cooling of the helium reservoir

5.3.1 Connect LN2 dewar to helium vessel of service dewar with LN2 transfer hose according to Fig. 2.

5.3.2 Adjust LN2 dewar pressure at 0.2 ~ 0.5 barg (attach a GN2 or GHe bottle if necessary).

5.3.3 Run GN2 exhaust through venting pipe with MV1 closed and MV2 open.

Caution

Cooling rate must be controlled so that it is less than 0.5 K/min. Fast cooling rate may damage the magnet because of the increasing of thermal stress in coil winding.

5.4 Start-up cryocooler

5.4.1 Connect gas hoses and control cable between He compressor and cold-head according to Fig. 3.

5.4.2 Run cooling water for compressor at the flow rate of 6~6.5 ltr/min.

5.4.3 Check the static helium pressure in compressor at HP and LP pressure gauges at 280~295 psig.

5.4.4 Start He compressor and check pressure for HP: 280~350 psig and LP: 75~160 psig.

5.5 Pump/purge of helium reservoir

5.5.1 Connect vacuum pump and GHe bottle according to Fig. 5.

5.5.2 Pump and purge helium reservoir three times at target vacuum of 10^{-2} torr and purge pressure of 0.5 barg at each time.

5.6 LHe filling of helium reservoir

5.6.1 Connect LHe dewar to helium reservoir according to Fig. 6.

5.6.2 Adjust LHe dewar pressure at 3-5 psi.

5.6.3 Purge LHe transfer line before inserting it into He reservoir.

5.6.4 Stop transferring when LHe level reads full (100%).

5.7 Close and secure thermal insulation vacuum gauge

5.7.1 Check the target vacuum reading < 10^{-5} torr.

5.7.2 Close and lock the Vacuum Gate Valve.

5.7.3 Shut down and secure the vacuum pump.

Caution

Do not move the valve handle once the valve is closed. Incorrect position can cause vacuum loss that can lead to quench when magnet is charged and large amount of cold GHe venting may cause asphyxiation and/or frostbite.

5.8 Charging the magnet

Warning :

When connecting the power cords to the power leads, make sure the polarity is correct.

5.8.1 Charge the magnet by trained and authorized operator.

Caution:
Clear all magnetic materials around the magnet.

5.9 Refilling LHe reservoir

5.9.1 Connect LHe dewar to helium reservoir according to Fig. 6.

5.9.2 Adjust LHe dewar pressure at 0.1 ~ 0.2 barg.

5.9.3 Pre-cool the LHe transfer line before refilling.

Warning
Before transferring liquid helium into the magnet, the transfer line must be properly pre-cooled to prevent a quench if magnet is charged.

5.9.4 Fully open MV1 for GHe venting.

5.9.5 Insert the transferline all the way to LHe reservoir and lift it 5~10mm from the bottom and then fix the position by the gutter nut.

5.9.6 Transfer LHe until 100% full.

5.9.7 Remove the transfer line and cap the port.

6. Documentation

6.1 Oxford Instr. Operating Procedure

7. Reference

7.1 "Cryogenic System Description of Superconducting Magnet for Polarized Ion Source at LINAC", Li Wang and Lin X. Jia, October 20, 1999

8. Attachments

8.1 Brief instruction for operators for SCS cooldown and refill.

8.2 List of the relief valves and manual valves as shown on Figures 1 through 7.

8.3 Figure 1. Schematic for vacuum space pumping.

8.4 Figure 2. Schematic for LN2 pre-cooling of SC magnet.

To fill I4 solenoid:

_ Move UHP He bottle into source terminal room and connect to the dewar.
_ Open the manual vent valve (above rack D).
_ Close the small brass valve that leads to the He gas flow meter.
_ Place the transfer line slowly into the dewar. Close the valve for the over pressure relief and relieve any excess pressure from the dewar using the dewar's vent valve. Do not let the transfer tube rest on the bottom of the dewar.
_ Leave a little pressure (3 psi) to pre-cool the transfer line.
_ When liquid He comes out of the line, place into the solenoid fill port and tighten the collar.
_ Use a heat gun to warm up the collar on the solenoid fill port and remove the transfer line from the solenoid.
_ Put the plug back in the fill port, tighten the collar and replace the plastic cover.
_ Remove the transfer line from the dewar, put in the plug, close the vent valve and open the pressure relief valve.
_ Disconnect the polyflo pressurizing line from the dewar.
_ Open the brass valve to the He flow meter.
_ Close the manual vent valve above rack D.
_ If the dewar is empty, take it to the He building, sign the log sheet on the door, and fill out an order form requesting a delivery date on e day prior to the fill day. Indicate on the form that you want dewar# 022 to be filled with 100L.

Suggested fill schedule:

Wed – Fill solenoid from full dewar. Leave half full dewar in ion source terminal.
Wed – Fill solenoid from half full dewar. Take empty dewar to helium building. Sign in dewar and fill out order form for the following Tuesday.
Wed – Sign out dewar from helium building and take to I4.

_ **Attachment 8.2**

Table 1. List of the relief valves and manual valves

Name	Description	Size	Pressure Rating
RV1	Spring Load Relief Valve	40 mm	3.5 psi
RV2	Spring Load Relief Valve	40 mm	3.5 psi
RV3	Venting Valve	12.8 mm	0.5 psi
RV4	Vacuum Relief Valve	40 mm	0.14 barg
MV1	Manual Ball Valve	9.5 mm	> 60 barg
MV2	Manual Ball Valve	9.5 mm	> 60 barg

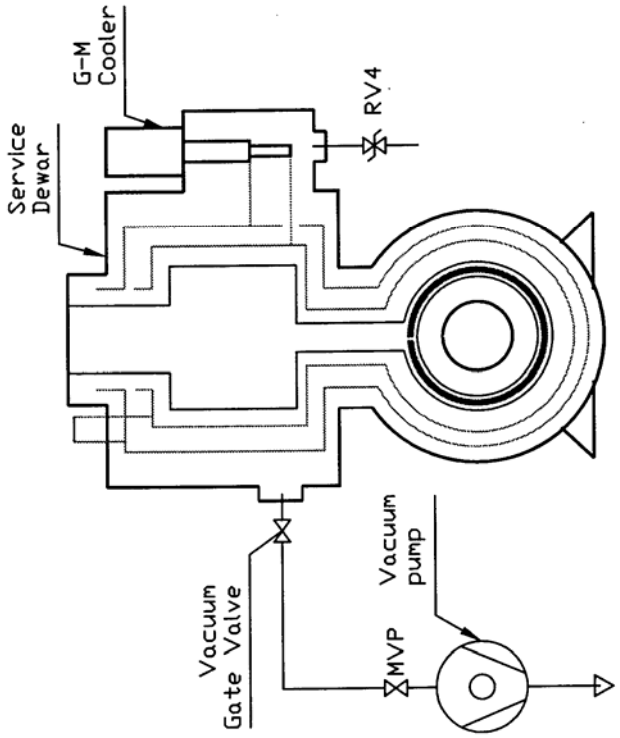

Figure 1
Schematic for Vacuum Space Pumping

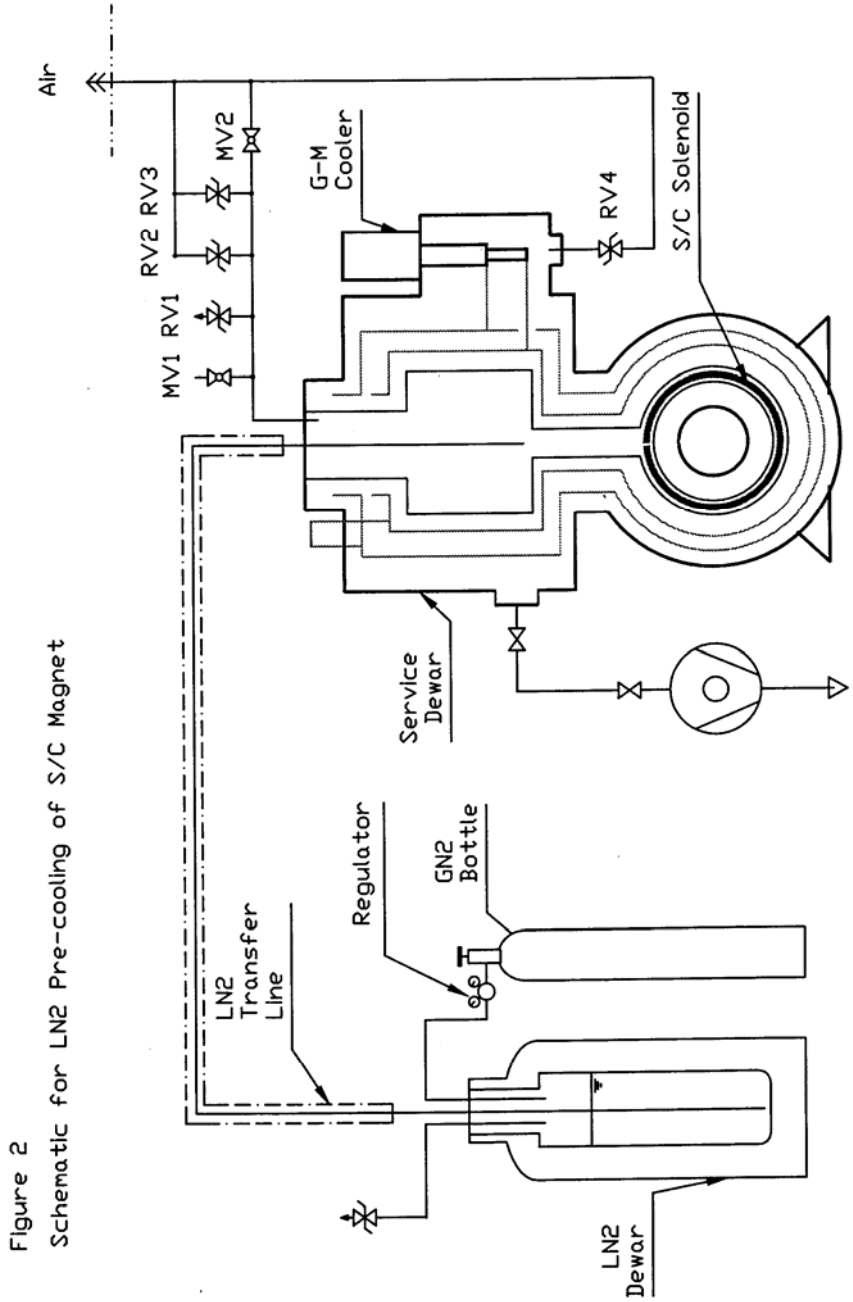

Figure 2
Schematic for LN2 Pre-cooling of S/C Magnet

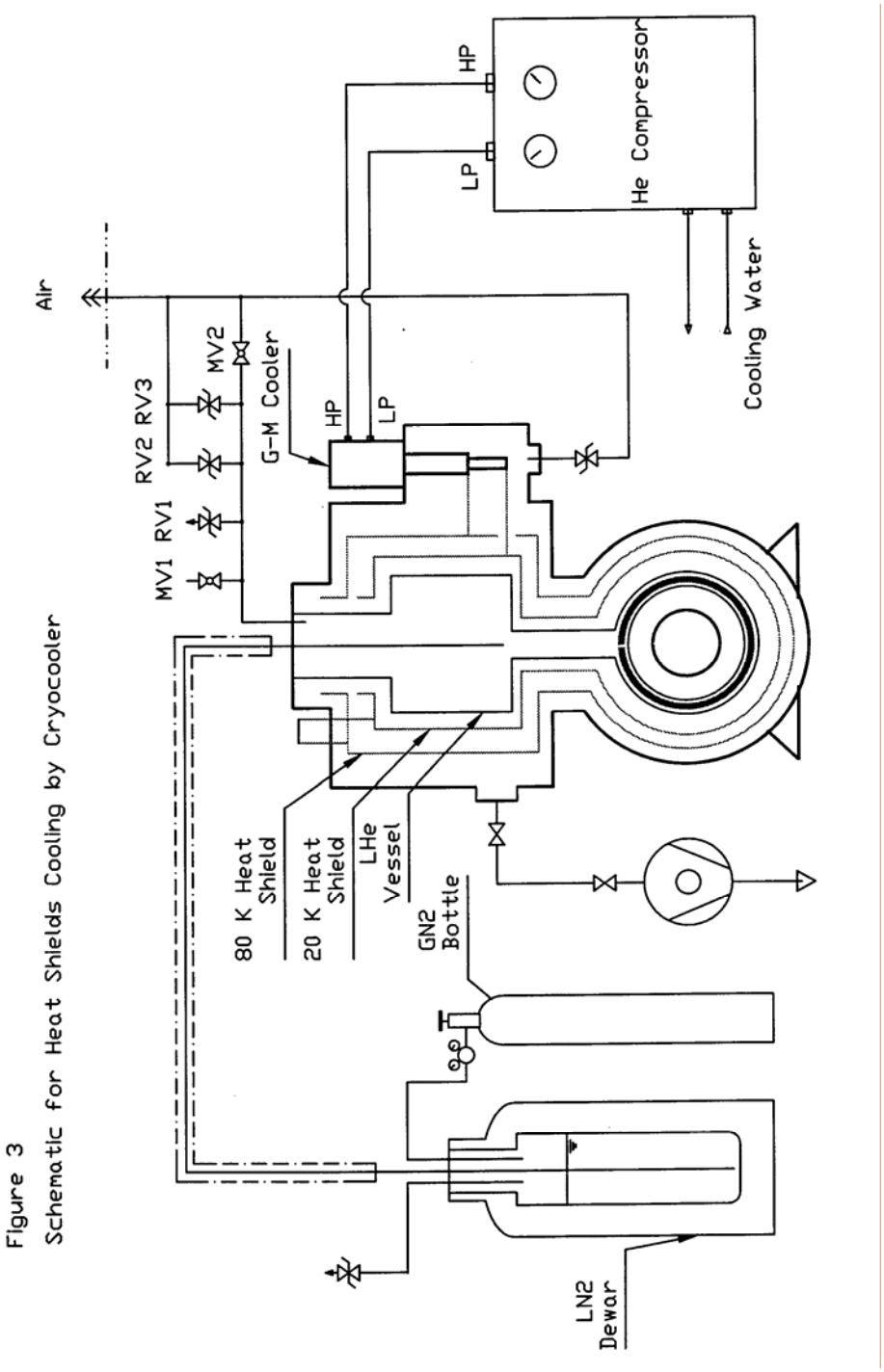

Figure 3
Schematic for Heat Shields Cooling by Cryocooler

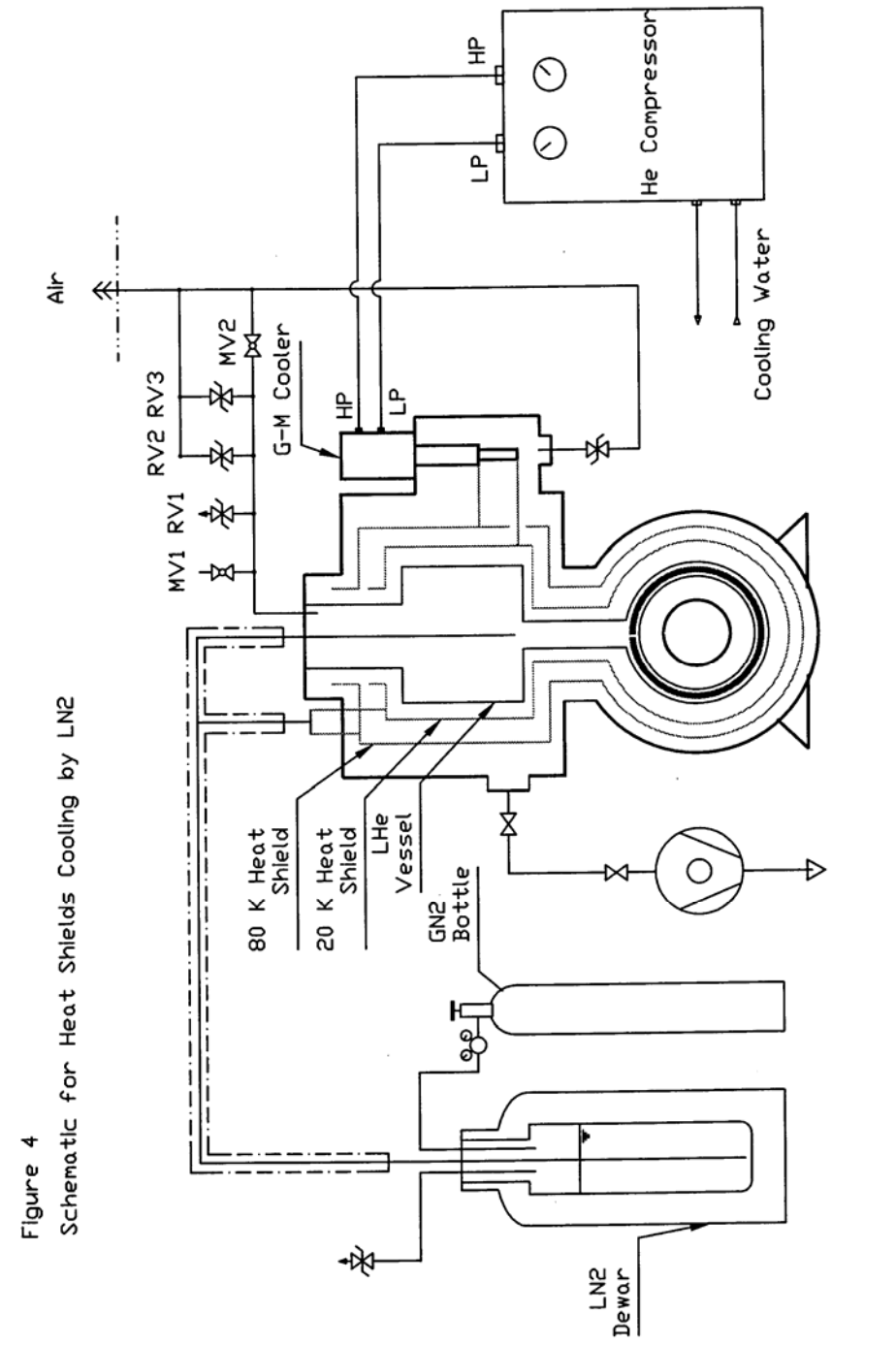

Figure 4
Schematic for Heat Shields Cooling by LN2

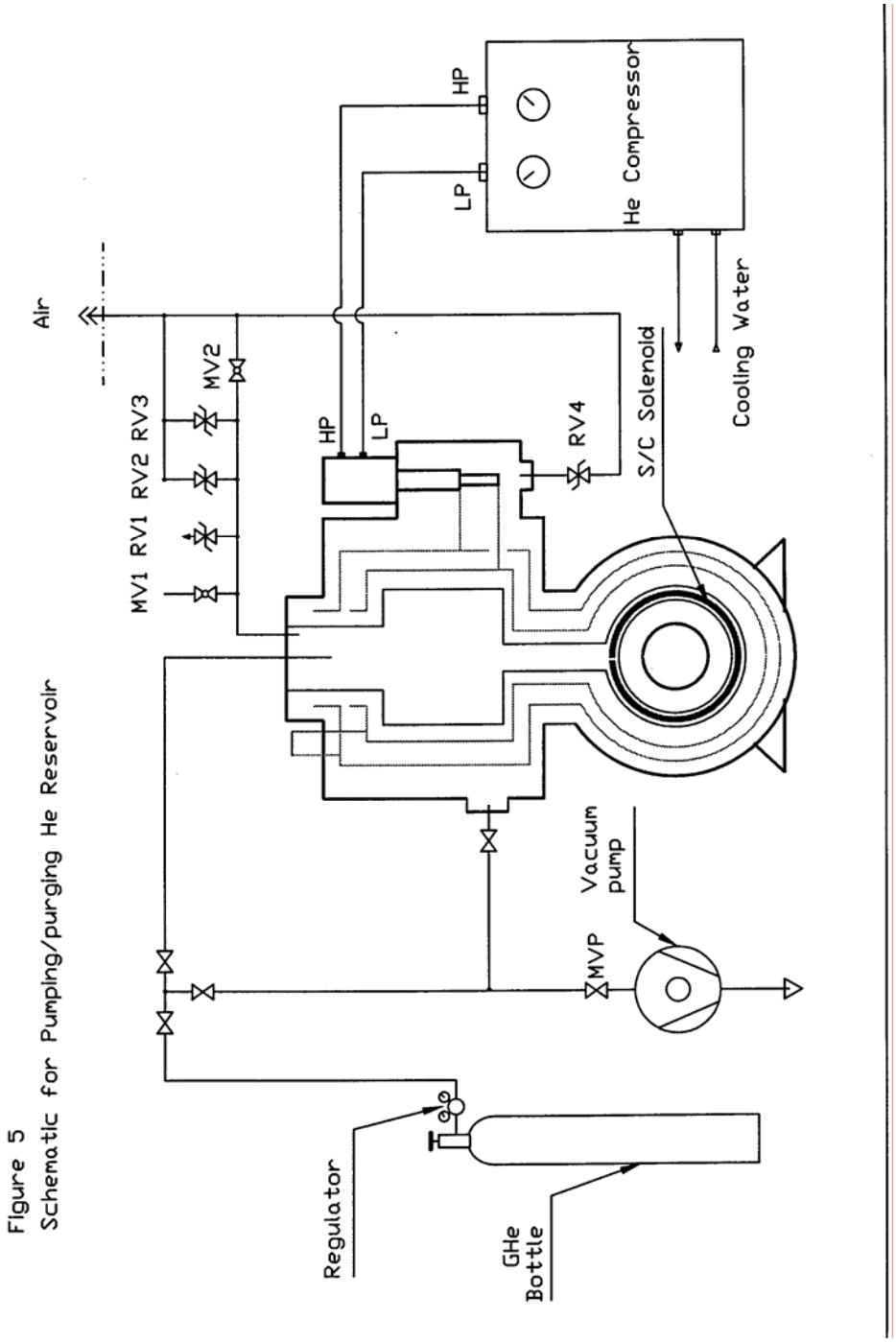

Figure 5
Schematic for Pumping/purging He Reservoir

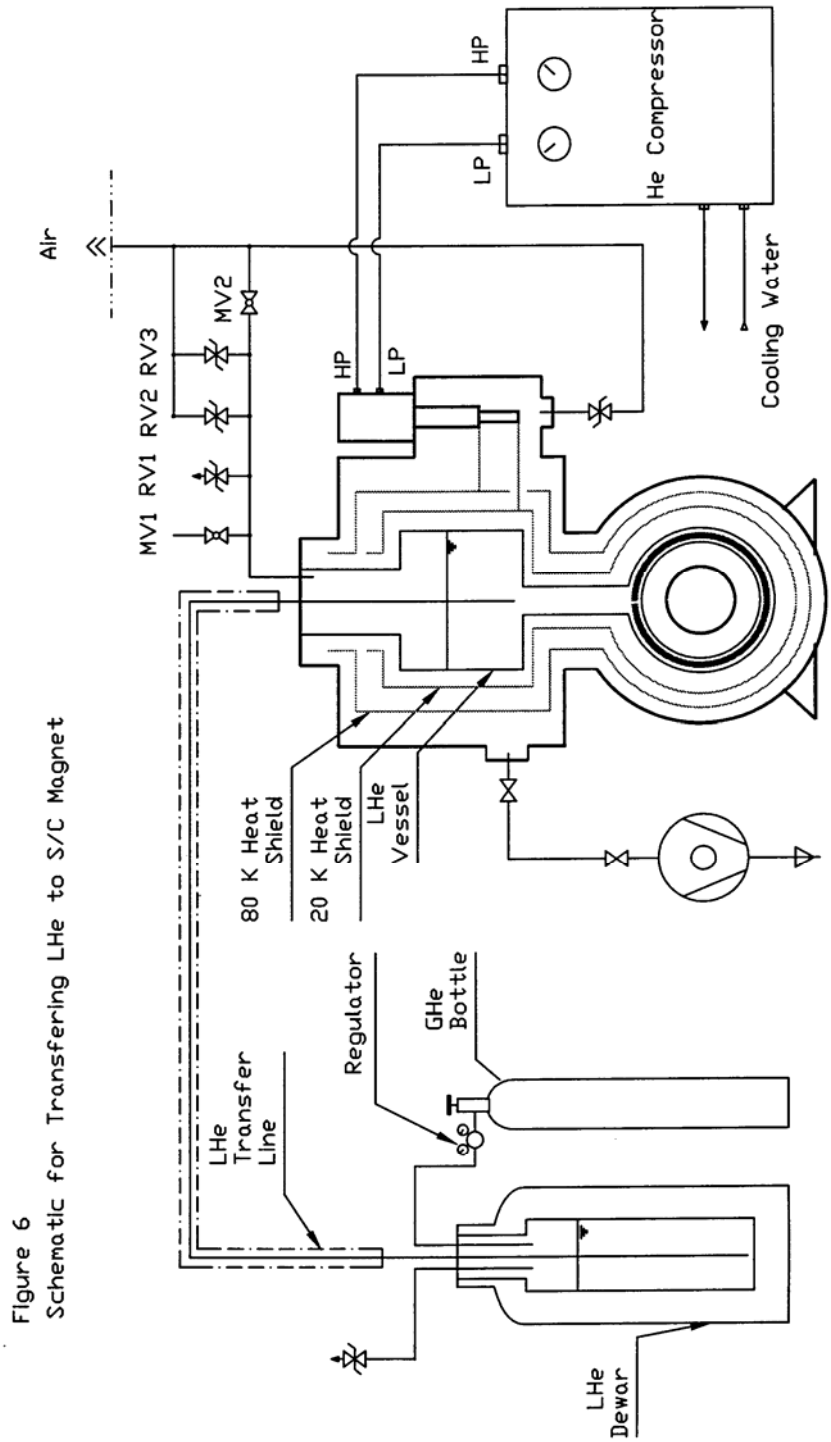

Figure 6
Schematic for Transfering LHe to S/C Magnet

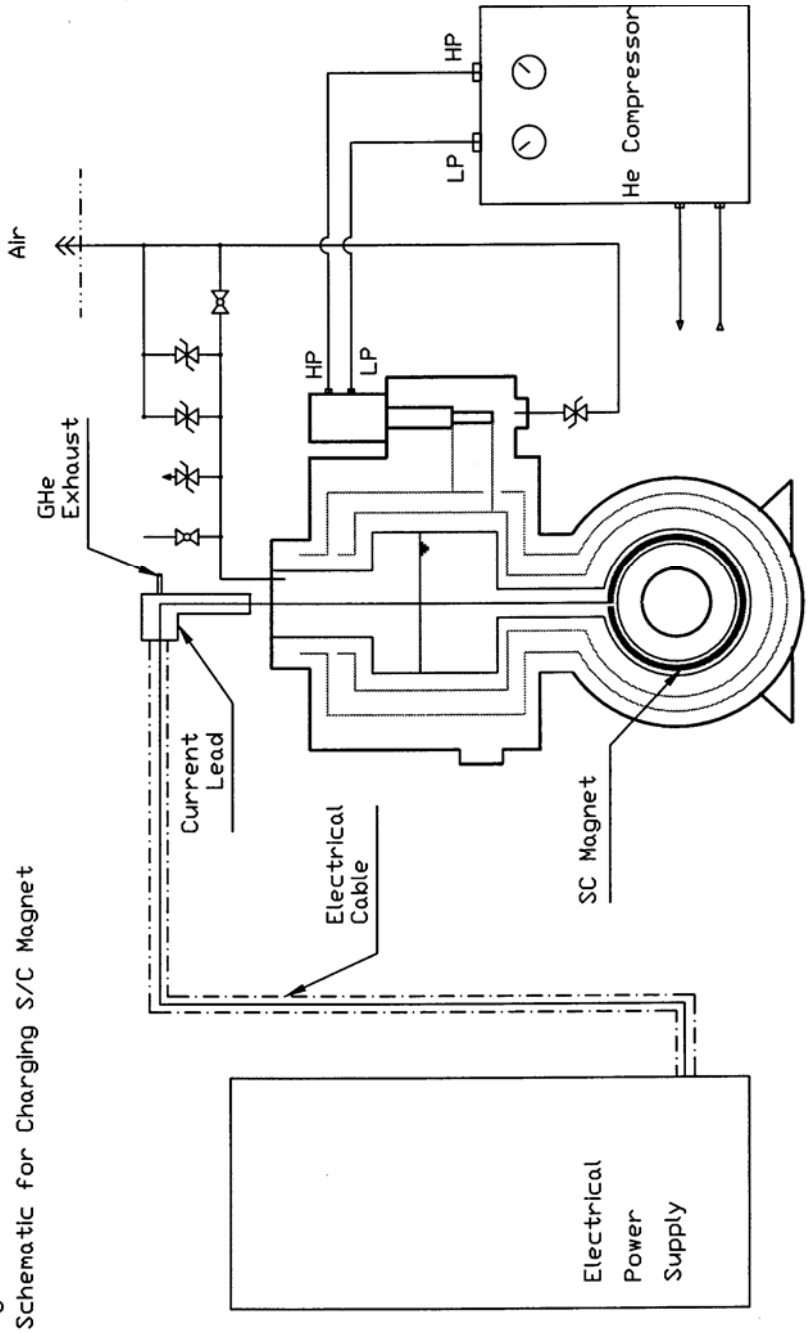

Figure 7
Schematic for Charging S/C Magnet