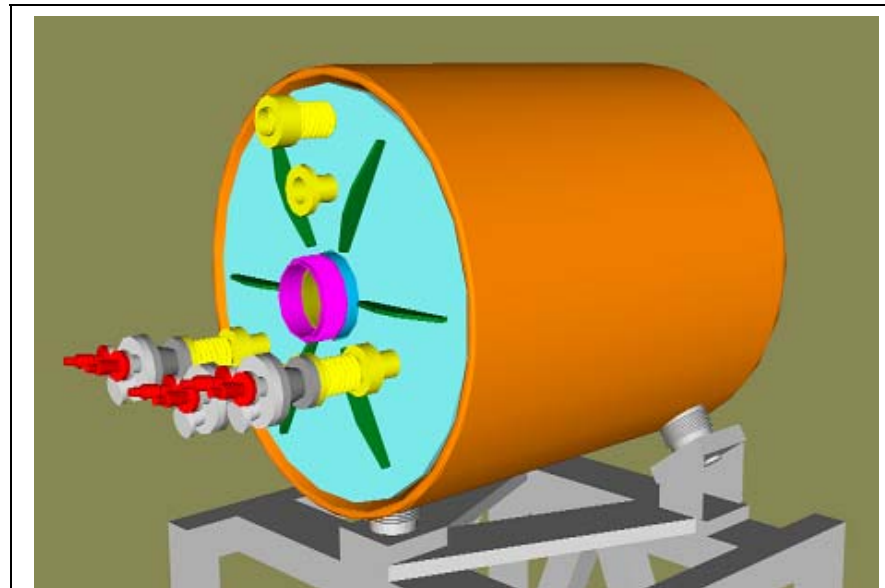


**Pulsed Magnet Status April 13 2004**  
**E951 15T Pulsed Magnet for Mercury Target Development**

**Peter H. Titus**

**MIT Plasma Science and Fusion Center, Cambridge MA**  
*(617) 253 1344, [titus@psfc.mit.edu](mailto:titus@psfc.mit.edu), <http://www.psfc.mit.edu/people/titus>*



**BNL Pulsed Magnet –Inertially Cooled , 69K LN2 Cooled  
Between Shots**

## Engineering Status

Calculations and Drawings are “complete” – but small revisions are expected based on final manufacturing details after negotiation with vendors. Drawings bid documents, and calculations may be found at: <http://www.psfc.mit.edu/people/titus/>



## Manufacturing Contract Status – We have a Contract (CVIP) and a Magnet Vendor (Everson/Tesla).

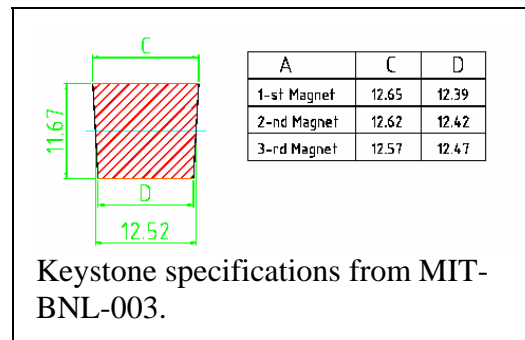
CVIP was chosen, Bid price was lower than, but consistent with MIT/PSFC Cost estimate



CVIP recently successfully built the HCX prototype Cryostat for MIT-PSFC.

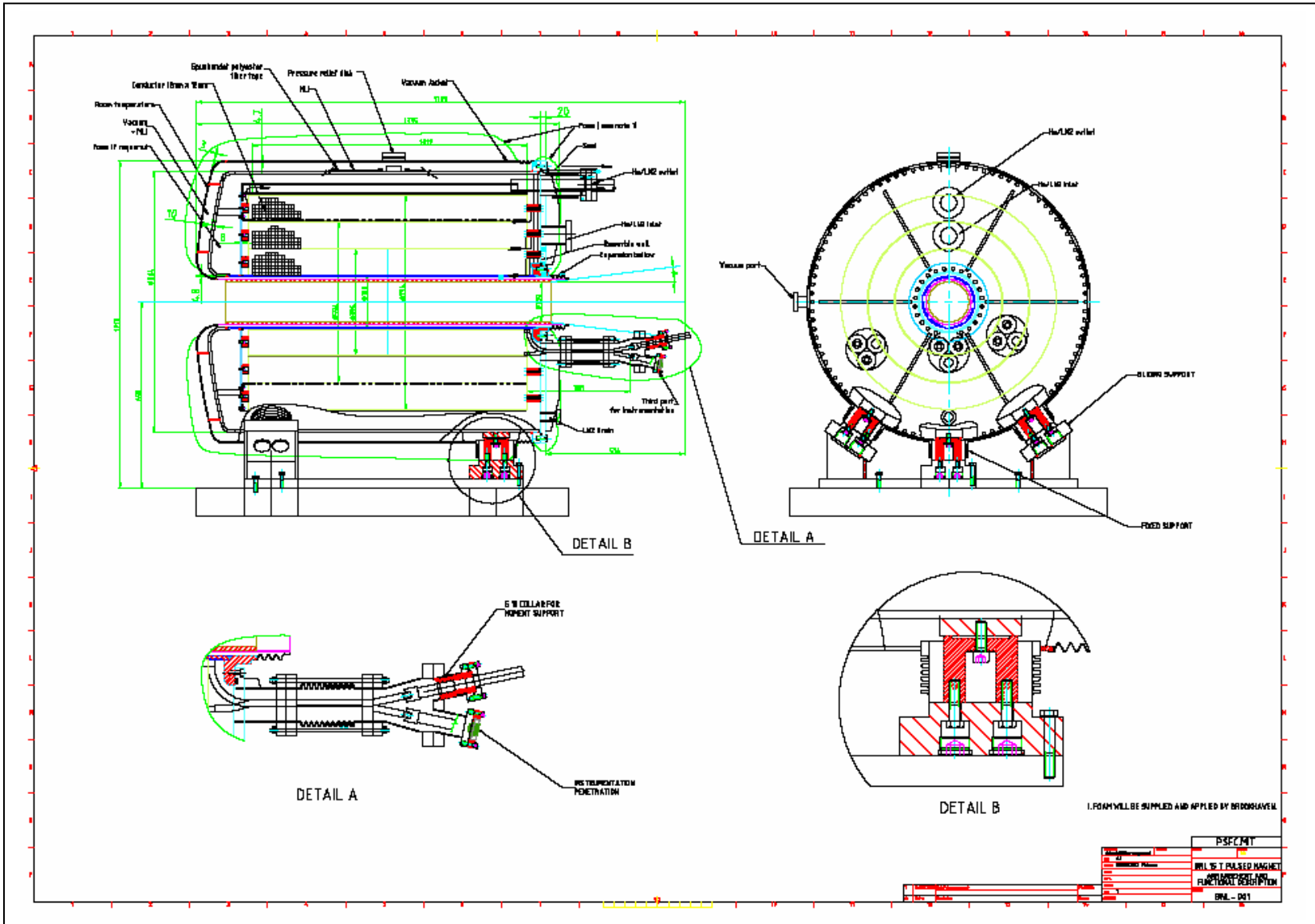
CVIP had a good track record with BNL and with MIT

Everson-Tesla has been added to the project as a CVIP subcontractor. Everson-Tesla has submitted interface drawings and manufacturing plans for the magnet. CVIP is still working on vessel drawings and plans.

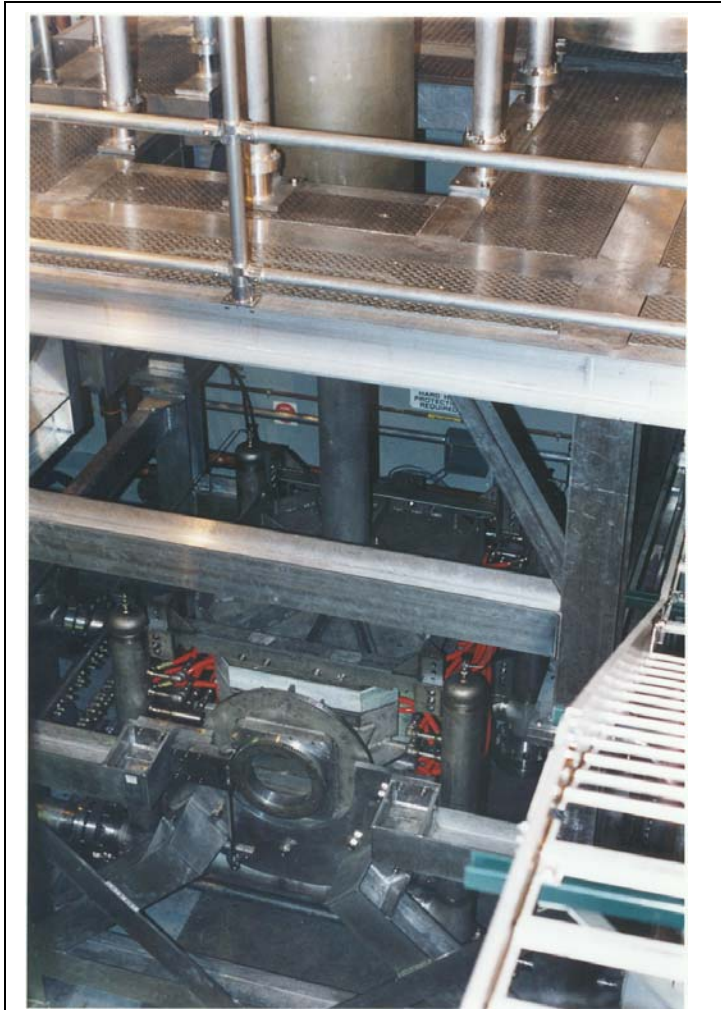


During a March 9 2004 visit to Everson, This preliminary test bend test was shown, and Everson indicated that the keystoneing was “about what was in the spec.”

- ✓ **Design Drawings Complete – Including some minor updates - weld details, material call-outs, resulting from the bid process. Drawing issue is controlled on the Titus MIT-PSFC web page with a A revision status table.**



## Pre-Operational Testing – Proposed to be Performed at MIT-PSFC Pulsed Test Facility



Lower Water Cooled Split Pair Copper Magnet -  
The BNL Pulsed Magnet would be in front of this  
Where the HXC Prototype cryostat is now  
positioned



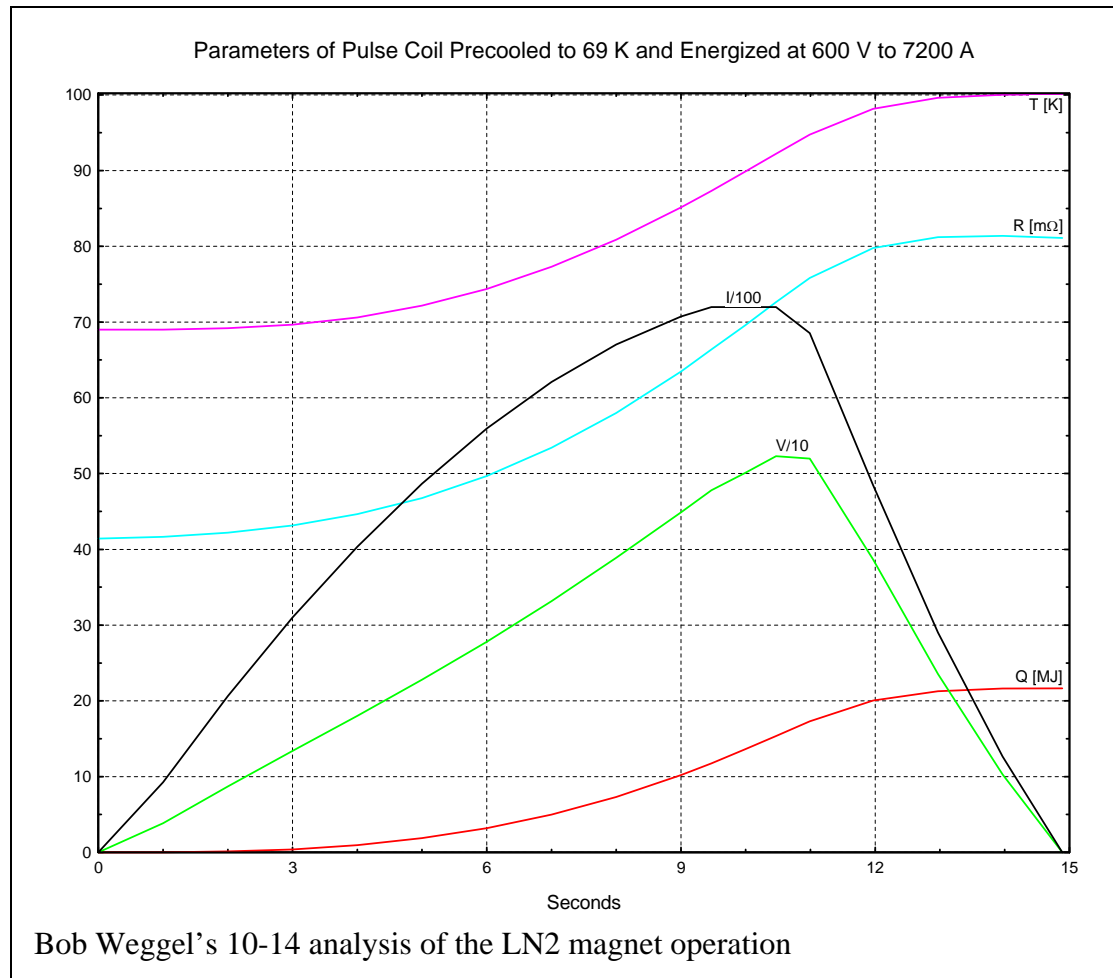
PTF Upper Cryostat



**Preliminary Review of the current /voltage profiles indicates that the PTF power supplies will meet the test requirements.**

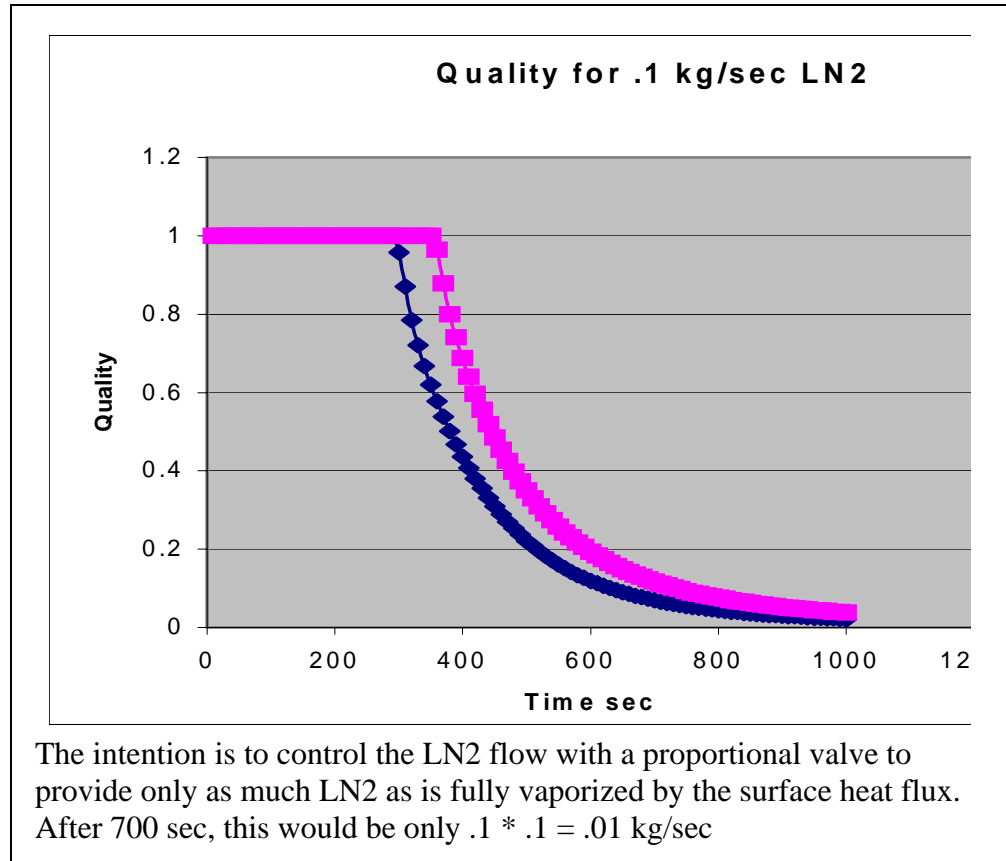
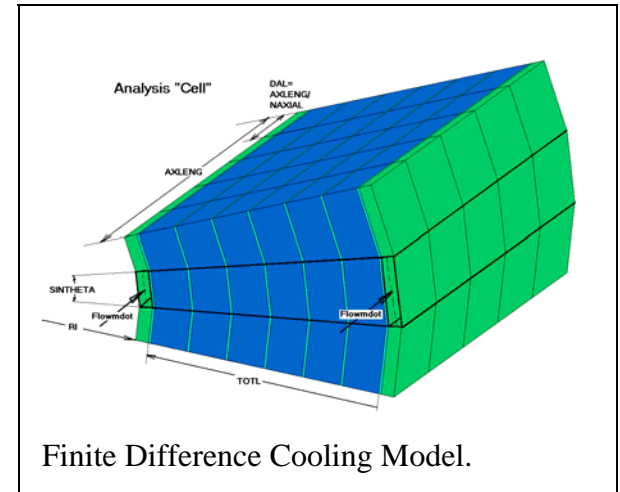


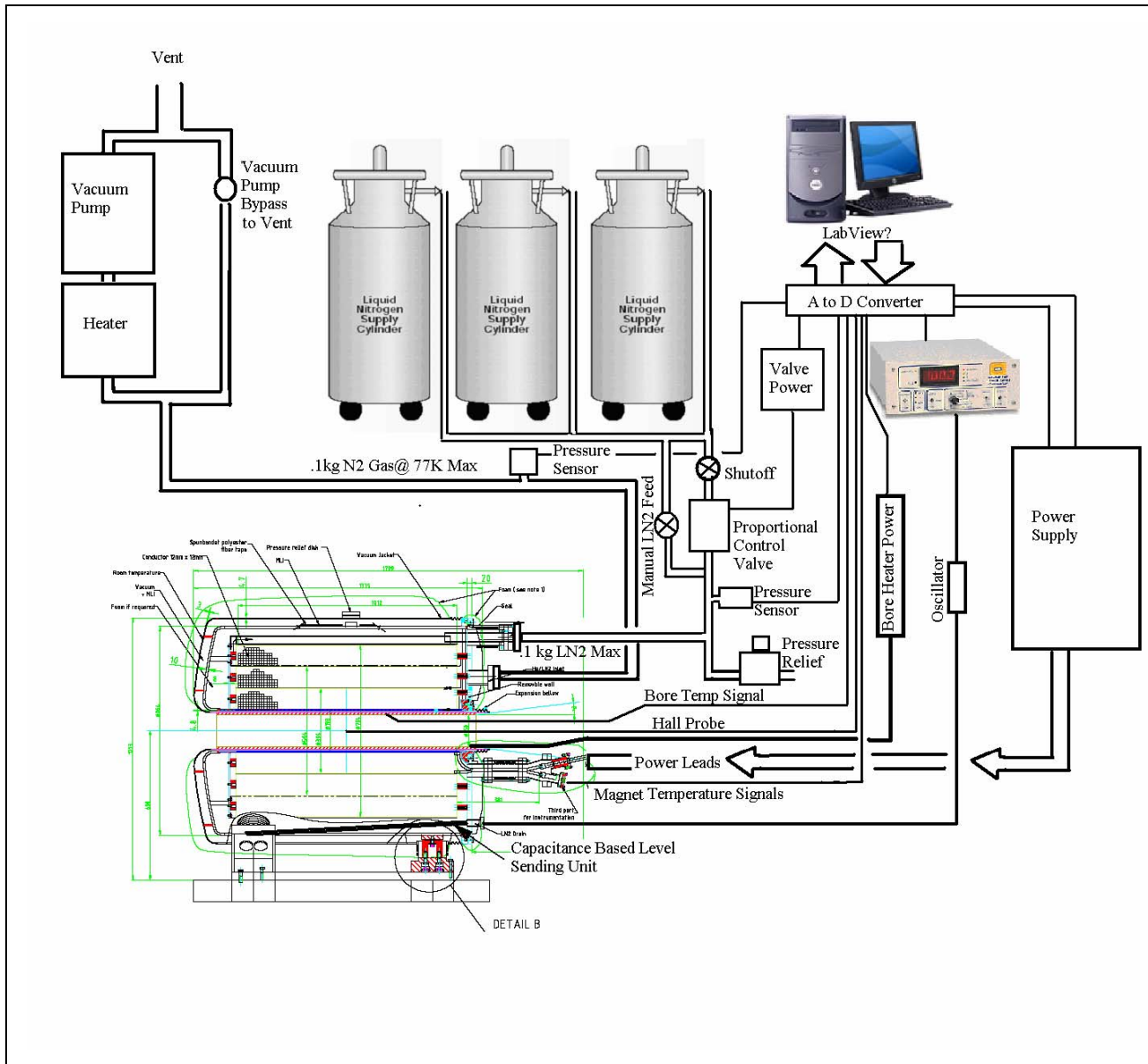
PTF Power Supplies



**Only Liquid Nitrogen Cooling Will Be Employed During Pre-Operational Testing**  
**C-Mod Main LN2 Supply Tank will be used with the LDX VTF supply line**

**Two Approaches are possible:**  
**Flood and Wait - Then Drain and Pulse.**  
**Develop and implement a “skid mounted”, deliverable**  
**Controlled LN2 Cooling System**





**Proposed  
“Elaborate” LN2  
System with flow  
metering capability.**

**Liquid Level Sensor**

The cap the Moc Upon re sensors including epoxies. of up to available

Three st typical c with an . pressure male NF of connec included be remc effecting

Sensor (

1. Rugg
2. Minia
3. Radit
4. Cape

Custom applicati

**Capacitance based level sensor**

## The flow/energy during vent to the vacuum pump should be:

!mass flow= .05 kg/sec  
!volume flow= 144 cu-m/hr  
!volume flow = 1.4125782 cu ft/sec  
!Exhaust Pipe Flow Velocity, 4in pipe= 16.515614 feet/sec  
!Exhaust Pipe Flow Velocity, 6in pipe= 7.1942017 feet/sec  
!Heater Power= 10.608 kW

```
! ** Calculations ****
clear
let mflow=.05 !kg/sec Vacuum Pump Flow
let N2gasden=1/.7996 !kg/m^3 STP ref air liquide web site
let N2gasspht=1.04 !kJ/kg/degc ref air liquide web site
print "Gaseous Nitrogen Density=";N2gasden;"kg/m^3"
print "Gaseous Nitrogen Specific Heat=";N2gasspht;"kJ/kg/degC"
let N2gasden=1.25 !kg/m^3 STP ref air liquide web site
let vflow=mflow/N2gasden*60*60 ! cu meter/hr
print "mass flow=";mflow;"kg/sec"
print "volume flow=";vflow;"cu-m/hr"
let vflow= vflow*(39.37^3/12^3)/60/60 !cu ft/sec
print "volume flow = " ;vflow; "cu ft/sec"
let area6=.5^2*pi/4
let area4=.33^2*pi/4
print "Exhaust Pipe Flow Velocity, 4in pipe=";vflow/area4;"feet/sec"
print "Exhaust Pipe Flow Velocity, 6in pipe=";vflow/area6;"feet/sec"
let heatpower=mflow*N2gasspht*(292-88) !kJ/sec or KW
print"Heater Power=";heatpower;"kW"
end
```

I talked with a local company for a heater. For a standard 12KW he provided a budgetary price of \$4600. We guessed that because of the low pressure we might need a larger heat transfer area. This was estimated at \$8500. It looks like this would have to be engineered a bit. The unit size is 2' by 1' by 4' tall. So we can get it into our lab. Their web page is at:

<http://www.thermaxinc.com/indirect.htm>

There are smaller Toyota Vacuum pumps, but the next size down does only 100 cu-m/hr. You might be able to put two in parallel, but I sent the link to the larger unit to be conservative, and with the larger size you could turn it on at the initial .1kg/sec flow (but you would need a correspondingly larger heater).

[http://www.toyota-industries.com/drypumps/s\\_t1000/index.html](http://www.toyota-industries.com/drypumps/s_t1000/index.html)




**PHPK TECHNOLOGIES***HOME OFFICE*

535 ENTERPRISE DRIVE  
WESTERVILLE, OH 43081-8846  
(614) 436-9114  
(614) 436-5816 FAX  
INFO@PHPK.COM

**Quote No.: P-6075**

**To:** Peter Titus                      **From:** Travis Windle  
**Fax #:** (617) 253-0807              **Date:** 03/31/04  
**Phone#:** (617) 253-1344  
**Subject:** Requested Quote              **Pages:** 1

PHPK Technologies is pleased to quote the following parts:

Dear Mr. Titus

Below you will find pricing for the requested items.

***Item: PV-80 Flow Control Valve***

1/2" NPS Remote Operated Cryogenic Globe Valve with a Linear Flow Plug, I/P Transducer, Positioner and Conflat Flange Ends.

The Valve will operate proportionally from customer 4 to 20 milliamp signal.

***General Terms and Conditions\****

Unit Price: \$5,817.00 ea. USD  
Shipping: FOB, Westerville, Oh.  
Delivery: 6 to 8 weeks.  
Payment Terms: Net 30 days, 1% net 10 days.  
Quantity: 1

Handling fee – 3% of equipment purchase price.

Handling Fee              \$174.51

Total Price, Handling Fee Included              \$5,991.51

If you have any questions regarding a valve or the quote itself, please feel free to contact us at the numbers listed above.

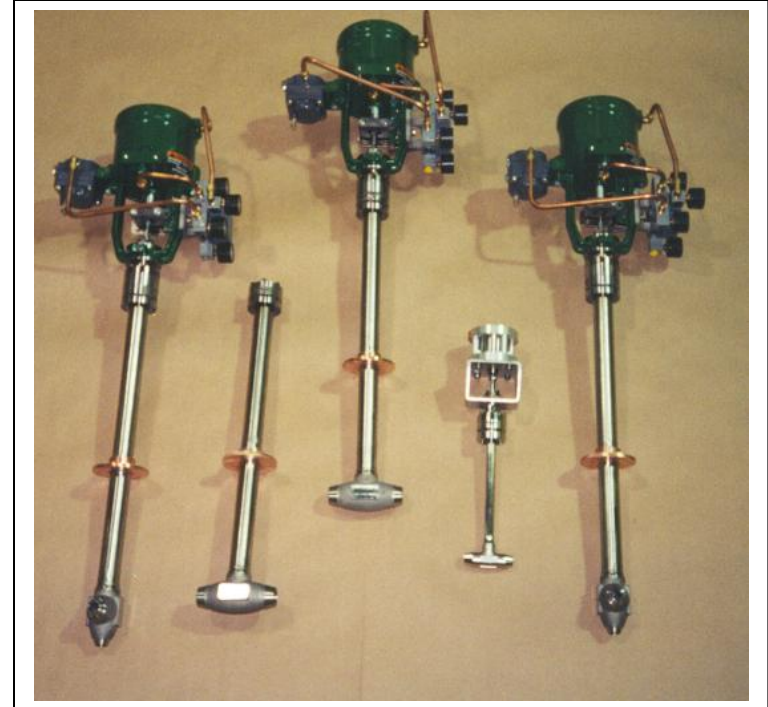
Thank you for the opportunity to quote these items.

Travis Windle

\*The above quoted prices do not include any applicable taxes, duties, tariffs, insurance, shipping or license fees. PHPK has not investigated the necessity for an export license. The validity of this quotation is dependant upon U.S. government approval of an export license, should one be required. This quote is valid for 30 days, from above date of issue. PHPK will not initiate an order until a purchase order is received prior to acceptance of any order. PHPK requires a minimum purchase of \$150.00. PHPK Technologies reserves the right to charge a restocking fee for cancelled orders. Delivery will be verified when a purchase order for the item is placed. Delivery delays as a result of import/export customs are not the responsibility of PHPK Technologies. Shipping, handling, taxes, and duties related to this order will be added to the customer invoice.

3/31/04, 4:36 PM

C:\WORK DIRECTORY\PROPOSAL\P-6075\P-6075 quote.doc



**For LN2, flow is reversed from what is shown in BNL-001**

**Additional Restrictions in the flow channels may be needed to completely fill the magnet flow passages. These will be added at CVIP during flow tests and possibly adjusted at MIT.**

**Either Orifices or “flappers” will be added to Channels.**

**“Flappers” might accommodate both LN2 and Gaseous N2 flows better.**

