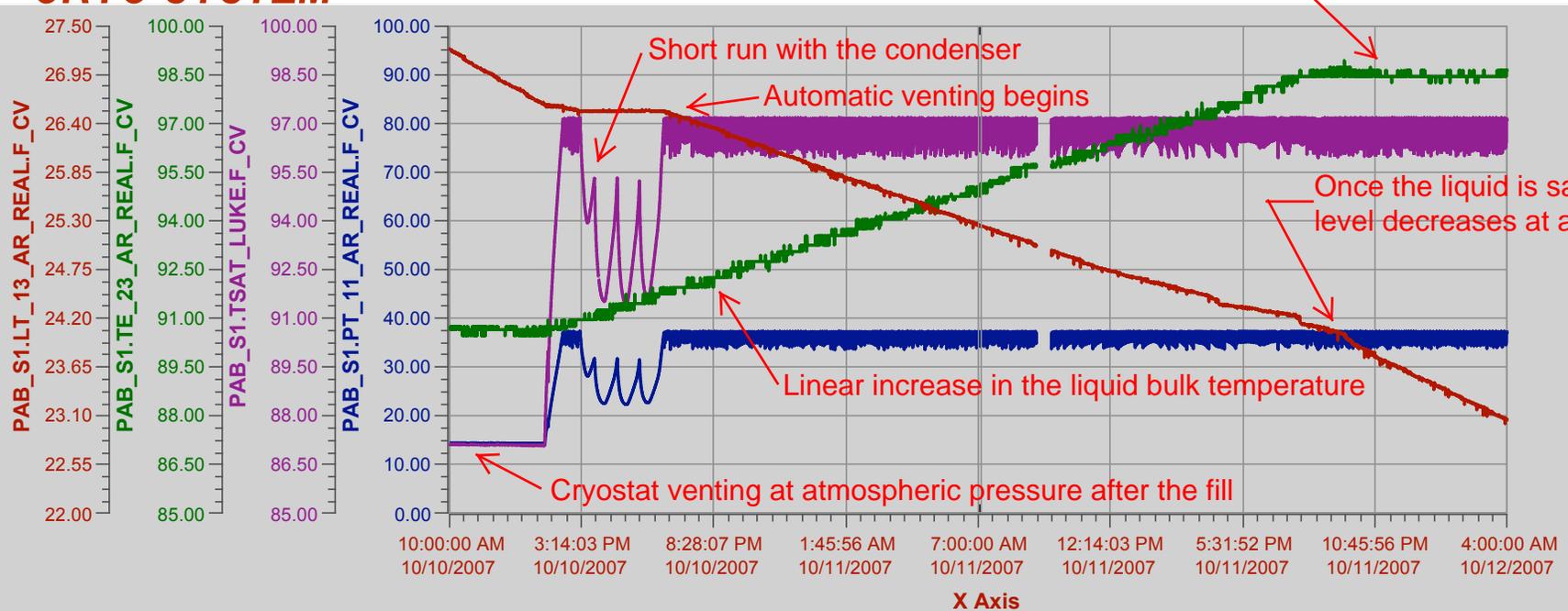


# CRYO SYSTEM

## FLARE HISTORICAL DATA - LUKE VALUES

[Back to Menu](#)



Pen Name	Description	Value	Eng Units	Low Ove...	High Ove...	Avg Over ...
PAB_S1.PT_11_AR_REAL.F_CV	AG- (F_CV)	36.48	psia	14.27	37.41	33.33
PAB_S1.TSAT_LUKE.F_CV	PAB_S1.TSAT_LUKE.F_CV	96.95	N/A	87.05	97.21	95.60
PAB_S1.TE_23_AR_REAL.F_CV	Luke Pressure Building Htr Temp (F_...	94.75	K	90.45	98.95	94.87
PAB_S1.LT_13_AR_REAL.F_...	Luke Argon Level Probe	25.25	inches	23.00	27.25	25.25

10/10/2007 10:00:00 AM 10/12/2007 4:00:00 AM

- Green = liquid temperature measured by thermocouple in heater block.
- Blue = cryostat vapor pressure measured by a Setra pressure transmitter
- Magenta = Saturation temperature based on the cryostat pressure.
- Red - argon liquid level measured by an American Magnetics transmitter.

There is an offset between the measured temperature and calculated saturation temperature at steady state.

At 6:58:05 PM on 10.10.07 the measured liquid temperature was 91.95 K and the level was 26.50 inches.  
 At 5:49:39 PM on 10.11.07 the measured liquid temperature was 98.15 K and the level was 24.31 inches.

See next page for heat leak estimate based on the rise in bulk temperature.

### Estimate of heat leak during a period of bulk temperature increase and venting

Average liquid level is  $\frac{26.50 + 24.31}{2} = 25.405$  inches.

Average volume of the cryostat during this period is  $\frac{\pi}{4}(22)^2(25.405) = 9657.14in^3 = 0.1582m^3$ .

The time period from 6:58:05 on 10.10.07 to 5:49:39 on 10.11.07 is 22.8594 hours or 82,294 seconds.

Heat leak into the cryostat is then calculated utilizing the specific heat and density of liquid argon

$$\frac{0.1583m^3}{1} \times \frac{1136J}{kg \cdot K} (98.15 - 91.95)K \times \frac{1394kg}{m^3} \times \frac{1}{82,294sec} = 18.88 \frac{J}{sec} = 18.88W .$$

$$\frac{\pi}{4}(22)^2(26.50 - 24.31) = 832.491in^3 = 0.013642m^3$$

$$0.013642m^3 \times \frac{1394kg}{m^3} \times 161900 \frac{J}{kg} \times \frac{1}{82,294sec} = 37.4 \frac{J}{sec} = 37.4W$$

This totals to a heat leak of 56.2 W for this period of venting and bulk temperature increase.

### Estimate of heat leak during a period of constant bulk temperature and venting

At 11:02:40 PM on 10.11.07 the liquid level was 23.7 inches. At 7:08:20 on 10.12.07 the liquid level was 22.26 inches. During this period of 29,140 seconds the argon boil off vapor was vented. The heat leak is calculated as follows

$$\frac{\pi}{4}(22)^2(23.72 - 22.26) = 554.994in^3 = 0.009095m^3$$

$$0.009095m^3 \times \frac{1394kg}{m^3} \times 161900 \frac{J}{kg} \times \frac{1}{29,140sec} = 70.4 \frac{J}{sec} = 70.4W \text{ for a period of venting with a constant bulk temperature.}$$

70.4 W corresponds to a liquid argon vaporization rate of

$$70.4 \frac{J}{sec} \times \frac{kg}{161900J} \times \frac{m^3}{1394kg} \times \frac{10^6 cm^3}{1m^3} = 0.3119 \frac{cm^3}{sec} = 18.7 \frac{cm^3}{min} = 1.122 \frac{liters}{hr}$$