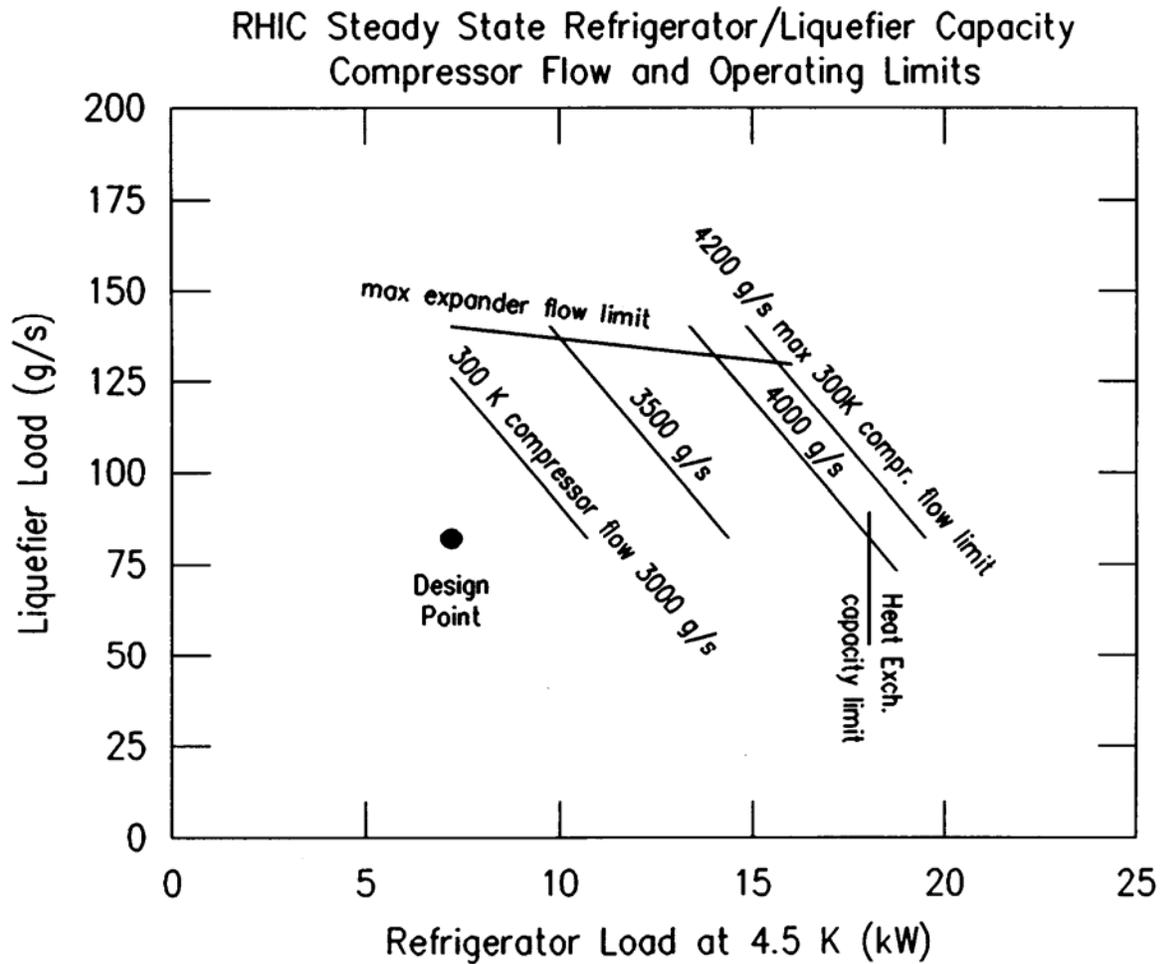


**vii. System Thermal Mass and Cooldown/Warmup Time Estimates**

Based on cool down rates through several thermal cycles of the accelerator, the total thermal mass of the magnets and heat shield is about 200,000 kg. Cool down of the accelerator is done in two phases, first to 80K then to 4.5K. Each wave goes through one ring at a time, with the Blue ring cooled first. A liquid nitrogen based system has been installed near building 1006B to facilitate cooldown to 80K. This system, called the 80K Cooler, takes pressurized Helium from one of two local compressors and cools it to approximately 80K via boiling heat transfer in a liquid nitrogen bath, then routes this cold gas to the accelerator. Typically, this phase takes 12 days per ring, at 120 g/sec of Helium flow through the 80K cooler.

Cool down to operating temperature is done with the main refrigerator and is begun after the 80K waves are complete. The 4.5 K waves are also done in series with it typically takes 5-6 days/ring to reach normal operating conditions.

The energy necessary to warm the magnet to room temperature from operating temperature is provided by electric resistance heaters inserted into the magnet laminations. A small flow of helium is provided during the time that the heaters are powered to spread the heat from the laminations to parts of the system not in contact with the laminations, and to couple magnet temperatures to temperature instrumentation. Warm-up to room temperature takes less than one week.



**Fig. 3-4.** RHIC steady state refrigerator/liquefier capacity compressor flow and operating limits.