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Helium Consumption of the SSC

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The cost of the helium inventory is about $3.7M, but even more costly will be the operating time necessary to accumulate it and move it. Steady loss of inventory is not only expensive in itself, but it is accompanied by contamination problems and a consequent loss of machine availability. That the system contains an uncomfortably large amount of refrigerant is further illustrated by the fact that at the single-phase circulation rate of 400 g/s in each sector, it requires 17 hours to circulate the total inventory through the system once. Handling the inventory prudently is a major consideration for the SSC, and its systems must be designed with this in mind.

A design criterion for helium loss during normal operation of the SSC can be developed from the experience at the TeVatron. Typical loss rates there are about 50,000 liters per month of which 60% is steady leakage, 25% is due to transient leaks and decontamination and repair operations, and the remaining 15% is unrecovered quench gas[1]. The cryogenic system of the SSC with 10 refrigeration plants, though much larger, is not in reality more complicated to make leak tight than the Tevatron system with a central liquifier, six satellite compressor stations, and 24 satellite refrigerators. It is reasonable, therefore, to try in the SSC with careful design and construction practices to improve on the steady loss rate at the TeVatron by a factor of two. Assuming that losses due to decontamination and repair should be scaled from the TeVatron by the total refrigeration capacity (factor of 3), then the total loss rate to be expected for the SSC operations is (0.5 x 60% + 3 x 25%) of 50,000 liters per month. This is 52,500 liters per month or about 472,500 liters for the operating year of 6000 hours.

The current price of helium is $74/1000 SCF or $1.85 per liter. Thus the total cost per year for helium for the SSC operations will be $875,000. During the same years operation, the cryogenic system electric power usage will be (33,600 x 6000) kW-hr that at a rate of $0.05 - 0.075 per kW-hr costs $10-15M. Therefore looked at as a utility, helium gas will be a small part of the total, and costs of helium conservation and usage must be included in the overall optimization of of the SSC operating costs. It is reasonable to strive for low helium consumption, but these efforts have to be regulated by the cost benefit.

This quantity of helium is only a fraction of one percent of the nation's yearly helium production, and so the SSC will not affect the price of helium. If it is delivered as a gas some 65 trailer loads a year will be needed, and if delivered as a liquid, as seems more likely, about 12 deliveries a year will be required. So the nation's helium delivery capability will not be strained. The total helium inventory of the SSC will be about 2,000,000 liters or 4 times the annual consumption estimated above. Thus if the facility comes into operation over the course of three years, these remarks apply to the initial inventory accumulation as well as the operating consumption.

[1]Helen T. Edwards, Ann. Rev. Nuc. Sci. 35, 605 (1985)