4. Civil Construction

In this section the civil construction associated with the Recycler project is described. The purpose of this work is to construct both the penetrations for the stochastic cooling fiber optic cables and the laser telescopes for signal transmission between the pickup and kicker tanks.

4.1. Stochastic Cooling Penetrations

The penetrations for the stochastic cooling system are situated at Main Injector quadrupole locations Q213 and Q109. As shown in figure 4.1.1, a 2" diameter pipe between the berm toe line and the tunnel is inserted in order to provide a conduit for alignment control cables and fiber optic signal transmission lines. This pipe is placed in a hole bored by a drilling crew.

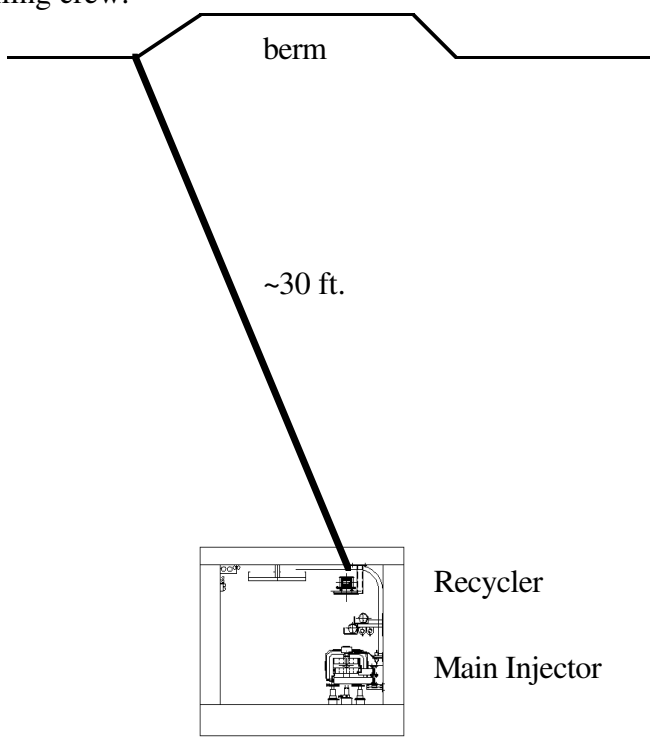

Figure 4.1.1: Tunnel and berm cross-section with a 2" diameter conduit for stochastic cooling signal transmission via optical fibers. In addition, the alignment control cables for aiming the laser beams and the electrical service for the required pumps and motion control must also fit in the conduit.

4.2. Stochastic Cooling Telescope

Approximately 8' below the surface near Q213 the horizontal, vertical, and two momentum stochastic cooling signals, transmitted as AM modulation on four separate laser beams, are aimed toward the Q109 location. The transition from optical fiber to a 1" diameter laser beam (and back to fiber optic again) is accomplished with commercial optical components. All of these components are passive and do not require power. The

lasers are aimed through a window into an evacuated pipe for signal transmission. The pipe has a diameter of 18" and is 3/16" thickness stainless steel coated for cathodic corrosion protection.

In order to aim the laser beams, it is necessary to have remote piezoelectric motion control. The power, control, and diagnostic readback cables for aiming come from the tunnel. The exact location of this optical transition/aiming hardware is at present designed to be approximately 8' underground. In order to assure maximum stability against transverse pipe motion, the pipe is buried below the frost line. Because the aiming mechanism is below ground, and that hardware must be installed and maintained, a manhole accessed underground enclosure is required on both sides of the telescope. These enclosures require sump pumps in order to keep the aiming hardware and optical fibers dry. The power for the sump pumps also comes from the tunnel via the stochastic cooling penetrations discussed in section 4.1. A sketch of an enclosure appears in figure 4.2.1.

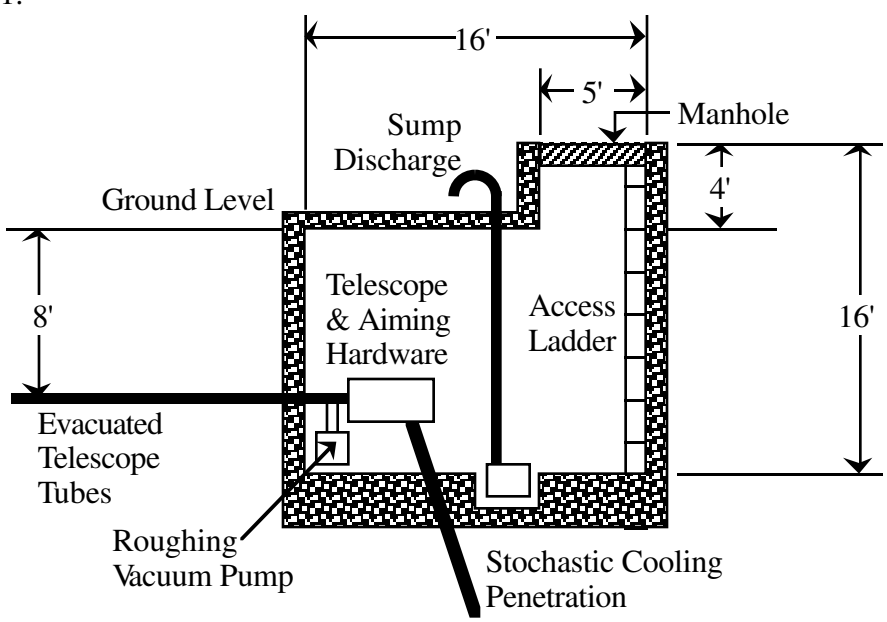

Figure 4.2.1: Sketch of one of the enclosures required at each end of the stochastic cooling signal telescope. One inexpensive model for this enclosure is a sewer access manhole constructed of round, pre-fabricated concrete components.

Therefore, the civil construction implications of the stochastic cooling telescope are; 1) the excavation of an 8 ft. deep and 1800 ft. long trench for burial of the signal transmission pipes, and 2) the construction of two human accessible underground enclosures on either side of the telescope.