7. DECONTAMINATION AND DECOMMISSIONING PLAN

Superconducting beam storage machines are by definition "ultra-clean" machines for three reasons:

1. The object of the Collider is to efficiently store beam for long periods of time and thus deliver particle collisions to the experiments for many hours between refills. Beam losses other than at collision points must be kept very small, otherwise the storage times will be short.
2. Superconducting magnets cannot sustain irradiation from beam loses. A very small amount of beam energy deposited in a superconducting wire will cause the magnet to quench and require the machine to initiate a beam abort.
3. Because the machine stores beam almost all the time it is in operation, the total number of particles accelerated per year is limited by the number of times the accelerator cycles (injection-storage-beam abort). The induced radioactivity in the machine components is directly proportional to the total number of particles accelerated (number of cycles times the number of particles/cycle) and subsequently lost somewhere in the machine. Since the number of cycles is by definition small in a storage type machine, it follows that very little induced radioactivity occurs anywhere in the Collider.

Because of the above, there is almost no induced radioactivity in the accelerator components except at a few well defined locations, and even those components will not be activated to appreciable levels. The majority of the superconducting magnets over the entire 2.5 miles of the Collider and most of the experimental apparatus will not sustain beam losses/irradiation, so that, at the end of the operational life of the complex, there will not be measurable amounts of induced activity on most of the accelerator and experimental apparatus. It is expected that majority of the machine will not have to be treated as Low Level Radioactive waste (LLRW) and can be recycled or disposed as clean material.

The locations where activation will occur are the Collider Beam Stops located on either side of the 10 o'clock intersection region, Transfer Line Beam Dump at the end of the W-Line, collimators, injection septums at the ends of the X- and Y-Lines, a small volume of soil near the three beam stops and some experimental equipment close to the collision vertex. See Figures 1-A-2 and 3-P-1 for the locations. Approximately 85% of beam loss in the Collider is, by design, at the Beam Stop for each storage ring.

Some LLRW will be generated from decommissioning of the W-, X-, and Y-Lines used to transport injection beams from the AGS. This includes the beamlines, Transfer Line Beam Stop and Injection Kickers at the end of the X- and Y-Lines. It is not uncommon for accelerator facilities to recycle components typically found in the Transfer Line. Many of the components in the Transfer Line are already built from material from earlier AGS experiments and from other DOE accelerators. Even if nothing from the Transfer line is recycled at the time of decommissioning the amount of material is not large relative to the total volume of material in RHIC and it does not present any special problems for disposal as LLRW.

Some of the concrete shielding blocks used throughout the complex were recycled from the former Bevelac at the Lawrence Berkeley National Laboratory. A few of these blocks arrived at BNL with low levels of (in the micro-rem/hr range) of induced radioactivity. Since these blocks will not be irradiated by beam losses for the reasons above, decades from now it is expected that these blocks will no longer be radioactive from a regulatory standpoint. At that time, they will have to be radiological characterized by coring and sampling to demonstrate the radiological status before disposal as clean material or reuse.

At the 4 o'clock region, the original concrete pad from the ISABELLE construction was raised to accommodate some of the insertion magnets of the RHIC lattice. To save on the purchase of new concrete, a few radioactive blocks from the AGS, that were no longer usable due to physical deterioration, were used as aggregate. In 1996, the most activated block had a level of 5 mrem/hr at one foot on one end. All the other blocks were much lower. It is possible that this material may have to be extracted from the concrete pad and disposed of as Low Level Radioactive Waste during D&D. At that time, the affected material will be characterized. Regardless, the relative volume of concrete is not significant and it is quite likely that characterization of the embedded blocks will result in the material not being considered radioactive from a regulatory standpoint at the time of decommissioning. The dominant induced radionuclides and associated half-lives in the embedded concrete and heavy concrete blocks are shown in Table 7-A-1.

TABLE 7-A-1

Dominant Induced Radionuclides in Concrete and Heavy Concrete Shielding

Isotope	Half-Life
^{57}Co	0.74 yr
^{54}Mn	0.82 yr
^{54}Mn	0.83 yr
^{22}Na	2.6 yr
^{55}Fe	2.94 yr
^{60}Co	5.27 yr
^{3}H	12.4 yr

There is no plan to use hazardous material in large quantities and no significant waste volume of non-radioactive RCRA material is expected to be generated at the time of D&D.

Decontamination and decommissioning of RHIC, reuse or restoration of the site should be subject to no major complications, with negligible long term effects and no significant adverse environmental effects, and a detailed plan will be developed at the actual time of decommissioning.