THE PILOT EXPERIMENT

Let me review briefly the history of the method. The advantages of the Cl^{37}-Ar^{37} method of detecting neutrinos was pointed out 18 years ago by Pontecorvo.[8] The experimental method was outlined and background effects were analyzed in detail by Alvarez[9] with the view of using the technique to observe neutrinos at a nuclear reactor. We developed a detector based upon these suggestions and performed experiments near a Savannah River reactor.[10] Since a nuclear reactor is a source of antineutrinos we found these antineutrinos would not drive the reaction. In terms of present concepts, these experiments served to test the principle of lepton conservation.

It was apparent that the Cl^{37}-Ar^{37} method with its inherent sensitivity to low-energy neutrinos would be useful to observe solar neutrinos.[7] The sensitivity of the apparatus was severely limited during the Savannah River experiments by a large background effect from cosmic ray muons. By placing the apparatus 2300 feet underground (1800 meters of water equivalent) the cosmic ray background effects were reduced to a negligibly small value. We used the limestone mine of the Pittsburgh Plate Glass Company at Barberton Ohio. Figure 2 is a photograph of the apparatus. It consisted of two 500 gallon tanks (total of 6.1 metric tons) of perchloroethylene, C_2Cl_4, equipped with agitators, and a helium purging system. Helium was passed through the tanks in series, through condensation traps and finally through a liquid nitrogen cooled charcoal trap. At the liquid nitrogen temperatures used, argon was adsorbed on the charcoal and helium passed through without adsorption. By this simple procedure any argon-37 produced in the tanks could be removed and transferred to a small charcoal trap with an efficiency of 90-95 percent. The efficiency of this process was measured by the isotope dilution method in each experiment by introducing 0.05 cm^3 of Ar^{36} carrier