0.0.1 RPC Gas System

The RPC gas system will be similar to that used in the BELLE[1] and BABAR[2] experiments, in which a gas mixing systems distributes gas to the individual RPCs through simple "flow resistors", with the output flow from each chamber separately monitored by a low-cost electronics bubbler[3]. A high-level diagram of the system for one of the Near Halls is given in Fig. 0.1.

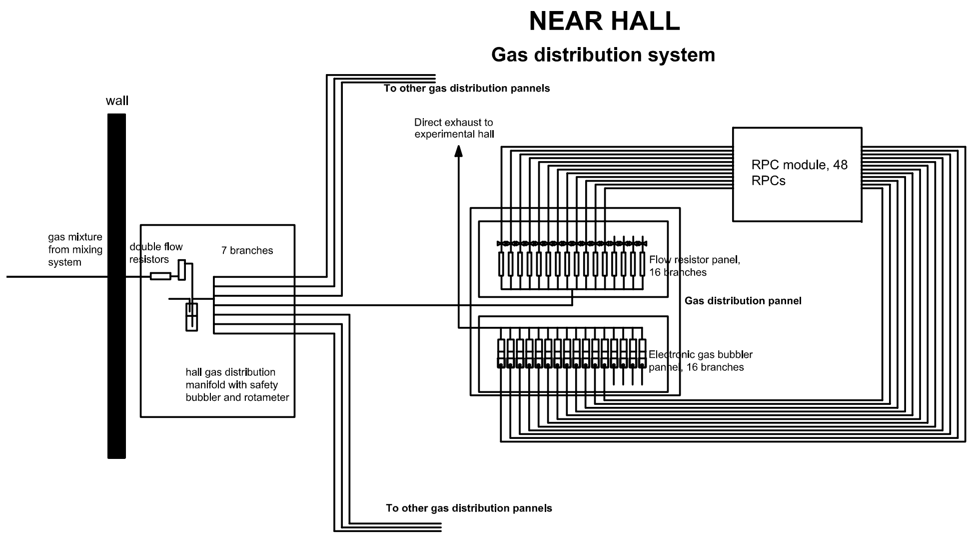

Fig. 0.1. Overall process diagram of the RPC gas system in one of the Near Halls. From[9].

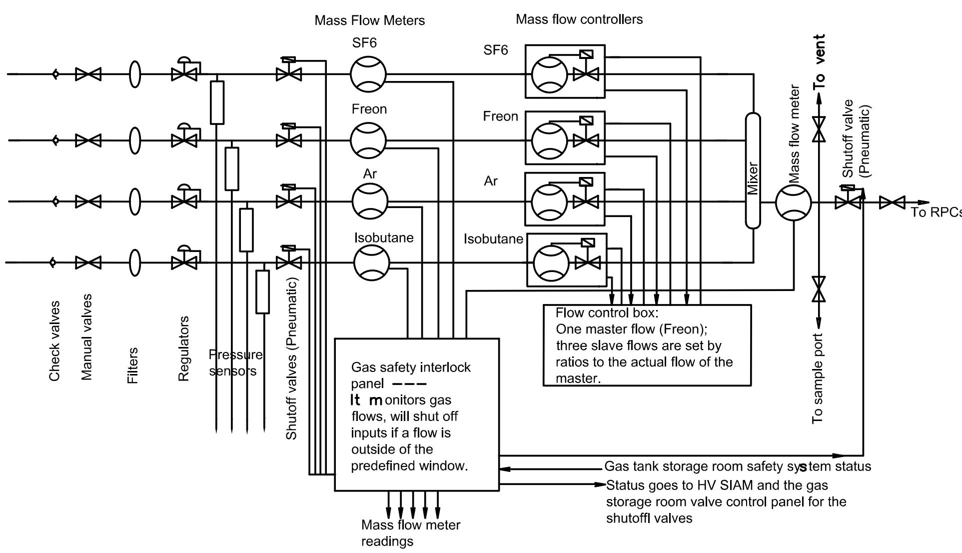

Fig. 0.2. Process diagram for the gas mixing subsystem. From[9].

Mixing of the chamber gases is performed with mass flowmeters, as sketched in Fig. 0.2. It may be advantageous to use "drop-in" modular mixing components recently developed for the semiconductor processing industry, such as the Integrated Gas System of Fujikin[5].

A four component gas mixture, Ar/R134A/Isobutane/SF_6 (75.4/20/4/0.6 % fractions by volume), will be used. The small admixture of SF_6 permits the RPCs to be operated with good efficiency at significantly lower voltage[6].

The electronic bubbler system[3] monitors the chamber gas flow by counting gas bubbles in a small oil bubbler as they pass a photogate, as indicated in Fig. 0.3. There will be one bubbler for every four RPCs, Detailed histories of the input and output gas flow will be available via the online slow-control system.

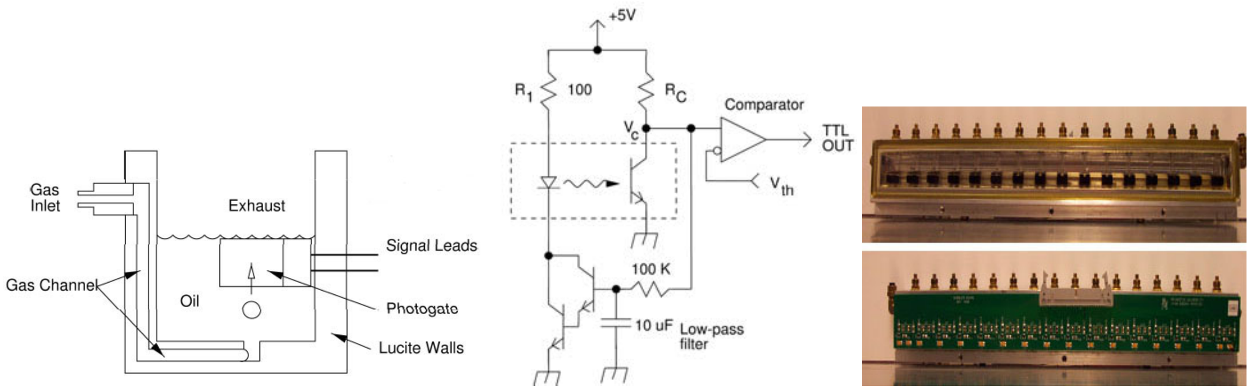

Fig. 0.3. Concept, circuit diagram and photographs of the electron bubbler system. From[3].

The gas will be input from multiple, switchable sources to minimize interruptions of the gas flow during chamber operation. However, the gas flow rate will be only $\approx$ 1 chamber volume per day (6 m^2/day = 5 kg/day), so that short interruptions of the flow will be of little consequence. The used gas will be exhausted into the return ducts of the detector hall air-handling system.

While a mixture of isobutane and air is flammable for isobutane concentrations between 1.8 and 8.4% by volume, the region of flammability is reduced by the presence of an additional inert component of the gas. In the RPC gas mixture the inert component is Ar/R134A/SF_6 with volume percentages 78.4/20.8/0.6. The range of flammability of this particular inert gas mixture together with isobutane and air has not been studed in detail, but it should be similar to that when using Ar/C_2F_6 (70/30), as was calculated in the Fire Hazard Analysis for the BaBar experiment[10]. As shown graphically in Fig. 0.4, there is no region of flammability for a gas mixture in which the ratio of isobutane to the inert component of the RPC gas is 4% or less. Hence, the RPC gas mixture is nonflammable when exhausted into the air-handling system, even in the event of prior air leaks into the RPCs.

An extensive safety system with status monitors and interlocks will be implemented via the slow-control system. For a recent example of a muon-chamber-gas safety system, see[4].

Each detector hall will have its own gas distribution system. The layout of the system in one of the Near Halls is sketched in Fig. 0.5.

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4. R. Messner, *The LST Gas Mixing System* (Oct. 4, 2004), http://puhep1.princeton.edu/~mcdonald/dayabay/BaBar_gas_system/messner_LST_gas_system.pdf
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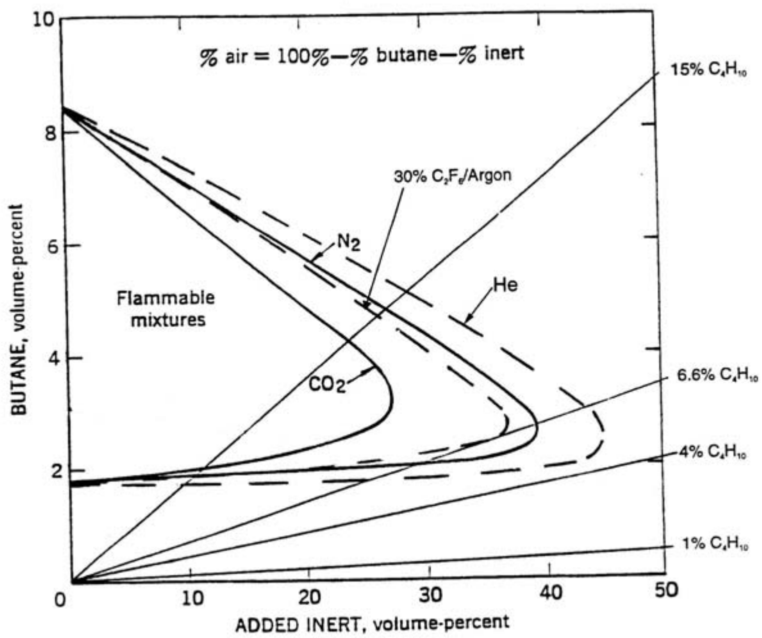

Fig. 0.4. Flammability regions for isobutane gas mixtures. There is no region of flammability for a gas mixture in which the ratio of isobutane to the inert component of the RPC gas is 4% or less. From[10].

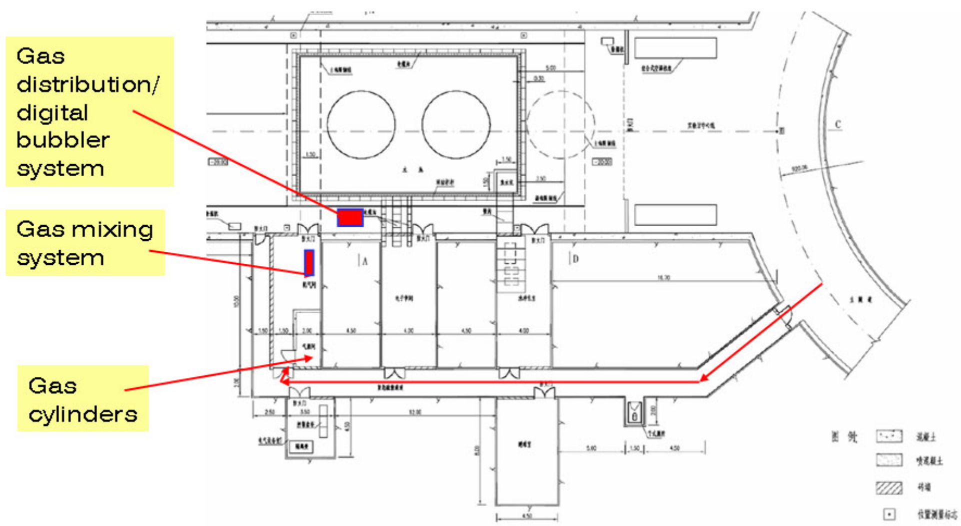

Fig. 0.5. Layout of the RPC gas system in one of the Near Halls.

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