SDC SOLENOID DESIGN NOTE #142

TITLE: Fast Dump Resistor Placement
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INTRODUCTION

This note discusses the possible locations in which to install the fast dump resistor that is used in discharging the solenoid after a quench. Three general locations are being considered. The first location would be somewhere on the solenoid. The second location would be somewhere on the wall of the collision hall. The third location would be up in the service building where the power supplies and dump switches are located.

ELECTRIC POWER CONSIDERATIONS

Certain supply current requirements will differ for each of the three possible dump resistor locations. This is mainly due to the resistance of the bus conductors which carry the current from the fast dump switches to the solenoid. The two lengths of bus conductors being considered are the distance from the service building to the collision hall (D_{ab}), and the distance from the entry point of the bus into the collision hall and the connection of the bus to the top of the solenoid (D_{bc}). The resistance per foot of bus is given as σ. The resistance of the vapor-cooled leads is negligible and has been ignored

Locating the dump resistor on the solenoid, the equivalent electrical circuit would be as in Figure 1.

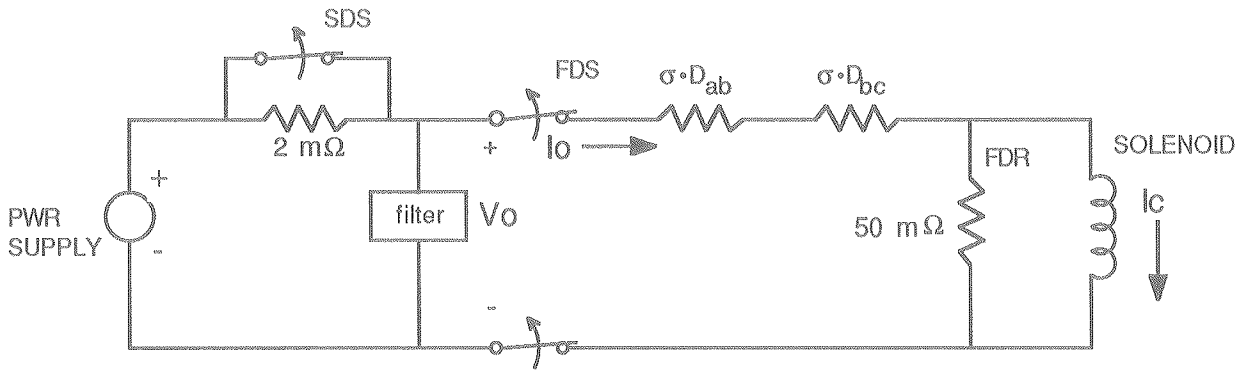

Figure 1

For this arrangment,the current required from the power supply and filter combination is equal to the desired current through the solenoid.

Locating the dump resistor on the wall of the collision hall, the equivalent circuit would be as in Figure 2.

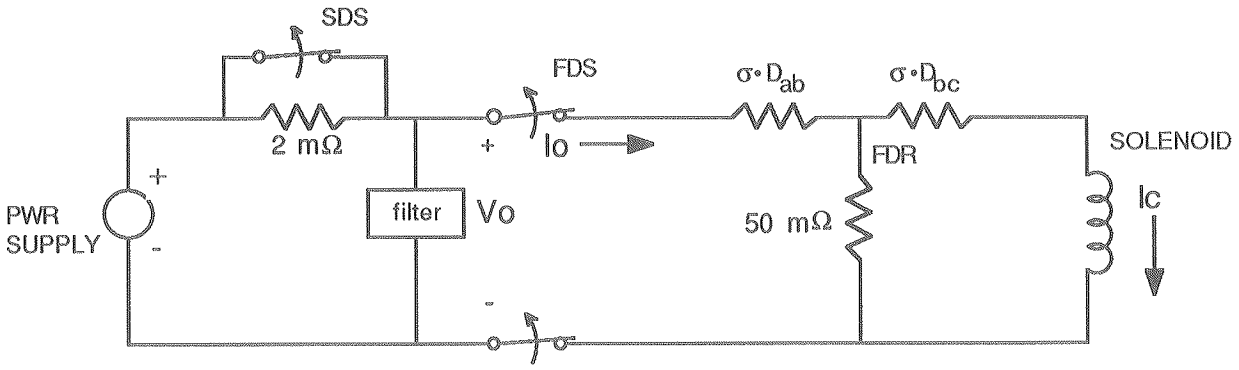

Figure 2

The current required from the power supply and filter combination given the desired current through the solenoid is given by Equation 2.

$$I_o = I_c \cdot \frac{50\times10^{-3} + \sigma \cdot D_{bc}}{50\times10^{-3}}$$

Equation 2

Locating the dump resistor in the service building, the equivalent circuit would be as in Figure 3.

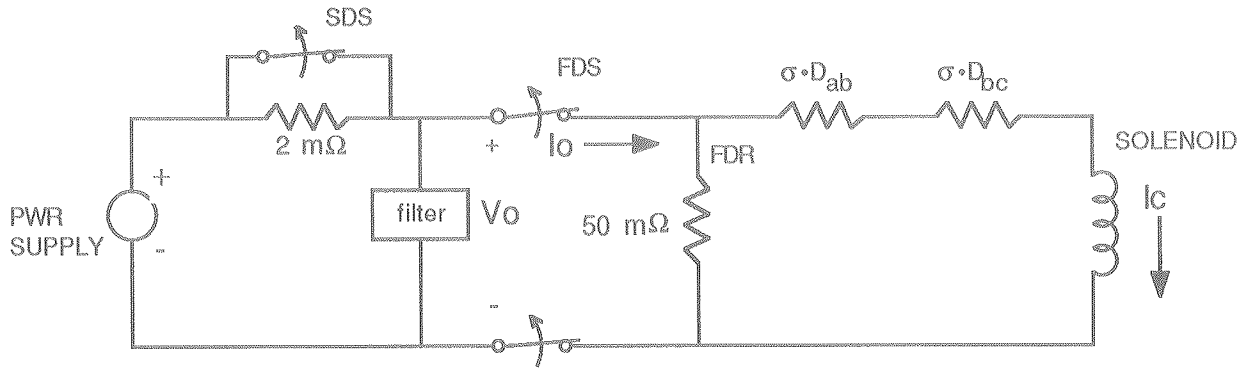

Figure 3

The current required from the power supply and filter combination given the desired current through the solenoid is given by Equation 3.

$$I_o = I_c \cdot \frac{50\times10^{-3} + \sigma \cdot (D_{ab} + D_{bc})}{50\times10^{-3}}$$

Equation 3

PRELIMINARY EXAMINATION

A comparison of the three locations for the dump resistor was made using the following parameter values:

D_{ab} = 162 feet
D_{bc} = 46 feet
σ = 1.72 mW / ft ; (3 inch extra strong copper pipe - DIV 118)

The following was computed for the supplied current and power for each dump resistor location. The column below labeled 'Max Delta' is the greatest difference between the values in the columns Loc #1, Loc #2, and Loc #3.

For Ic = 10,000

	Loc #1	Loc #2	Loc #3	Max Delta
Io	10,000 A	10,015.82 A	10,071.55 A	71.55 A
Po=Vo*Io	35.78 kW	35.88 kW	36.03 kW	0.26 kW

For Ic = 8,000

	Loc #1	Loc #2	Loc #3	Max Delta
Io	8,000 A	8,012.66 A	8057.24 A	57.24 A
Po=Vo*Io	22.90 kW	22.96 kW	23.06 kW	0.16 kW

OTHER CONSIDERATIONS

Another consideration would involve the large amount of heat that is dissapated by the fast dump resistor when a quench occurs. It would be desirable to not have this large temperature rise occur inside the collision hall. Small electronic equipment used for detection and data acquisition may respond adversely to the rise in temperature. For this consideration, it would be better to have the fast dump resistor some where in the service building, or perhaps on the roof of the service building, where the heat would not cause a problem.

Putting the fast dump resistor in the service building would also make maintenance of the resistor connections more convenient.

CONCLUSION

Locating the fast dump resistor in the service building would be the best choice as long as the requirements on the supply current from the power supply, filter combination does not become excessive. The preliminary examination made above gives a clear idea of the magnitude of the supply current, Io, required for this location.