Why suppression diodes on AC solenoids for arc suppression

thread240-149664

Recently I have been involve in replacing numerious Scram Solenoids (type AVCO B7122-145) at a Nuclear Power plant. The circuits have diodes in parallel with the solenoid and the supply is 120VAC. After researching the associated drawings I found a note describing their function. "Arc Suppression".
Could anyone explain to me the necessity of "Arc Suppression" in a non-division atmosphere. No gas, no fiber, no chemicals etc. Also, the word "Varistors" was used in the notes for the connection diagram.

Thanks, 12 Fish
As Iron sharpens Iron so does a man sharpen the countenance of his friends.

The arc suppression are there - to suppress arcs. Arcs do not only start fires or explosions in atmospheres with gases. They also emit EMI that disturbs electronic eqipment and the consume electro-mechanical contacts. If the switching is done with transistors and othe semi-conductors, the inductance will generate voltage peaks when the current is interrupted and those peaks can destroy the semi-conductor. So arcs shall always be avoided.

Diodes are not used in AC circuits, for obvious reasons. What you see may be either zener diodes (back/back) or Tranzorbs or similar devices. The Varistor that you mention is the more effective component to use in AC circuits. It is a resistor that has a high resistance up to a certain voltage, after which it behaves more or less like a zener. It is symmetrical (behaves the same for positive and negative periods). By conducting (shunting energy away) above a certain voltage, it eliminates the arcing, which needs a certain voltage to start.

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Thanks skogsqurra for the promt response. The circuit is zener diodes (back/back). I suppose there could be other equipment (components) in the circuit that could be affected by EMI as I didn't research it that far. As you know, the nuclear (Electrical Generation) is somewhat antiquated and I didn't envoke my thinking into EMI as a consideration. After 27 years in this industry it is sometimes difficult to think, and logic has never been the primary tool in this industry.

Thanks again,
12 Fish
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MOV or Metal Oxide Varisistors (i.e. Varisistor) are another means of supression that go along with those that skogsgurra mentioned.

The "Arc Supression" that is intended is not for the solenoid itself, but for the relay driving the solenoid. This reduces the stress (arcing) on mechanical relay contacts. The supression device acts on the inductive kickback of the solenoid when the solenoid is de-activited.

This is sort of related to you inquiry, but your question made me think of it.

In my circuits, I always put a device, such as a diode, in the circuit to shunt the flyback, but recently I was introduced to the concept of also using a zener diode with the regular diode. If I remember correctly, the zener is in the circuit to cause the flyback shunt to 'hold off' to a certain voltage as this causes a greater force on the contact opening, which in turn makes the contacts open faster and this is supposed to help increase the contact life.

I dind't really get into the details of it, and my explanation may be off, but I still thought it was an interesting concept that I hadn't heard of before.

Noway2,

We are probably using somewhat differing terminology, but if I understand you correctly, you say that you use a zener parallel to a relay coil. That is normal practice and you are right in saying that the contacts open with a greater force.

What happens is that the magnetic field collapses faster and that, of course, makes the opening of the relay contacts faster and therefore more vigorous.

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There are two delays when a relay or contactor opens. One is the delay from the interupting of the cotrol current to the time the device operates. With a freewheeling diode there will be a delay dependant on the time constant of the circuit until the voltage drops enough for the relay to start dropping out mechanically. This delay can be shortened considerably with a varistor or zeners.
The second delay is the time for the contacts to clear the arc, or the arcing time. This time is very short compared to the time constant delay. In some applications the faster decay of the holding force with the zener circuit will be beneficial to contact life.
With most designs, once the holding force decays to the point that the armature starts to move and introduces an air gap, the armature will continue, under spring pressure, to the fully open position. The acceleration of the part(s) will be retarded by the decaying holding force. This retarding force is greatly reduced by the introduction of an air gap into the magnetic circuit and by the inverse square law of magnetic attraction.
I suspect that in most applications, even though it is possible to calculate a difference in clearing time, the actual difference in clearing time will be so little as to have little effect on contact life.
However, in a hypothetical case when a relay as carrying maximum current, the relay is designed with an intentional air gap, (sometimes done to avoid magnetic sticking in small relays with small operating forces), and the time constant of the relay coil is relatively long, the zener circuit may well have a noticable effect on contact life.
yours

Liked that analysis waross! The difference is certainly small. But probably noticable in those small relays with a little "anti-stick" copper rivet.

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