SiD Solenoid Dump Resistor

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Design Parameters and Concept

- Assume worse case of 2 GJ
- Use CMS parameters:

  Same Conductor with 20 kA Current and Peak Discharge Voltage of +/– 300 volts.

  Then the dump resistor must have the same value of 30 mΩ and magnet quench protection should be O.K.

- Minimize Size with a 150 C Pressurized Water Cooled Stainless Steel Dump Resistor

Pressurized Water Dump Resistor Design

- Pick 150 C and .48 MPa (69 psi) as a very reasonable temperature and pressure.
- Water will absorb .50 MJ/liter (30 C to 150 C) in sensible heat without bulk boiling. This is 58% of 1 atm, 100 C water.
- A 1000 gallon = 3800 liter (1.5 m x 2.2 m tall cylindrical tank) will absorb 1.9 GJ (at least 10% of energy will be left in the magnet)
- Local boiling will occur on the stainless steel dump resistor giving a very high heat transfer coefficient.

Pressurized Water Dump Resistor Design

- The peak nucleate boiling heat flux = 126 W/cm^2 with a temperature rise of 18 C .
- Maximum Power = 20000^2 X .03 = 12 MW.
- Thus we need at least 10 m^2 of stainless steel area.
- Pick 6/1 aspect ratio rectangular conductor.
- This works out to be 1.51 cm X 9.06 cm X 57 meter long = 625 kg of 304 stainless steel.

Pressurized Water Dump Resistor Advantages

- Dump resistor is much smaller than an air cooled design. Pressurizing reduces both water and stainless steel over a 1 atm water cooled design.

- A 1 atm boiling water resistor would need only 885 liter but that volume would need to be vented outside or it could dampen things in the hall.