THE FERMI SMTF MODULATORS

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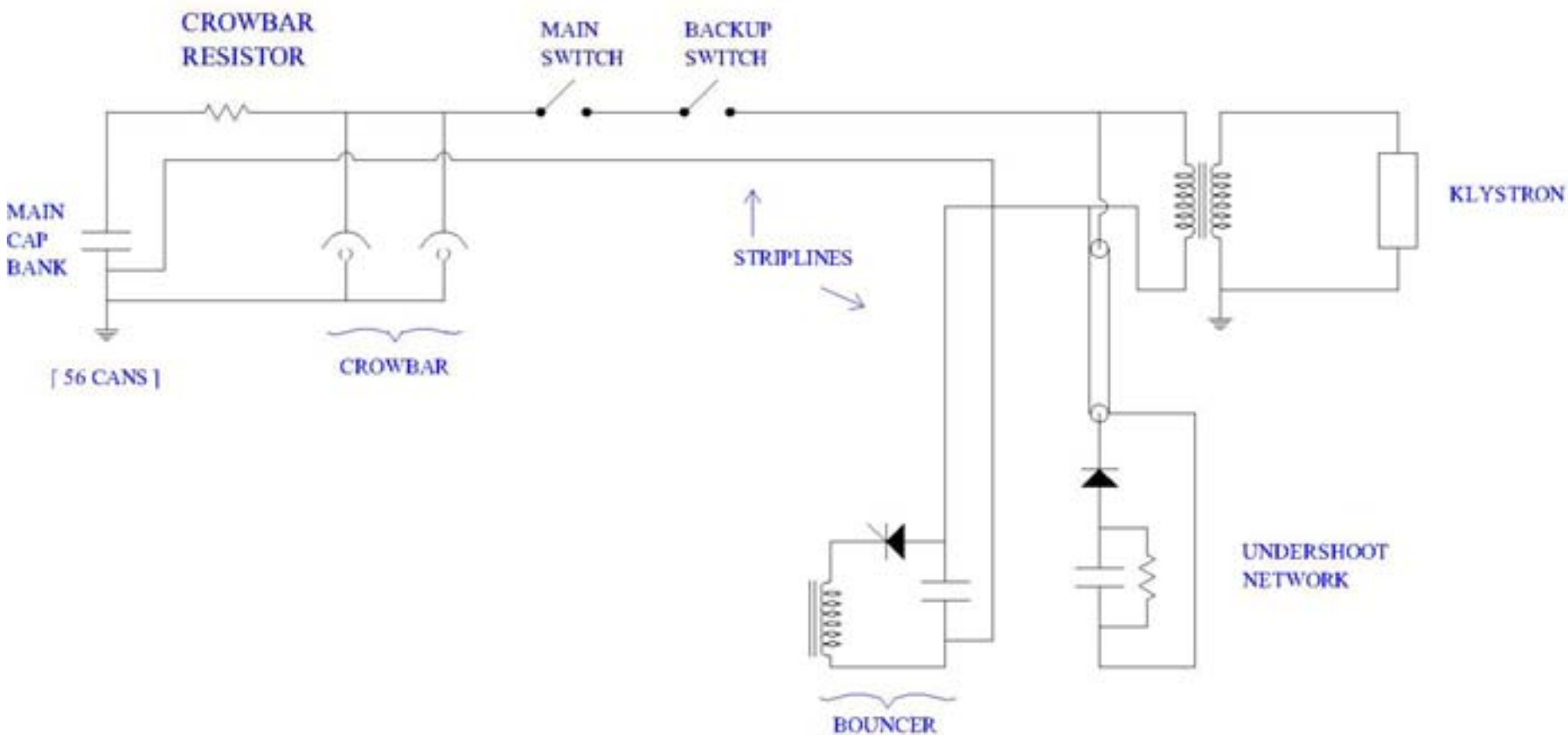
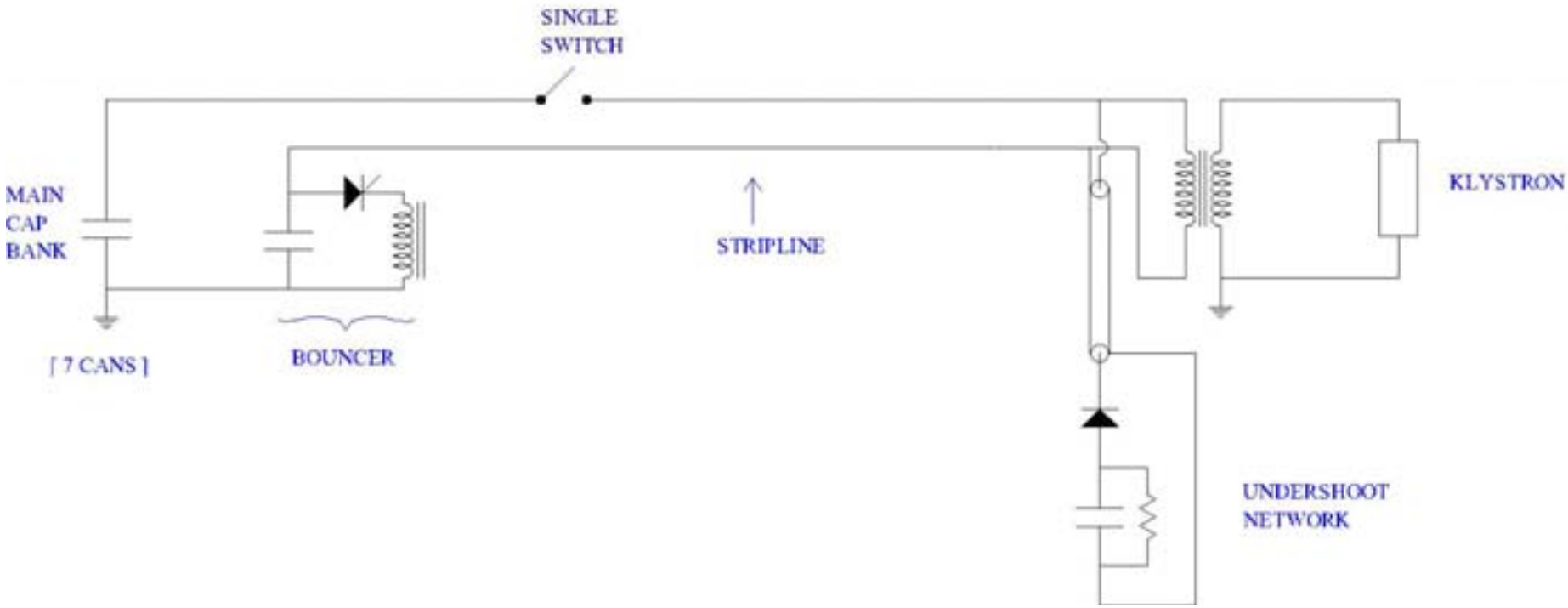
- We are building two modulators for SMTF
- The 1.5ms unit is an upgraded TESLA unit
- It is suitable as ILC baseline unit
- This will describe the new design

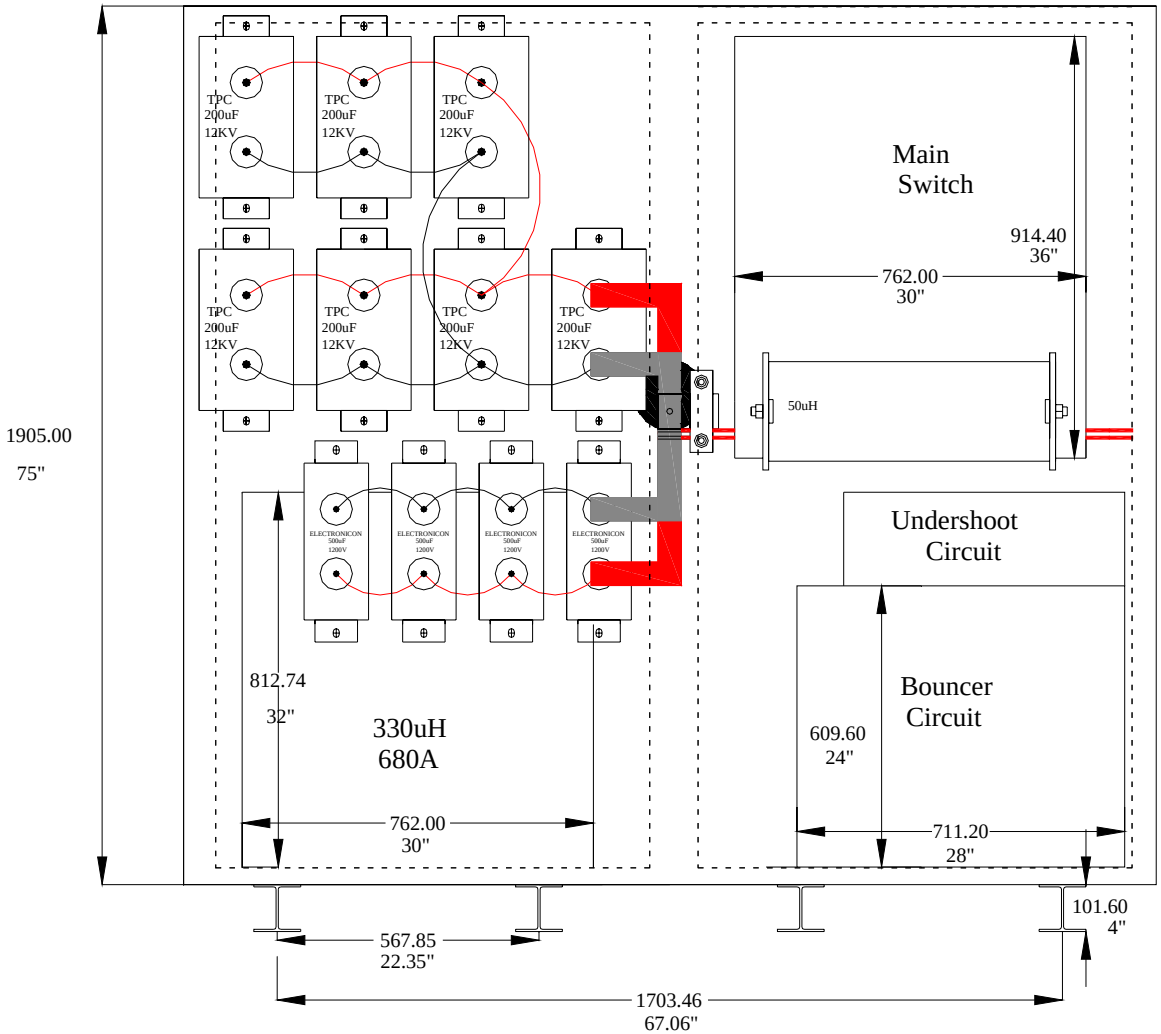
TESLA MODULATOR



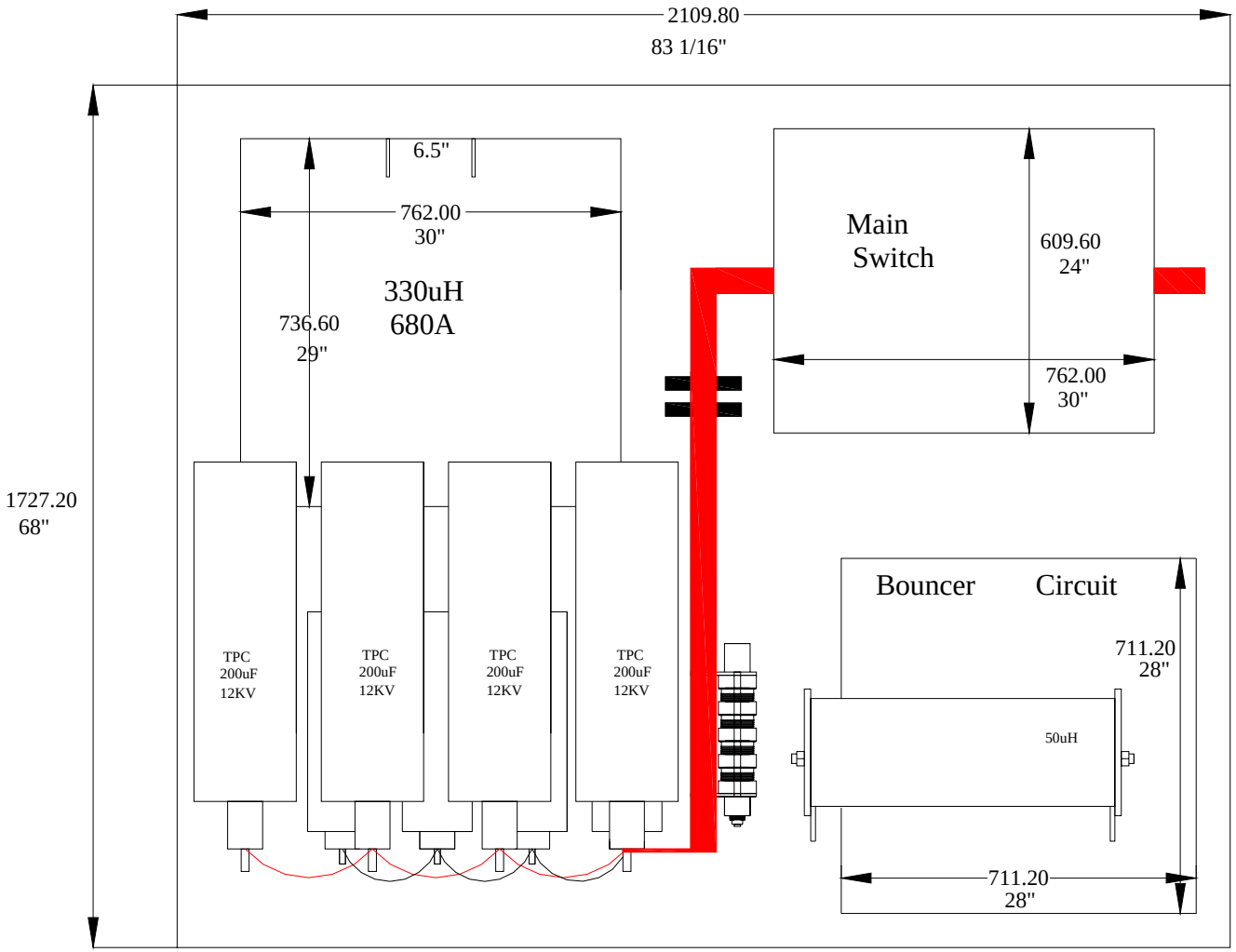
SMTF MODULATOR



FRONT VIEW


TPC
200uF
12KV
Main
Switch
914.40
36"
762.00
30"
50uH
Undershoot
Circuit
Bouncer
Circuit
609.60
24"
711.20
28"
812.74
32"
330uH
680A
762.00
30"
1905.00
75"
101.60
4"
567.85
22.35"
1703.46
67.06"

TOP VIEW


2109.80
83 1/16"
1727.20
68"
6.5"
762.00
30"
736.60
29"
330uH
680A
TPC
200uF
12KV
TPC
200uF
12KV
TPC
200uF
12KV
TPC
200uF
12KV
Main
Switch
609.60
24"
762.00
30"
Bouncer
Circuit
711.20
28"
50uH
711.20
28"

DESIGN CHANGES

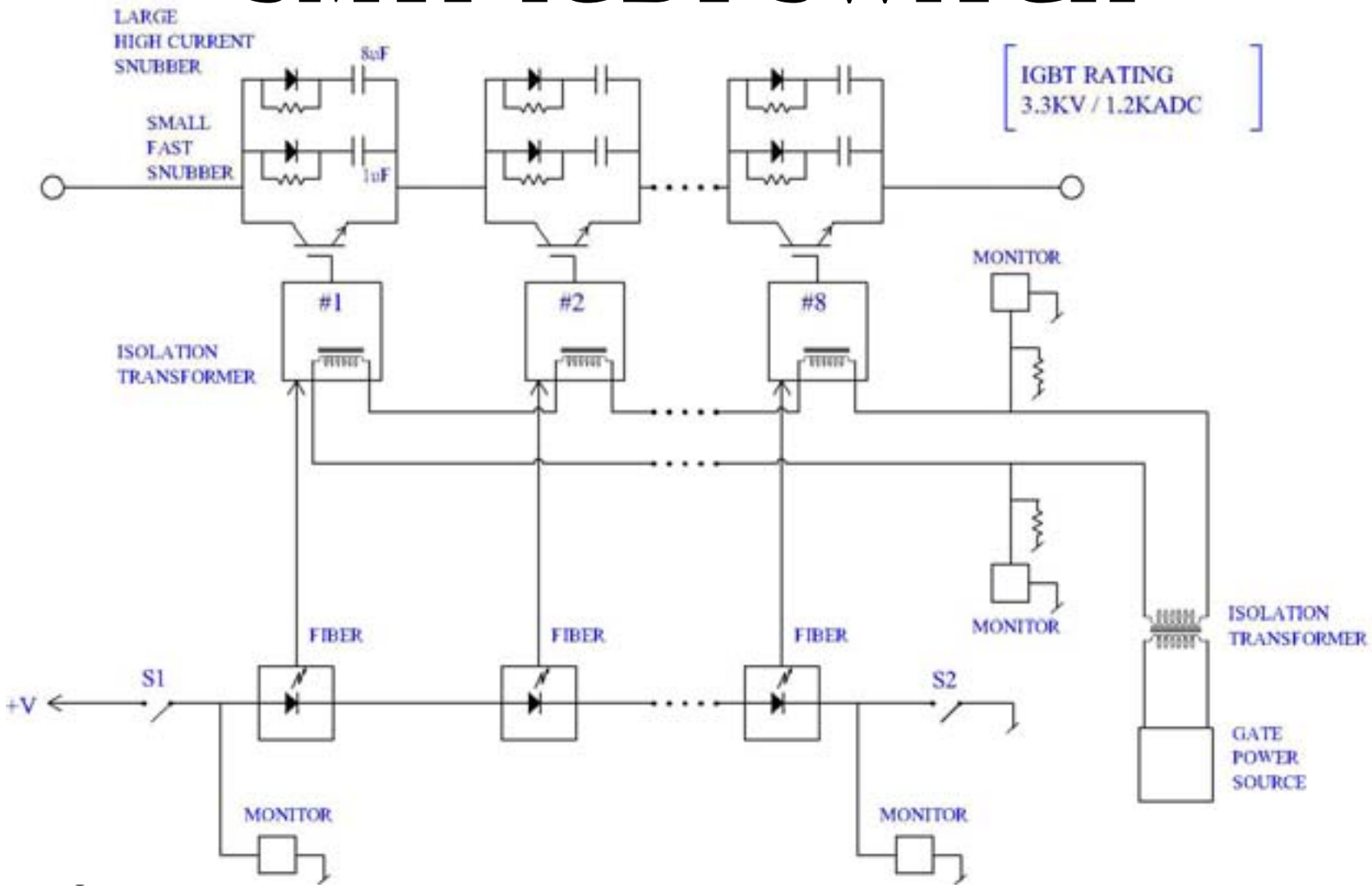
- Use Traction capacitors
- Small size (1/6 volume)
- Self Healing – no catastrophic shorts

- Simplified layout
- Eliminates one strip-line

DESIGN CHANGES

- Use Single IGBT Switch Assembly
- Built-in redundancy
- Eliminate back-up and crowbar
  - Existing Fermi TESLA Switches
    - 140k Operating Hours at DESY
    - Backup circuit never needed

SMTF IGBT SWITCH



NEW IGBT SWITCH DESIGN

- Higher Voltage Margin
- Peak voltage/IGBT = 53% of rating
- If one device shorts = 60% of rating

- Individual High Current Snubbers
- No snubber failure shorts entire switch

NEW IGBT SWITCH DESIGN

- Redundant ON/OFF control lines
- Control system has redundant paths
- Both paths monitored for integrity

- Doubly isolated gate power transformers
- Shorted transformer alarms, still runs
- Transformers built corona-free

RELIABILITY AND AVAILABILITY

- View the IGBT switch as modular
  - One IGBT circuit can fail
  - Switch continues to operate
  - Whole switch will be easily changed
- Capacitors are self-healing
  - Scheduled replacement possible
- Magnetics are passive
  - Must be designed for long lifetimes

COST COMPARISON

- Comparison of Single Quantity Costs
- Baseline *vs.* Marx type
  - Note that comparison is unrealistic until Marx modulator built and fully tested
- Ignore Charging Supply- Similar for Both
- Focus on cost of circuit elements
  - Ignore mechanical aspects
  - Ignore labor and controls

BASELINE MODULATOR COMPONENT COSTS

• Cap bank (1.4mF/12kV)		$18k
• Slope comp.(Bouncer circuit)		$24k
• Switch		$27k
• IGBT's	$18k	
• Snubbers	$6k	
• Gate circuits	$3k	
• Undershoot network		$2k
• Pulse transformer		$56k
• Protection circuits		$10k
• TOTAL		$137k

MARX MODULATOR COMPONENT COSTS

• Cap Bank (.8mF/12kV)		$7.6k
• Slope Comp. (Vernier circuit)		$6.8k
• Switches		$97k
• IGBT’s	$40k	
• Other parts	$57k	
• TOTAL		$111k