Topics for Today:

- URL: http://www.ece.mtu.edu/faculty/bamork/EE5223/index.htm
- Labs EE5224 Begins Wed of Week 3, i.e. Jan 25th
- EERC 134 SGOC lab access for pre-labs and related software.
- Software Aspen
 - Locals: confirm operation.
 - Online: run via Remote Desktop remote.mtu.edu
- Zones of protection, operation and protection strategies
- How to read a one-line (print out week 1 handout "Sub Schem")
- Instrument transformers: VTs, CTs, CCVTs, MOCTs, etc.
- CTs pedestal vs. bushing
- CT saturation & accuracy, ratios, multi-ratio Cts
- Next: print out "CT" handout, Study Chapter 5 info on CT saturation & accuracy

SMART GRID CAREER OPPORTUNITIES – EE5224 Lab:

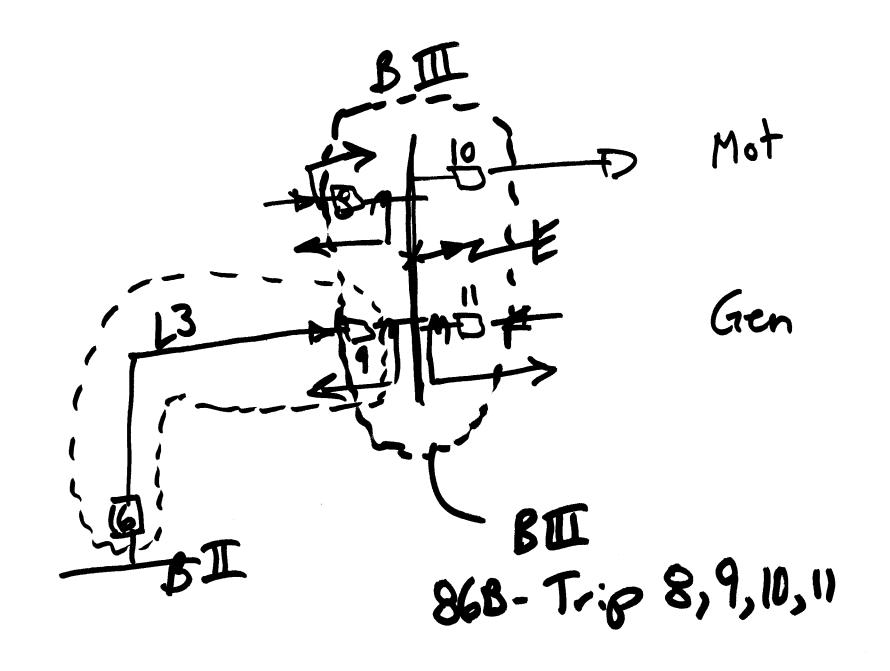
- First protection lab meets Wednesday Week 3. The weekly cycle for labs will be to meet in EERC 134 as follows:
 - Wed 10am-noon; Wed 4-6pm; Thurs 4-6pm, Fri 10am-noon
 - No labs will meet during Winter Carnival week
 - Lab 11 (last lab) during Week 13 of semester.

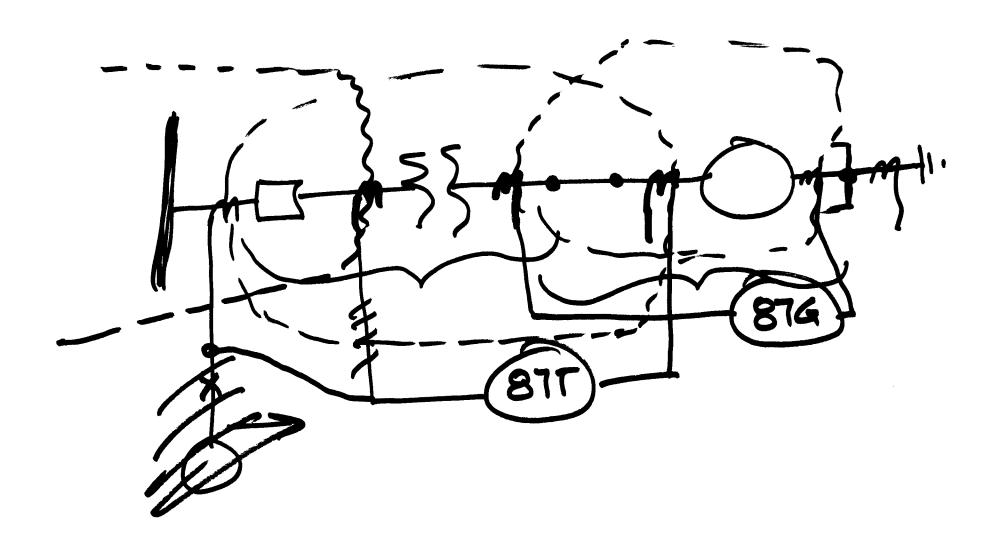
There are currently 3 open slots in Wed lab section. You can still add!

You are encouraged to add this lab, the employers

- consulting firms,
- utilities,
- grid transmission companies,
- corporate or gov't R&D groups, and
- equipment manufactures

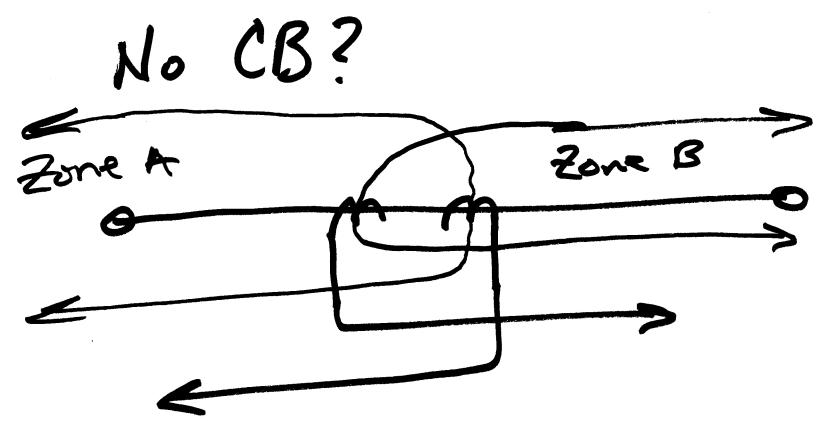
look very highly at this practical experience with state of the art equipment and practical knowledge of relay applications and smart grid technologies. "Relay engineers are like gold."





Zones of Protection

- Overlapping
- Preferably at CB (Note: CT is actual boundary of Zone!) Zone A



Typical Spacings and Clearances in a Substation

See up-to-date NESC to verify!

Voltage Level		Min Conductor Spacing			Min Switch Spacing Ph-Ph			Min L-L	Min No.	Min	Min Bus
KV (L-L)	BIL (kV)	Cent-Cent	Ph-Gnd	To Grade	Horngap	V Break	H Break	Phase Clearance	Bells at Deadend	Cable Size	Size
7.5	95	1'-6"	71⁄2"	8'	3'	18"	2'-6"	7."	1	#2	1/2"
15	110	2'	10"	9'	3'	2'	2'-6"	12"	2	#2	1/2"
23	150	2'-6"	12"	10'	4'	2'-6"	3'	15"	3	#2	1/2"
34.5	200	3'	15"	10'	5'	- 3'	4'	18"	4	1/0	1/2"
46	250	4'	1'-6"	10'	6'	4'	5'	21"	4	1/0	1/2"
69	350	5'	2'-5"	11'	7'	5'	6'	31"	5	1/0	1/2"
115	550	7'	3'-71⁄2"	12'	10'	7'	9'	53"	8	4/0	1/2"
138	650	8'	4'-1"	13'	12'	8'	11'	63"	10	250	1/2"
161	750	9'	4'-10"	14'	14'	9'	13'	72"	12	350	1"
230	900	11'	6'-1⁄2"	15'	16'	11'	16'	89"	14	500	1"
230	1050	13'	7'-3"	16'	18'	13'	18'	105"	16	750	11/4"
345	1300	15'	8'-51/2"	18'	20'	15'		119"	19		2"
500	1800	25'	12'			25'			24		4"
765											

Page # 2 Bushings HV Lead Connections into equipment. Porcelain Bushing Porcelain F": Oil-Filled Bushing