Ongoing List of Topics:

- URL: [http://www.ece.mtu.edu/faculty/bamork/EE5223/index.htm](http://www.ece.mtu.edu/faculty/bamork/EE5223/index.htm)
- Labs - EE5224 - Lab 3 begins Wed Feb 13th
- Term Project - details coming after WC break.

Today:

- CT ratios, MR (multi-ratio) CTs - look at IEEE stds.
- Calculation of measurement error for given ratio & burden.

Next:

- Print out MOCT & CCVT handout from web page
- MOCTs - Magneto-Optic Current Transformers
  - Faraday effect, “faraday rotators,” Verdet constant
  - Shift of polarization angle due to strength of H-field
  - Design kept to low near-linear range
- Linear Couplers, Rogowski Coils
- CCVTS
- Voltage & Current relationships during faults, §3.5-3.10
Super Bowl - JAN 3, 2013

- "Power Surge"
- Utility lost power (Entergy, - )?
- Entergy: All normal.
- NFL: looking into it...
- Problem inside the dome.
- Fire, elevators, gas leak ? ?
- No fire, hot small/smoke near elevator # ?
- Circuit breaker(s) tripped, investigating...

⇒ Pribable Inference.
Figure 5.10 Burdens on CTs for various types of CT connections and faults. The unexcited CT load is neglected.

5.6.1 CT Ratio Selection for Phase-Connected Equipment

Select the ratio such that the maximum short time or continuous current will not exceed the thermal limits of the CT secondary and connected equipment. The conventional practice, over many years, has been that the secondary
Replay Input Sources

\[ Z_{B,\text{TOTAL}} = 2Z_{\text{cable}} + Z_S + Z_{BG} \]

**Figure 5.10 Continued**

Current should be just under 5 A for the maximum load. This was because instruments were often in the same circuit, and they had 5-A movements. Following this practice, select the CT ratio of 100/5 \((R_e = 20)\). This gives a maximum continuous secondary current, when the load is 90 A, of \(I_s = 90/20 = 4.5\) A.

### 5.6.2 Select the Relay Tap for the Phase-Overcurrent Relays

Overcurrent taps represent the minimum pickup or operating current of an overcurrent relay. Thus, a tap is chosen that is higher than the maximum load, in this example, above 4.5 A. How much higher is based on relay characteristics, experience, and judgment. There is no problem if a time overcurrent relay picks up on a cold load, offset currents, or other, provided these currents subside below the relay pickup before it operates. This may be required when the margin between minimum fault and maximum load is small.

Small tap 5 is selected. The ratio above load 5/4.5 = 1.1. This provides a small margin more than any potential increase in the continuous load, but a large margin with inverse-type relays for transient overcurrents, such as a cold load. Minimum fault of 350/20 = 17.5 A, and 17.5/5 = 3.5 times the minimum relay pickup that is desirable for any possible fault restriction.

If tap 6 were selected, then the margin above load is greater (6/4.5 = 1.33), but a smaller margin (17.5/6 = 2.9) above the relay pickup.
\[ Z = 8 \sqrt{3} \angle (B - 8) \text{ or } "C800" \]

\[ \frac{X}{R} = \sqrt{3} \]

@ 100A  \( (2\theta \times \text{rated}) \)

\[ 5A \]
\[ E_{SE} = I_2'(Z_{E,\text{tot}}) \]

1. Calculate \( E_{SE} \)
2. Find \( I_E \) from curve
MR CT 1200/5 Ratio

1: 240 x 1

40 x 2
20 x 3
100 x 4
80

R2: 0.0027 R/°F