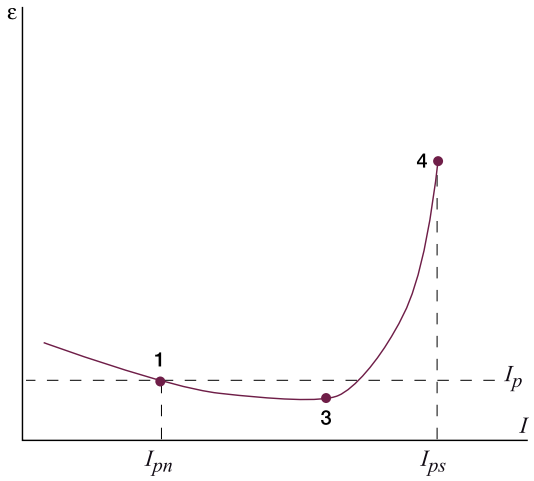

Figure 1.8

1.2.4 Saturation factor

I_{ps} is called the instrument security current for a measuring transformer and accuracy limit current for a protective transformer. The ratio of I_{ps} to the rated primary current I_{pn} is called the Instrument Security Factor (FS) and Accuracy Limit Factor (ALF) for the measuring transformer and the protective transformer respectively. These two saturation factors are practically the same, even if they are determined with different error limits.

If the primary current increases from I_{pn} to I_{ps}, the induced voltage and the flux increase at approximately the same proportion.

$$(FS)ALF = \frac{I_{ps}}{I_{pn}} \approx \frac{B_s}{B_n}$$

Because of the flat shape of the excitation curve in the saturated region, B_s could be looked upon as approximately constant and independent of the burden magnitude. B_n, however, is directly proportional to the burden impedance, which means that the formula above could be written

$$(FS)ALF \sim \frac{1}{B_n} \sim \frac{1}{Z}$$

The formula states that the saturation factor depends on the magnitude of the burden. This factor must therefore always be related to a certain burden. If the rated saturation factor (the saturation factor at rated burden) is given, the saturation factor for other burdens can be roughly estimated from:

$$(FS)ALF \approx (FS_n)ALF_n \times \frac{Z_n}{Z}$$

where

$(FS_n)\ ALF_n$	rated saturation factor
Z_n	rated burden including secondary winding resistance
Z	actual burden including secondary winding resistance

NOTE! For more accurate calculation, see chapter 2.6.2 and 2.6.3.

1.2.5 Core dimensions

Designing a core for certain requirements is always a matter of determining the core area. Factors, which must be taken into account in this respect, are:

- Rated primary current (number of ampere-turns)
- Rated burden
- Secondary winding resistance
- Accuracy class
- Rated saturation factor
- Magnetic path length

The procedure when calculating a core with respect to accuracy is in principle as follows:
A core area is chosen. The errors are calculated within the relevant burden and current ranges. If the calculated errors are too big, the core area must be increased and a new calculation must be performed. This continues until the errors are within the limits. If the errors in the first calculation had been too small the core area would have had to be decreased.

The procedure when calculating a core with respect to a certain saturation factor, $(FS)\ ALF$, is much simpler:
The core area cm^2 can be estimated from the following formula:

$$A_j \approx K \times \frac{(FS)ALF \times I_{sn} \times Z_n}{N_s}$$

where

K	Constant which depends on the core material (for cold rolled oriented steel K~25)
I_{sn}	Rated secondary current
Z_n	Rated burden including the secondary winding resistance
N_s	Number of secondary turns

NOTE! It is important for low ampere turns that the accuracy is controlled according to the class.