

Inter-Turn Fault Detection of Air-Core Reactors

Problem Statement:

Design and model Avista's existing air core reactor bank as a small-scale test apparatus to examine the behavior of inter-turn faults between reactor windings.

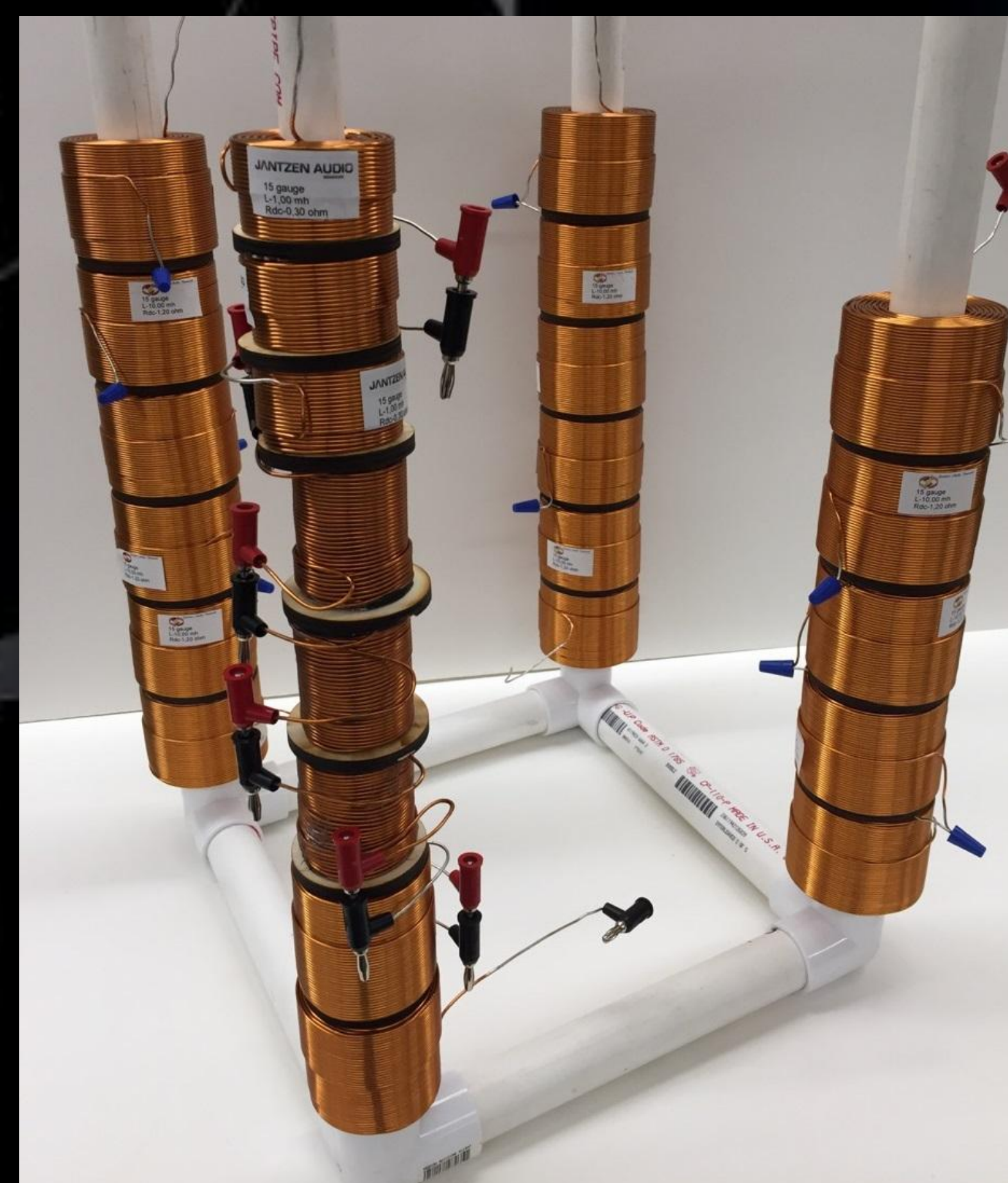
Background:

- Although general relaying protection schemes are already used, an algorithm to protect air-core reactor banks from specific inter-turn faults has yet to be developed.
- The ability for a protective relay to detect such a fault and prevent cascading damage of a reactor coil is essential for making electrical power safer.

Design Specifications:

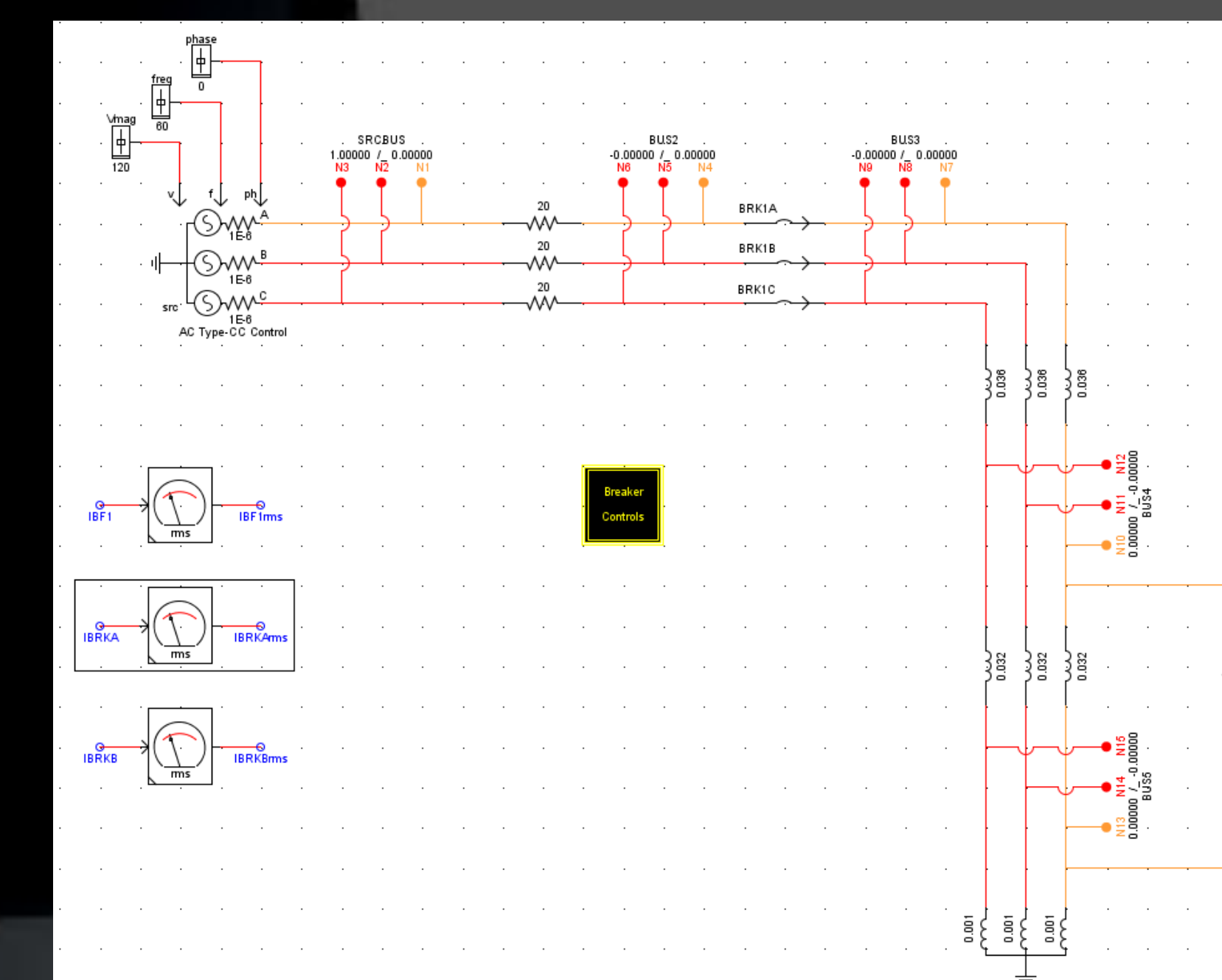
- 120 V_{AC} line-neutral
- Less than 5 A phase current
- Self wound test coils on a single phase
- Ability to cascade shorted test points
- Matching RTDS (Real Time Digital Simulator) model for comparison

Test Model:

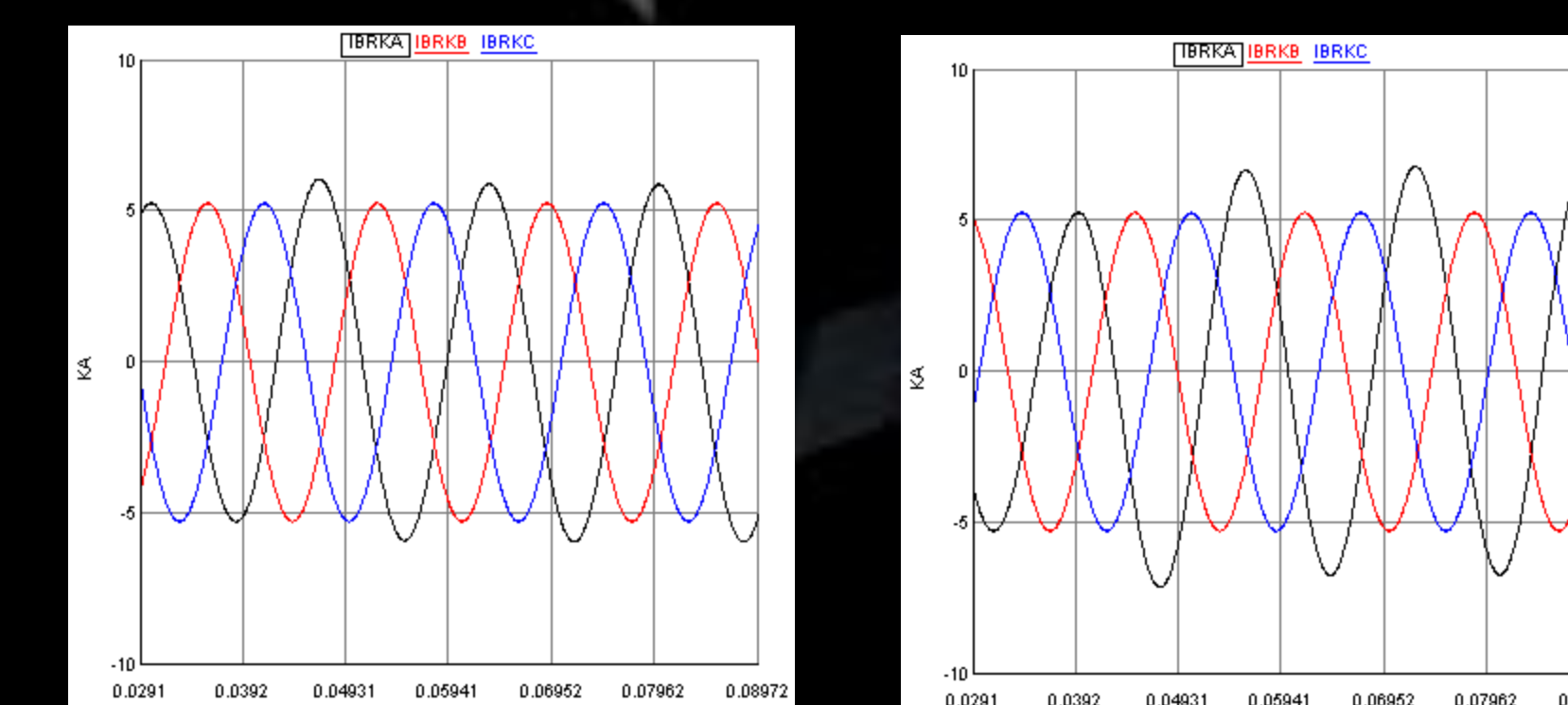


3 phase test model with hand-wound test coils and shunting points shown in front

RTDS Model:



RTDS cross-reference circuit of the test model shown above



10mH (12.5%) Fault

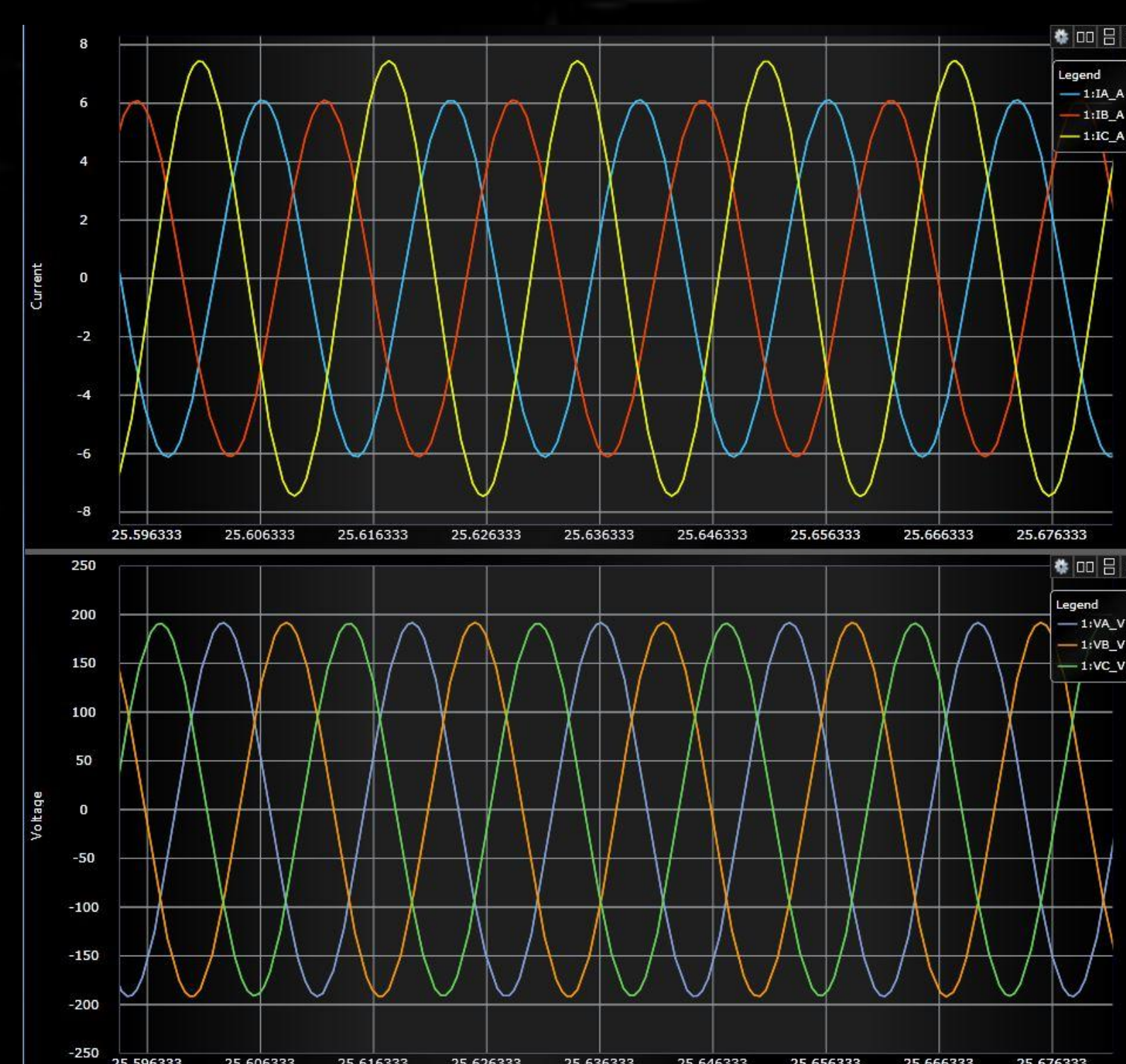
20mH (25%) Fault

Results:

After in-depth testing and comparison of various fault current waveforms between the small-scale model and the computer simulated RTDS model, it was apparent that both systems experienced the same behavior during inter-turn fault simulations. This concluded that the small-scale model was built correctly and was evenly balanced as a 3 phase system.



VARsity Design Team (L-R): Jacquelyn England, Justin Jeter, Andrew Hoth, Tanner Mort, Asad Iqbal



Fault Waveform collected from the test model with a 5mH (6.25%) Inter-turn fault