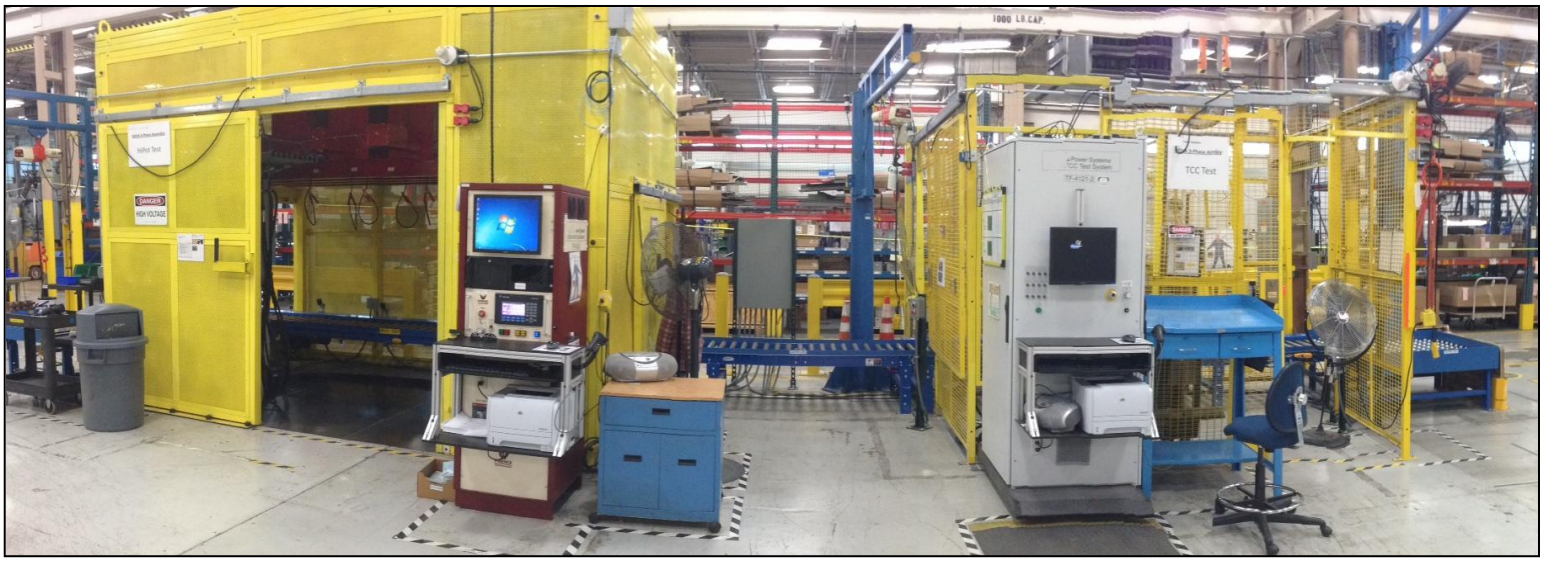
High Voltage High Current Functional Test Lines



Background:

Emerging Technologies was called upon to develop and deploy two complete functional test lines for high voltage and high current testing of power industry products. The two lines were designed to be functional duplicates. Significant challenges included development of custom current sources, Faraday cages, high voltage switches, as well as a significant volume of functional tests at two separate test stations per line. Additionally the DUT's required a five section semi-automatic conveyor system to move the heavy product through the test stations. The customer provided an RFQ and multiple test specifications as the basis for the design.

Scope:

The new systems are comprised of two separate, independent lines (single phase test & three phase test). Each line has two major test areas (AC high current testing, up to 1,100 Amps, and AC high voltage testing, up to 70KV) which are tied together via a five stage automated conveyor system. The two lines are functional duplicates allowing one line to provide backup for the other, should the need arise, for additional throughput or during system maintenance.

Design:

Emerging Technologies provided a design package for each individual piece of test equipment as well as complete design package for the overall systems (including field install instructions). Design changes and design reviews were executed throughout the project in order to maintain alignment with the customer's system needs. Individual test equipment designs were executed as sub-procedures to the overall test lines. Weekly status updates were used to keep the project team up to date, on schedule, and on task. Design documents were provided in formats compatible with the customer's documentation standards and conventions.

AC High Current Testing:

The AC high current testing system utilizes a main functional test system coupled to a stand-alone Mobile Current Source. This approach allows the current source to be close to the DUT minimizing the length of cabling required to pass the high current to the DUT. Decoupling the current source from the main test equipment also allows for the ease of interchangeability and maintenance of this significant and complex component.

AC High Voltage Testing:

The AC high voltage test system also uses a main functional test system with an auxiliary system located inside a Faraday cage. The split between the functional test system controls was required for safety, ease of test, as well as cost control. Custom developed high voltage switches were required to accommodate the different modes of testing to satisfy the customer provided test specifications.

Automated Conveyor System:

The conveyor systems were broken down to five main sections: manual in-feed section powered high current test cage section, manual intermediate section (between the test cages), powered high voltage test cage (Faraday cage) section, and finally a manual exit section. Operator controls were placed in areas required to facilitate easy operator control during normal production activities. Safety-stop pull cords were implemented

as well. The two conveyor lines are identical in control but different in height and width to accommodate the difference in physical dimensions of the single phase and three phase product.

Software:

Each functional test system required the development of custom functional test software based on the customer provided test specifications for the different variations of product tested. The test applications are developed using National Instruments LabView. Included are features for custom configuration, test sequencing, and results storage. The user interface is designed to have a similar look and feel as other existing test equipment in the plant.

Field Installation:

Field installation was performed in two separate outages. Each outage was nine days in duration. Included in the installation process was; site clearance, test cage erection, conveyor installation, test equipment installation, and finally system commissioning. Electrical, Mechanical, and Facilities modification, and installations were required. The field installation was implemented using a team of resources including Emerging Technologies staff, Customer staff, and third party installation contractors.

Faraday Cages:

Custom Faraday cages were required for high voltage testing. The cages were designed using Solidworks modeling, and fabricated based on the model, then set up and previewed at the fabrication facility prior to installation at the customer's manufacturing facility during the planned outage. Special attention was given to the final coatings which included powder coat as well as traditional paint coatings. Sliding doors were designed to allow for easy travel to minimize operator fatigue. All doors are equipped with redundant safety switches and individual grounding straps. Each cage is equipped with multiple light beacons to indicate when testing is in progress. Special low impedance grounding was required and applied to this installation.

High Voltage Switches:

Custom high voltage switches were required to facilitate different combinations of interconnection with multiple models of DUT. The switches were designed to be corona free and verified in operation with use of a corona imaging system as well as partial discharge monitoring equipment. The switches were designed to be PD free up to 35KV and operate for HiPot testing up to 70KV. Six switches were required per line for a total of twelve overall. Automatic control with position feedback was incorporated in the design.

Systems Integration:

The new systems access the plant network and manufacturing database to acquire product specific test specification data as well as store results information after testing. The test applications include configurable parameters which are accessible to system managers to allow for system adjustments to be made without updating source code. Handheld barcode readers are used to easily gather product ID as well as other required parameters. Reports are generated, printed and stored to the test system in multiple formats. Customer plant standards and conventions were observed with respect to the integration.

Summary:

With the completed systems in place, the customer is able to run high voltage and high current functional testing concurrently on each test line. Each line provides a backup for the other line and subsystem test equipment provides back up for its identical counter-parts. The look and feel of the sub-systems is similar, allowing operators to easily move from one system to another with minimal time required to become acquainted with the operation of the system. The customer benefits from modularity throughout. Interchangeable hardware and software designs allow for great manufacturing flexibility.

Emerging Technologies, LLC Responsibilities:

- Functional Specification Generation
- ✓ Design / Engineering
- ✓ Fabrication
- ✓ Programming – Software
- Programming – Firmware
- Circuit & PCB Design
- ✓ On-Site Commissioning
- ✓ Post Commissioning Support
- ✓ Other – Database Interface

Technologies:

- Embedded Computers
- Microcontrollers
- ✓ Visual Software
- ✓ Control Software
- ✓ Data Acquisition
- ✓ Computer Based Control
- ✓ Communications – GPIB, Ethernet, MODBUS
- ✓ System Integration
- ✓ Other – High Voltage Switching

Customer Category:

- ✓ OEM
- Custom Equipment
- Utility
- R&D