Off-The-Shelf Static Excitation System: A Cost-Effective Alternative for Hydrogeneration Plants

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Overview

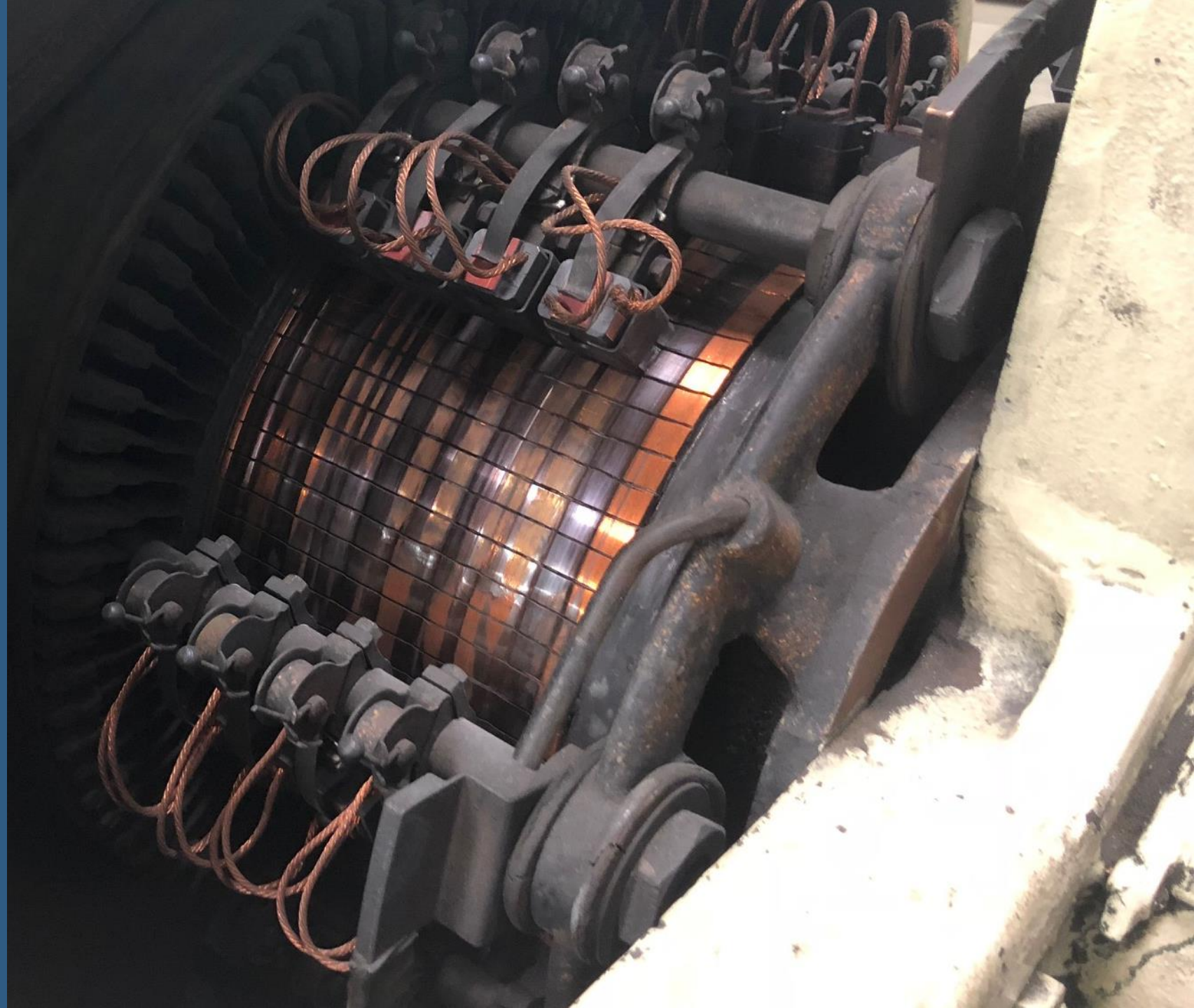
- Introduction
- Problem Statement
- System Requirements
- Engineering Development
- Design Revision
- Future Work

Introduction

- Holliday's Bridge Hydroelectric Plant, South Carolina.
- One (1) Motor-Generator Set used as the primary excitation system for two (2) generators.
- MG Set Serviced on June 2017.
  - Commutator was Turn-And-Undercut on site.
- Commutator was in such a bad condition that it had to be serviced a year after.

Holliday's Bridge

Existing MG Set



Problem Statement

- Replacing the Commutator was non cost-effective.
- MG Sets suffer the disadvantages of every rotating apparatus.
- Static Excitation Systems are too expensive for small generators.
- Local support & OEM service is expensive and rarely available.
- All of the designs and parts are proprietary.

System Requirements

- System Cost below $80,000 USD.
- 2300V Plant Bus.
- 125V 110A Excitation Output.
- Power Factor Controller.
- User friendly interface.
- Use existing sensors (CTs and PTs).
- Protection Relay.

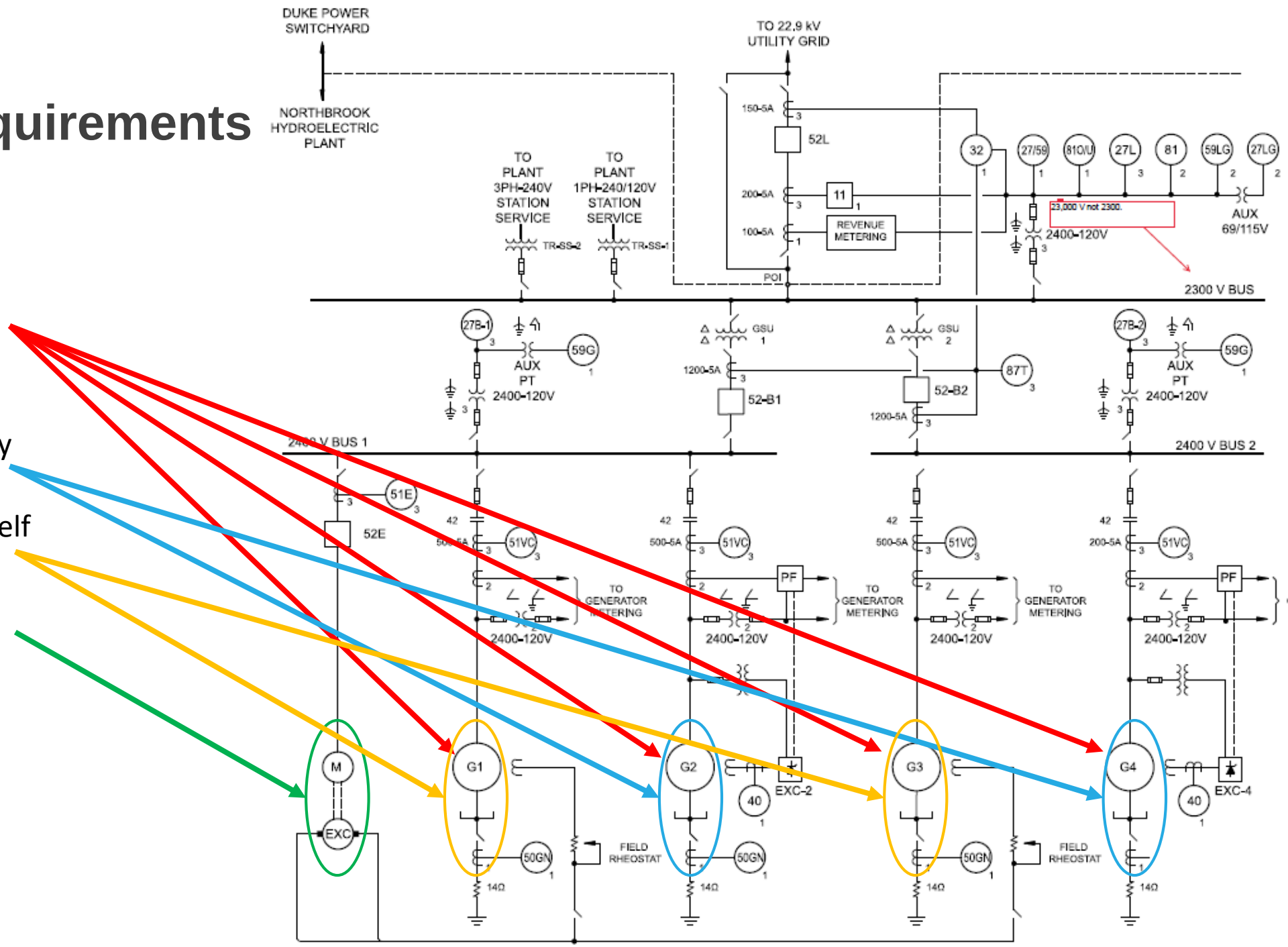
System Requirements

Units Powered by Original MG Set

Units with Proprietary Static Exciter

Units with Off-The-Shelf Static Exciter

Existing MG Set



Static Excitation System

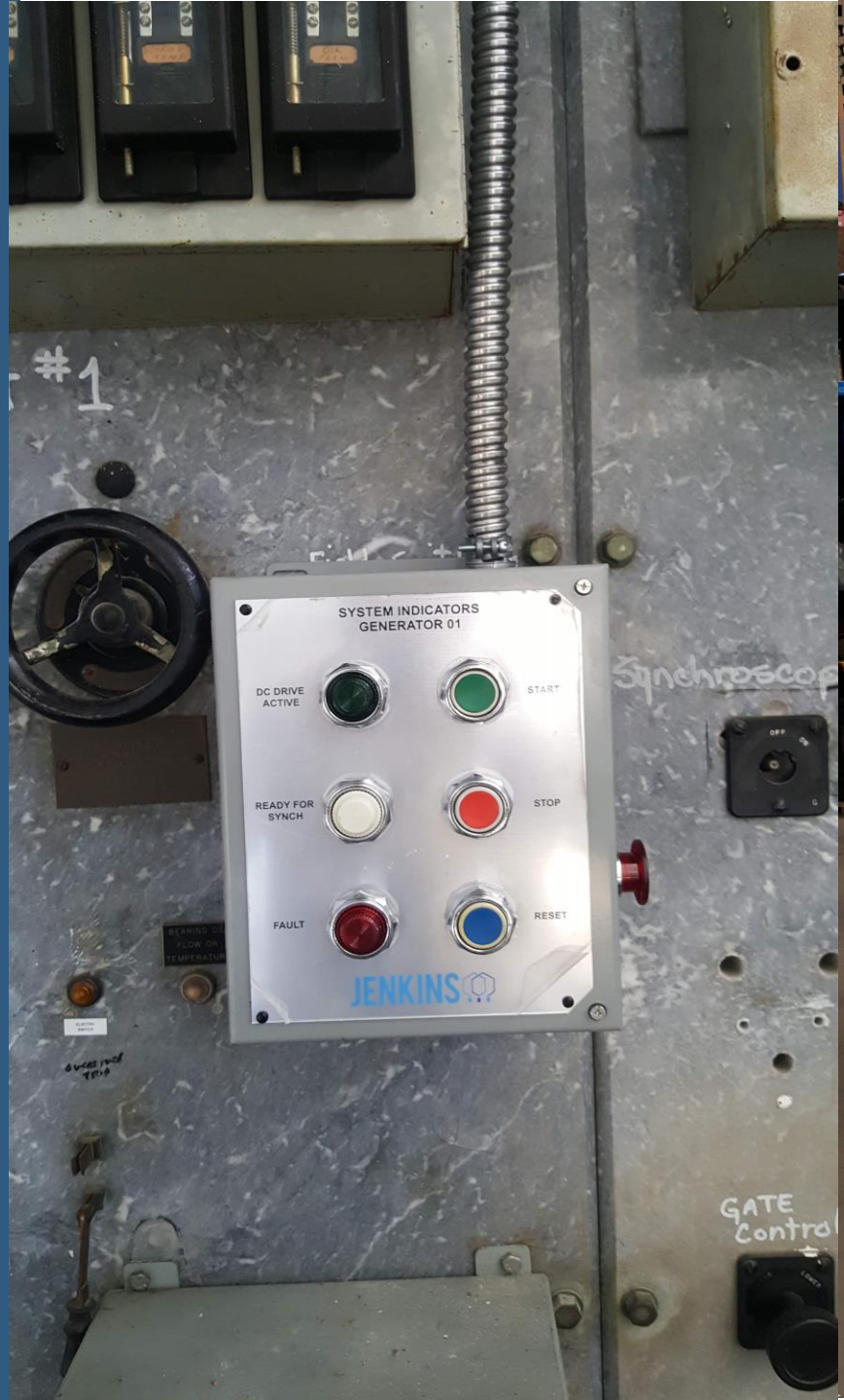
Engineering Development

Engineering Development

- Step-down transformer 2400 VAC – 230 VAC
- 125 VDC 110 A DC Drive
- Energy Isolation Capabilities
- Push-Button Interface
- Power Factor Controller
- Protection Relay:
  - Under-excitation (40)
  - Time Overcurrent (51VC)

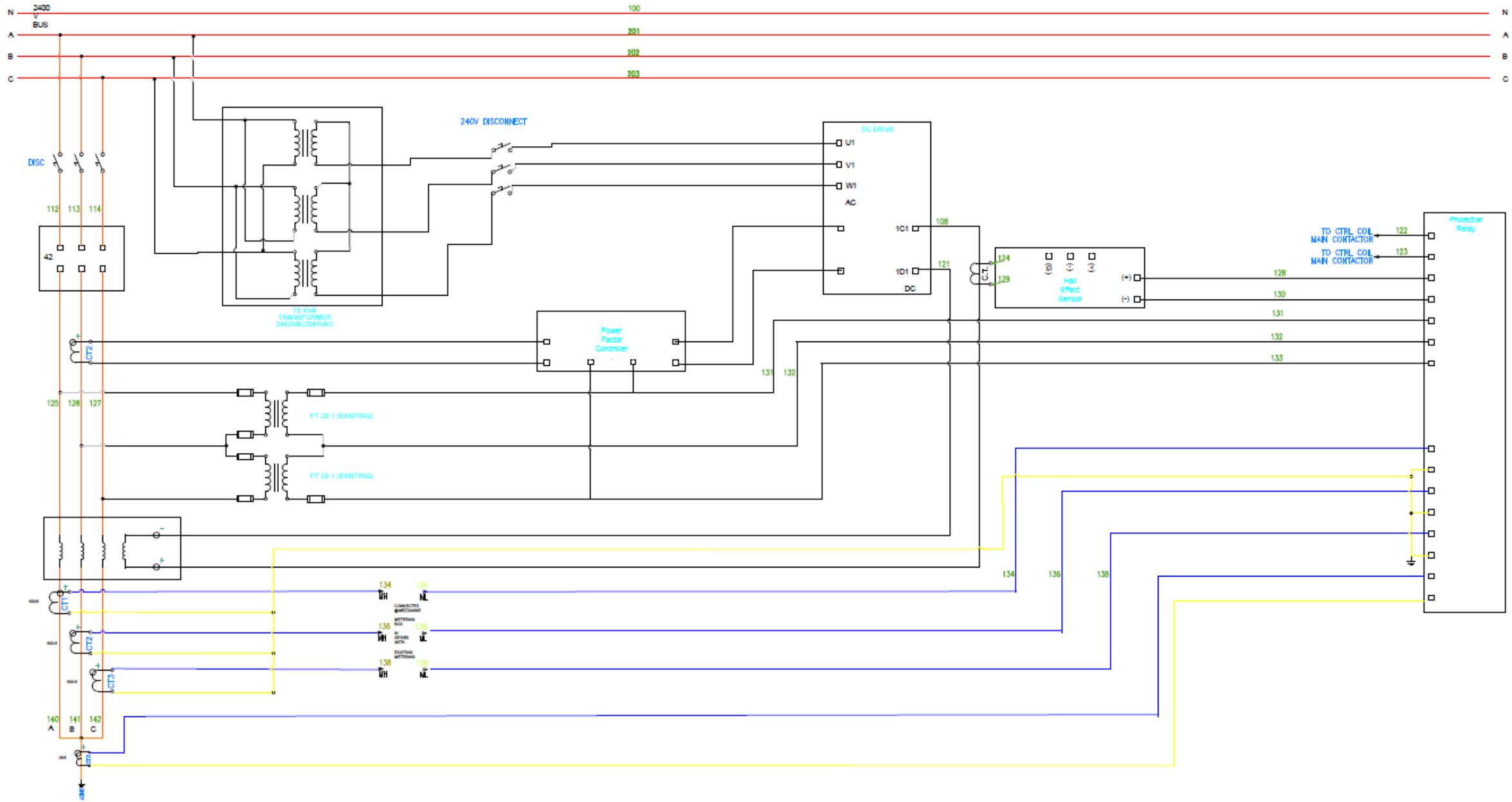
Static Excitation System

Design Revision



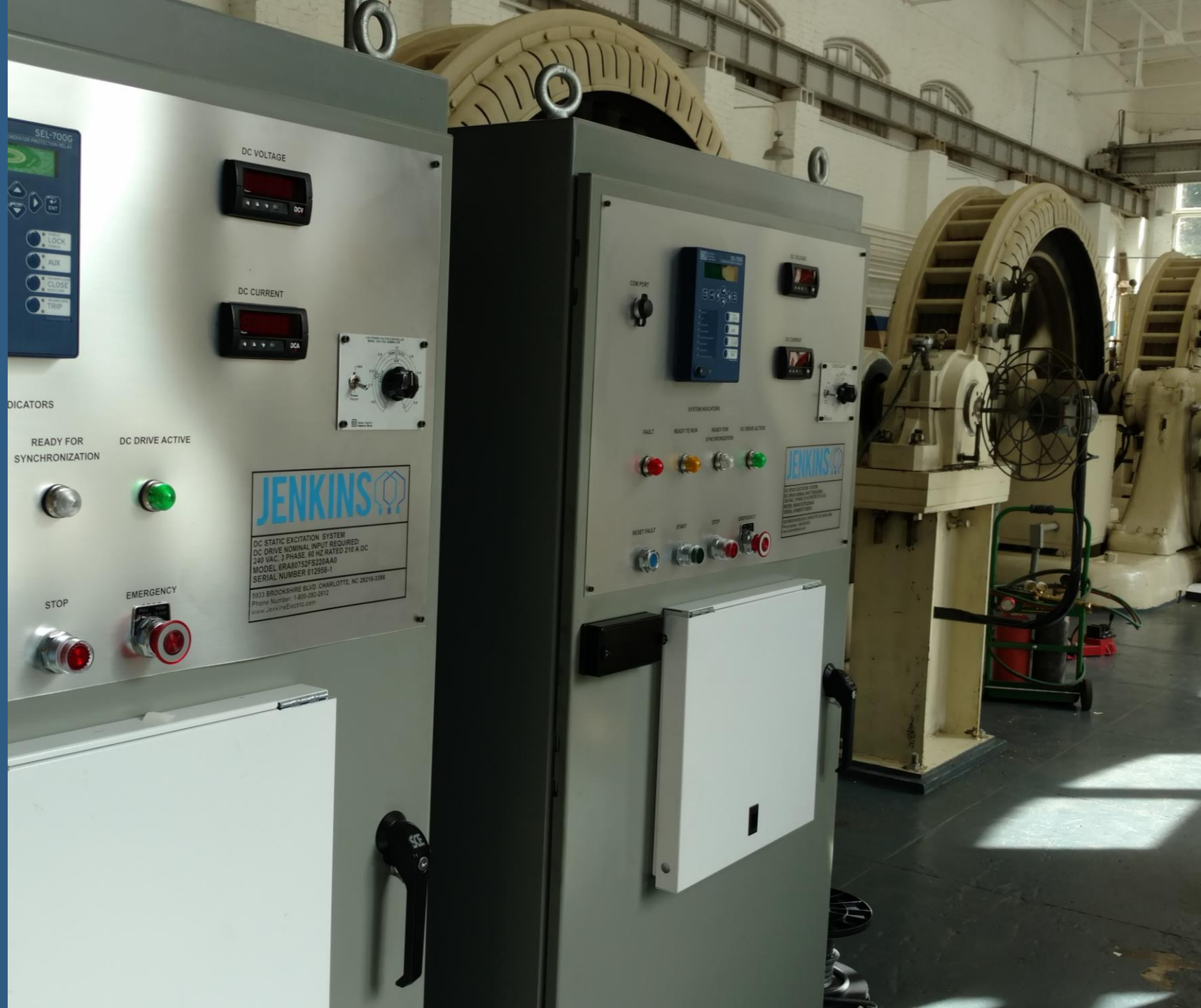
Design Revision

- Step-down transformer outside the static excitation system.
- Energy isolation of system on the 230 VAC side instead of the 2300 VAC.
- DC drive with programming and I/O capabilities.
- Remote add on control box.
- Addition of metering transformers.
- 2 weeks of installation and commissioning .


N
A
B
C
2400 V BUS
100
201
202
203
240V DISCONNECT
DISC
112 113 114
A2
75 KVA TRANSFORMER 2400VAC/240VAC
DC DRIVE
U1
V1
W1
AC
1C1
1D1
DC
108
121
C.T.
124
129
Hall Effect Sensor
(+)
(-)
128
130
131
132
133
Power Factor Controller
131 132
CT2
125 126 127
PT 20:1 (EXISTING)
PT 20:1 (EXISTING)
CT1
CT2
CT3
134 134
136 136
138 139
140 A
141 B
142 C
CT4
Protection Relay
TO CTRL COIL MAIN CONTACTOR
122
TO CTRL COIL MAIN CONTACTOR
123
134 136 138

Static Excitation System

Future Work



System Development Roadmap

- Upgrade to HMI control and display of generator information.
- Use a more standard DC drive with shorter lead time and easy swap.
- Add PLC to integrate the full generator operation and DAQ.
  - Mechanical Control - Blade / Gate
  - Vibration, Temperature & Water Level Monitoring
  - Auto synchronization optional
- Remote control and monitoring
  - Alarms and events (text/email messages)

Thank You!

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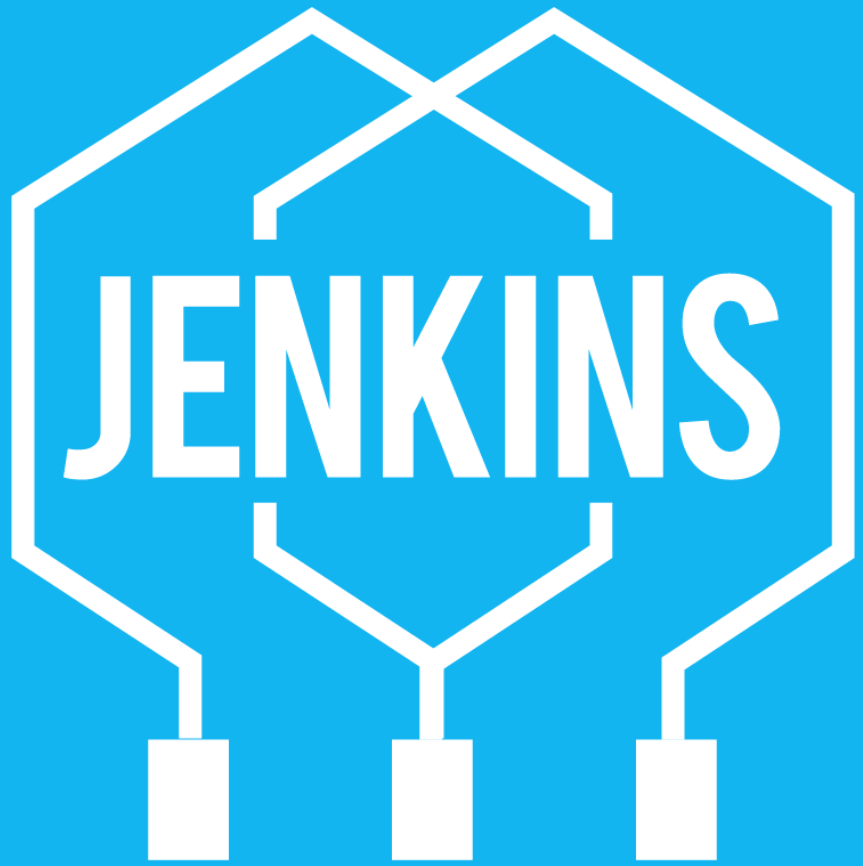

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