ETAP Transient Stability
Validation Cases and Comparison Results

Case No. 1
Generator Start-Up Simulation

ETAP TS V&V Case Number TCS-TS-143

Comparison with Field Measurement Data

Highlights:

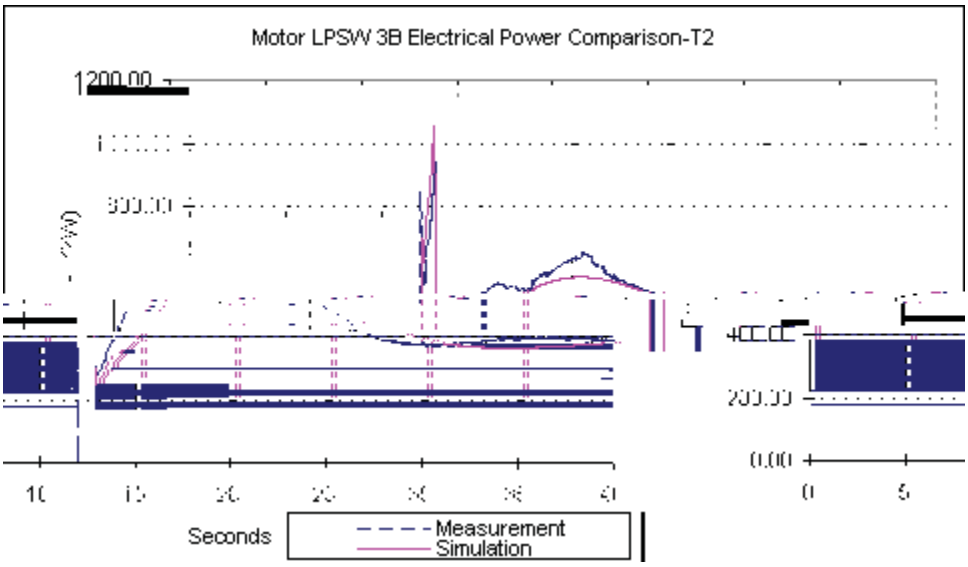
- Comparison between the ETAP Transient Stability/Generator Start-Up simulation results and field measurement data
- Special study of the emergency generator start-up for a nuclear generation plant
- ETAP built-in frequency dependent synchronous generator, induction machine, and network models
- ETAP built-in IEEE Standard 2.1 synchronous machine model
- ETAP built-in hydro turbine and speed governor/gate control model, including water tunnel system.
- ETAP built-in IEEE ST1D excitation and AVR model, including DC flashing and V/Hz switching control.
- ETAP built-in double-cage induction machine model
- Multiple voltage levels, multiple substations, and multiple loads
- Comparisons include starting generator frequency, voltage, output current and power, starting motor voltage, current and input power.
- Excellent correlation between ETAP simulation results and the field measurements data
- Accepted report by the client and NRC (Nuclear Regulation Commissioioents dfi7 ƀDC255 0.137 0.1

Fig. 1. Hydro Generation Station System One-Line Diagram

2. Simulation Events

The simulation events on the study are set up exactly the same as the site test procedures, which are as follows:

- Start generator, with the exciter running in field 72 (r62 (r% 0 Td-5 sV4)5 (ra)6 -5 sit O)-2 (n)1 (e



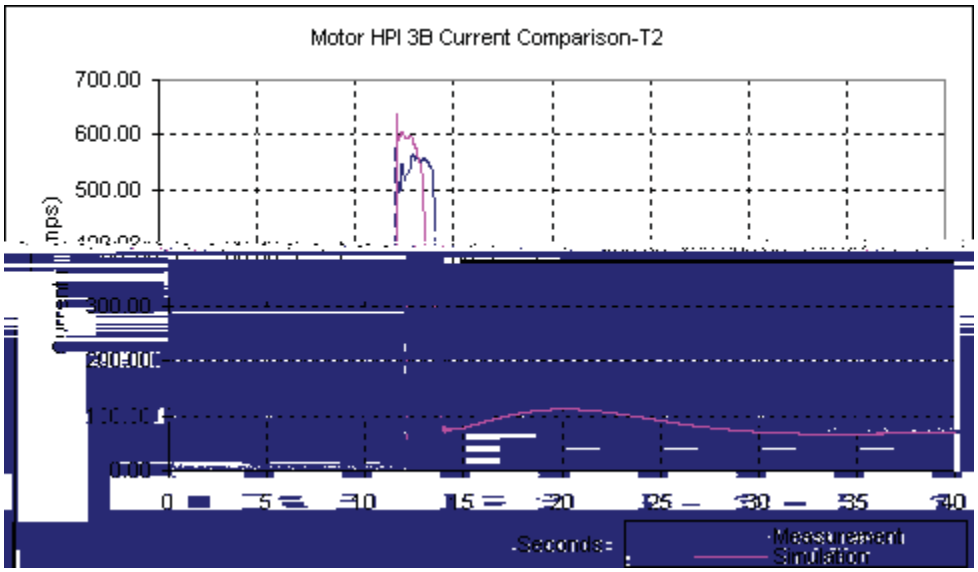


Fig. 10. Motor HPI-3B Current

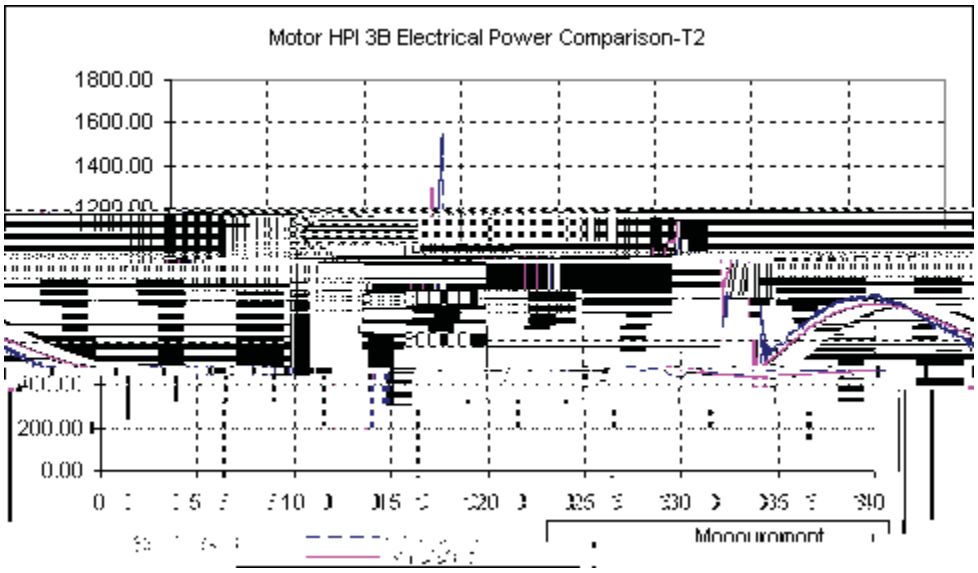


Fig. 11. Motor HPI-3B Electrical Power

Figures 9-11 show motor voltage, current, and electrical power comparison for motor HPI-3B. Simulation results also very closely agree to the measured data.

4. Conclusions

In this comparison case, a nuclear generation plant emergency backup generator start-up condition is studied. The actual generator start in the real system is performed and all the key variable responses are recorded. ETAP Transient Stability/Generator Start-Up program is used to simulate the real system and the results are compared to the field measurements. A close examination shows the ETAP simulation results closely correlate to all the field measurement data that have been compared. Note that some of the dynamic parameters for the generator and motors (including inertia constants and shaft damping constants) are estimated due to lack of actual data. These factors have direct effect on the motor acceleration times.

Reference:

1. JJ Dai, Di Xiao, Farrokh Shokooh, Christopher Schaeffer, and Aldean Benge, "Emergency Generator Start-Up Study of a Hydro Turbine Unit for a Nuclear Generation Facility," , Vol. 40, pp.1191-1199, September 2004.

2. ETAP Transient Stability V&V Documents, Case Number TCS-TS-143, 2023.