



# Documentation of Energy Management Systems and the DUtrain Power System Handler



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## Introduction

With the increasing penetration of renewable energy sources into electrical networks, there come issues with ensuring proper grid and transmission system performance in current power systems. As a result, energy management systems (EMS) must adapt to address these issues. The DUtrain Power System Handler (PSH) software, a type of a dispatcher training simulator (DTS) replicating an EMS, is a useful tool that can be used to research possible new processes and procedures for updating electrical networks so that they may be better prepared for decentralized energy sources in the network. The UCD Energy Institute recently installed the DUtrain PSH into the lab in order to research renewable energy systems and how to remedy potential issues associated with their integration. The goal of this project was to provide documentation of the DUtrain PSH for users that included relevant background information, network set-up within the lab, and execution of network applications.

## Relevant Background

### Energy Management Systems (EMS)

Energy management systems (EMS) are computer systems that enable the real-time monitoring of electric networks and updates the system based on transmission, generation, and load changes. [1][2].

### EMS Supervisory Control and Data Acquisition (SCADA)

Energy management systems monitor power systems and perform supply/load matching in real time using supervisory control and data acquisition (SCADA). SCADA retrieves status values, analog, and pulse accumulations [5].

### EMS Network Applications

Energy management systems have various network applications related to analysis of transmission, distribution, and generation systems: power flow analyses, contingency analysis, state estimation, voltage-var dispatch, etc. [5]

## DUtrain Documentation

The DUtrain PSH training software, originally developed by the Power Systems Institute at Duisburg University, is an operator training simulator. The following is documentation of the DUtrain system with regards to its set up in the Energy Institute and its applications.

### UCD DUtrain Network Set Up

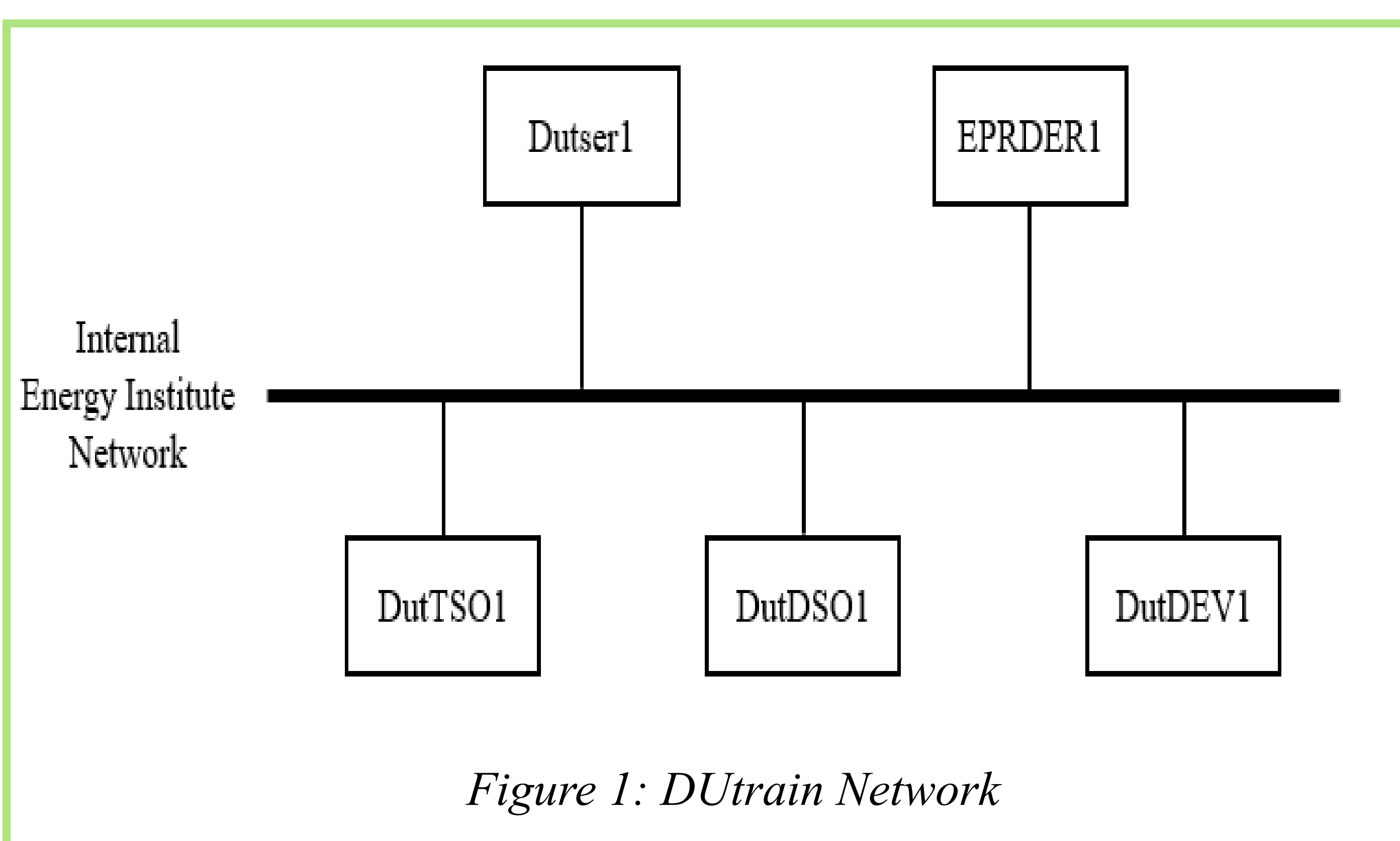


Figure 1: DUtrain Network

### DUtrain Network Applications: Power Flow Analysis

\*These simulations are from the PowerWorld power system simulator tutorials using the B7FLAT electrical grid set up.

Figure 2: Power Flow Analysis and Mismatch Data

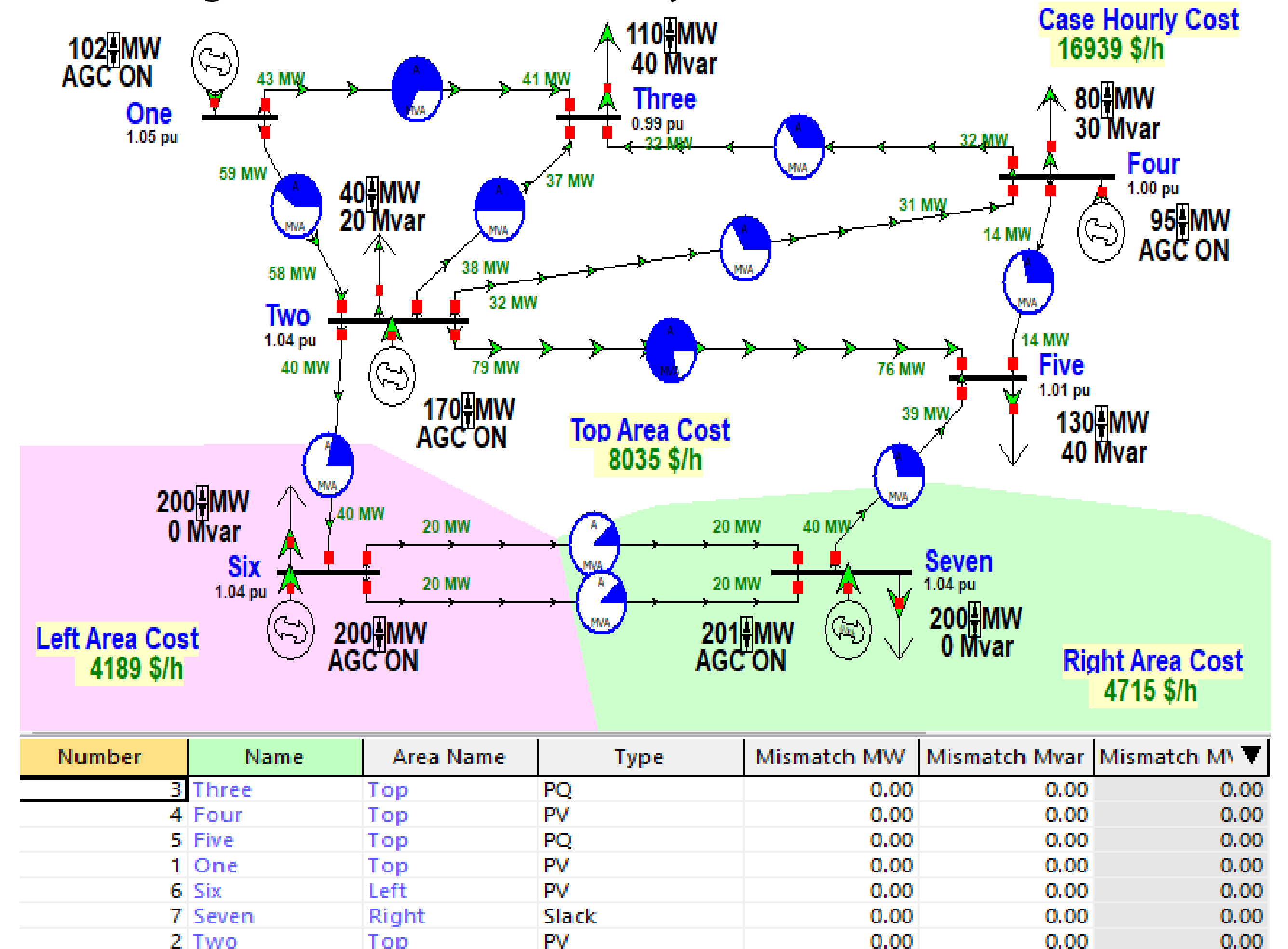
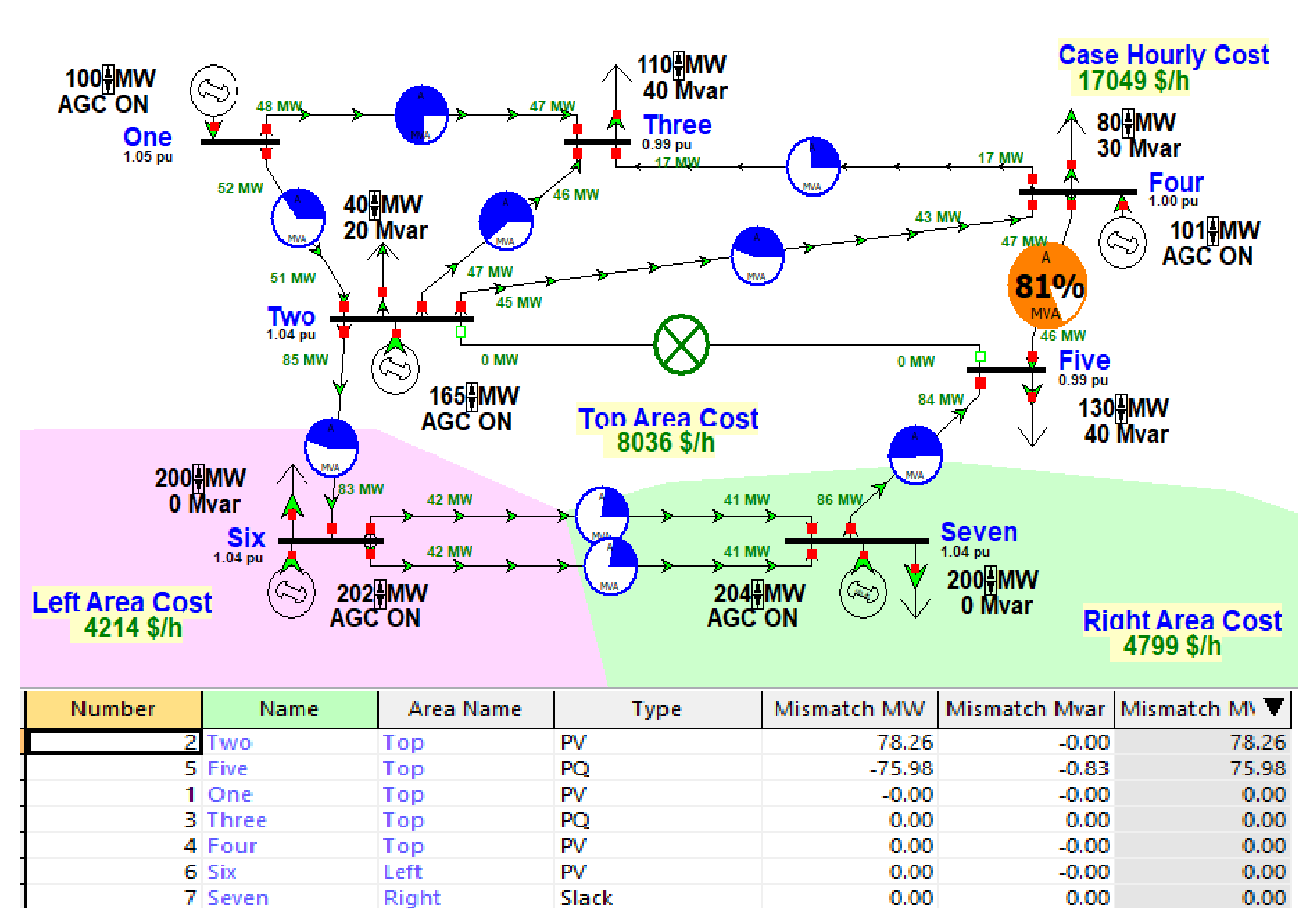


Figure 2: Power Flow Analysis and Mismatch Data with Line Fault



## Future Work

- DUtrain simulation set-up description and walk through
- Network management tool so eliminate need for manual connections
- Enhancing display capabilities of desks

## Bibliography

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