Exercises for Lecture 5

1. Why would we want to automate substations?
2. What do the following acronyms stand for:
    - SCADA
    - RTOS
    - ADC
    - RTU
    - IED
    - HMI
3. What are the most common components in a SAS?
4. What are the three hierarchical levels that commonly appear in SAS architectures?
5. Where do RTUs, HMIs and IEDs typically appear in these levels in modern substations?
6. Why is configuration effort such a large part of the cost of substation integration?

Answers to Exercises for Lecture 5

1. In order to implement protection and control functions, to provide a facility for remote monitoring and control. Furthermore, we may want to integrate business or management applications such as metering or maintenance logging/statistics.

2. Acronyms

   - SCADA – Supervisory Control and Data Aquisition
   - RTOS – Real-Time Operating System
   - ADC – Analog-to-Digital Converter
   - RTU – Remote Terminal Unit
   - IED – Intelligent Electronic Device
   - HMI – Human Machine Interface

3. RTUs, IEDs and HMI are common to most modern SAS architectures.

4. Most SAS architectures have devices operating close to the *process*. Functions that involve various items of equipment in the same bay operate at *bay* level. Finally functions concerning the whole station and upward communication to SCADA are considered to be at *station* level.

5. IEDs typically operate at the process and bay levels depending on their functionality (how they are programmed and configured), RTUs and HMIs are typically considered to operate at the station level in most modern substations. Small bay-specific HMIs can be implemented on IEDs but these are generally not considered when talking about HMIs in general.

6. Substation automation systems can vary considerably in their architecture, types of components and communication interfaces used. This means that there is very little that is just “plug and play”. Functions that require communication and interaction between devices from different vendors or from different product generations can require a lot of effort by the systems integrator to get working smoothly and reliably.