![Nokian Capacitors logo] **NOKIAN CAPACITORS**

Method of using the Real Time Digital Simulator (RTDS)®

Introduction

In the initial situation without compensation, an industrial load requires compensation of reactive power to improve voltage stability and thus increase production volume of the process. In addition, transmission grid owners generally require their customers to keep the power "clean".

This document describes a method for the dimensioning and optimisation of a Static Var Compensator based on site measurements and the use of a Real Time Digital Simulator (RTDS)® in the laboratory.

The supplying network and a part of the load(s) are the existing and fixed parts of the simulated network model. The compensation equipment is configured and changed in order to optimise performance, equipment costs and minimise losses.

The high voltage equipment of the SVC is modelled and altered in the simulation model. A real control system of the SVC is connected to the simulator, interacting with the simulation model.

The simulation can be done using measured load data or a simulated load model. Using measured data eliminates the risk of modelling errors of the load.

Adding reactive power compensation to an existing system increases the voltage stability and gives the possibility to run the load at an increased power. The compensation system needs to be dimensioned for a new operation point at 10% to 30% higher power compared to the non compensated situation.

The required actions

For the previously described situation, the following steps are required:

1 A defined need for compensation
2 Modelling the network and load environment
3 Measuring load voltage and current
4 Setting up the simulation environment, including the SVC control system
5 Running the simulations and collecting the results
6 Presenting the results with different options to the customer
7 Making a proposal (offer) for an SVC

Modelling the network and environment

The following schematics is an example of an industrial network with an Electric Arc Furnace (EAF). The schematic is based on RSCAD software used by the RTDS® system.

The load measurements

Using measured load data is preferrable, the load currents and voltages are measured on site. The data logging system must use a minimum of 6.4 kHz sampling frequency for 6 channels and the recording capability of at least one complete melting period in the case of an Electric Arc Furnace load.

Nokian Capacitors has prepared a complete transportable system that can be used for measurements on site. The picture on the right shows a typical environment for taking measurements. No special arrangements are required to run the measurements.
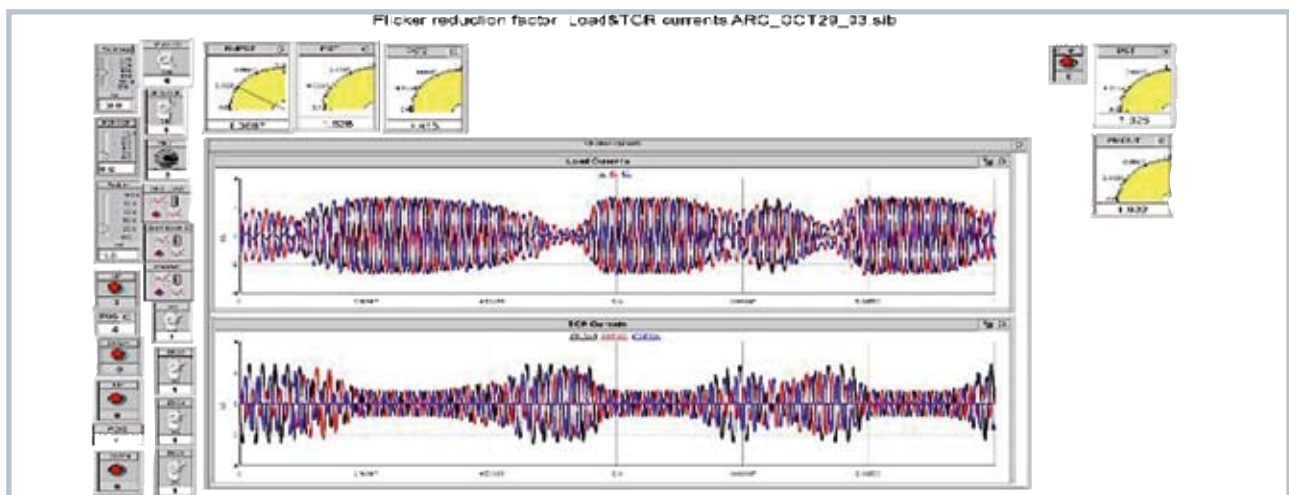
The simulations

The measured data or simulated load model is run on an RTDS® simulator. The simulation model and control system parameters are altered to give maximum performance. Simulations may be used to optimise losses and performance.
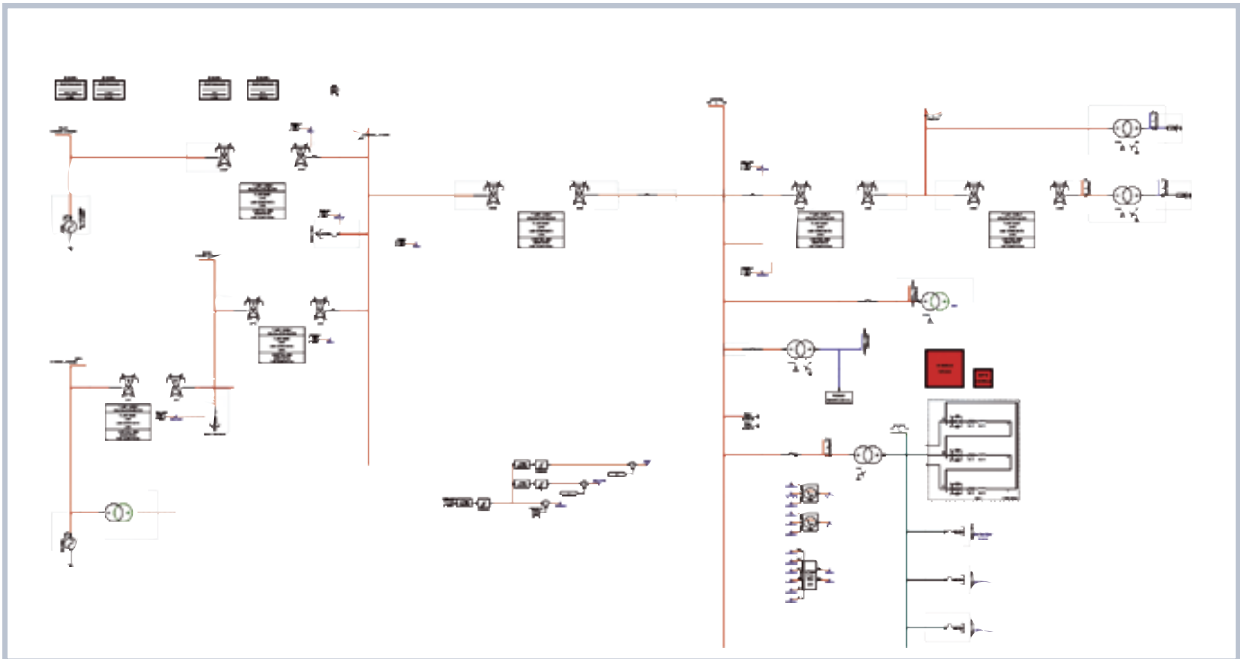
The RTDS® simulation graph below shows an example of a simulation interface. The upper curve shows the load current and the lower curve the TCR (Thyristor Controlled Reactor) current. The meters indicate compensated flicker value, non-compensated flicker value and flicker reduction factor.
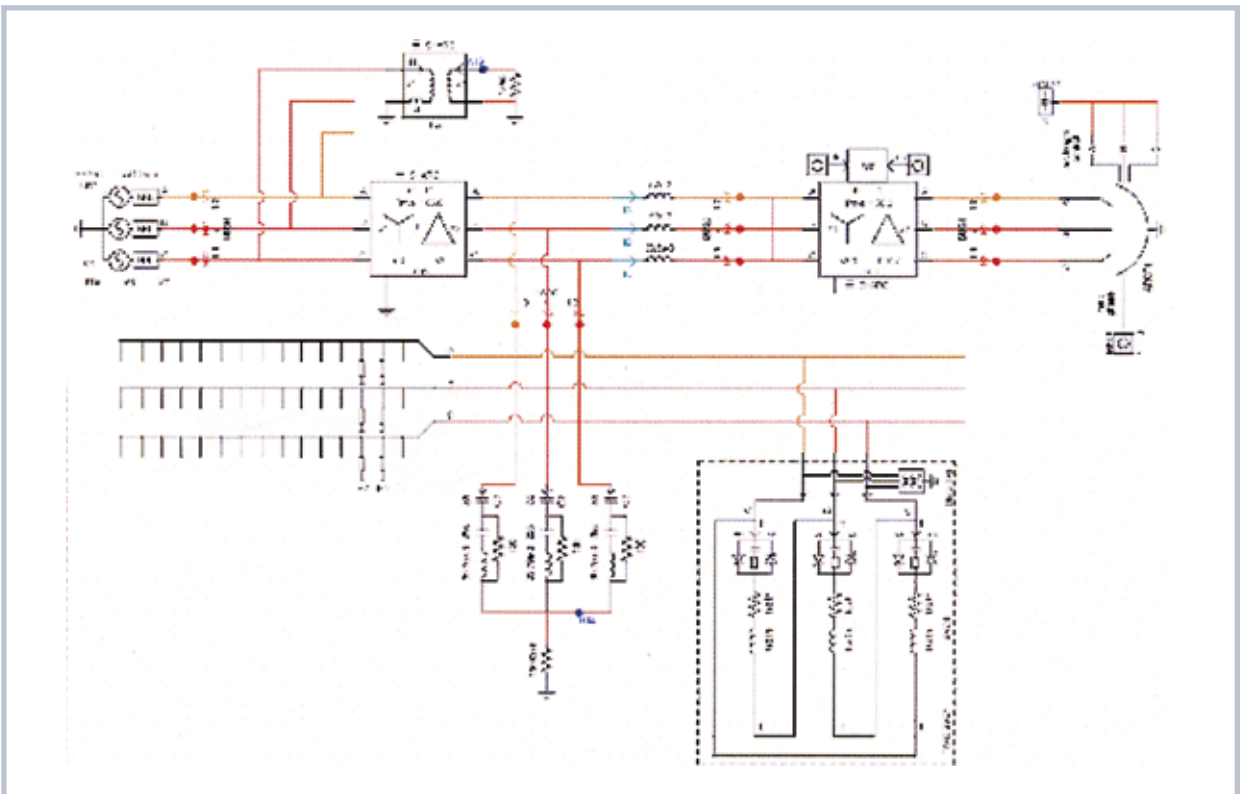

Measurements on site.

RTDS simulation results, HMI-window

RTDS simulation network model

*Detailed picture of the RTDS® simulation*

Picture of a typical simulation environment.

In the photo above, the cubicle on the right is an SVC controller, the two cubicles on the left are network simulators (a 2-rack simulation) and the PC on the table is an HMI computer for the simulator.

Summary

The flow chart on the right shows the simulation procedure steps.

The load voltage and current of an existing load are measured and used for Real Time Digital Simulations (RTDS)$^{®}$ for dimensioning the SVC and defining control parameters when measured data is not available for a similar Electric Arc Furnace (EAF) load this case can be used.
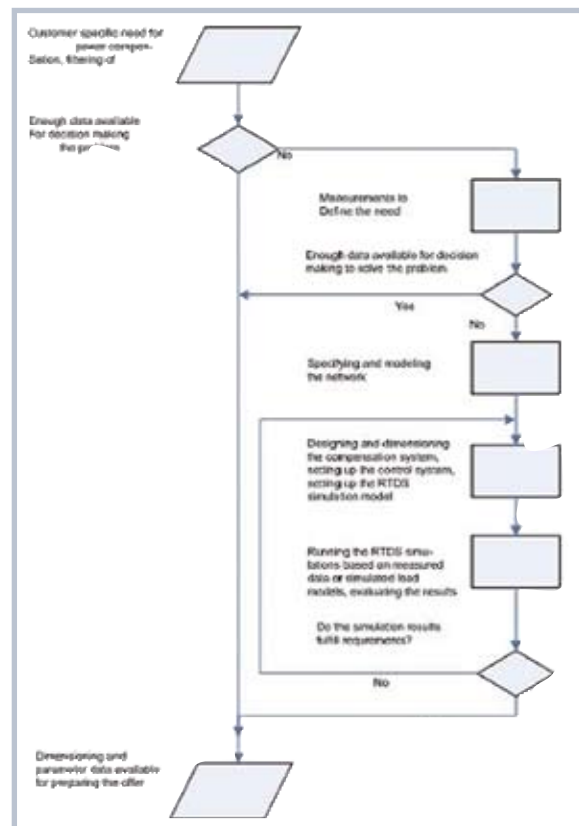
Flow chart of case study.

In line with our policy of ongoing product development we reserve the right to alter specifications.

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