Global Instrumentation and Control

Computerized Scaling Manual

Background

Westinghouse's Computerized Scaling Manual (CSM) is a software application that automates the documentation of a plant's scaling calculations.

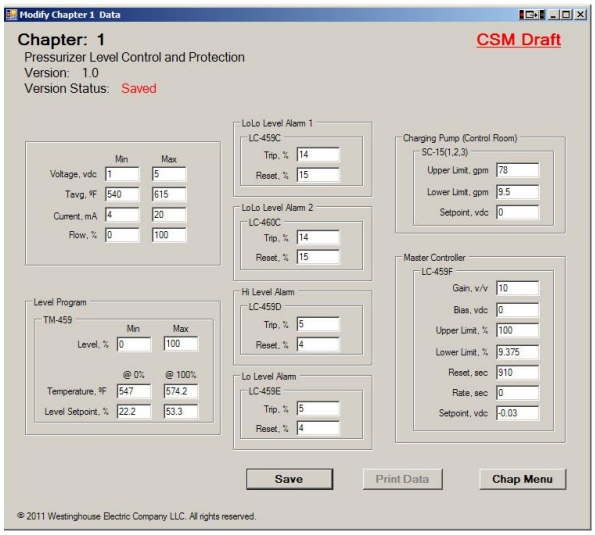
When manually done, current scaling practices can be tedious and time consuming, and can lead to errors. Errors in scaling can directly affect a plant and impact indication, trip set points, and normal operation.

The CSM takes plant information, such as a pressurizer level program, and calculates the card or module settings in accordance with plant scaling methodology. The CSM then produces a document that contains the scaling derivation for each function using the latest plant information.

Description

The CSM uses control system settings and other plant information as input to generate a suite of scaling information. This scaling information includes a methodology document, a system schematic diagram and procedure calibration datasheets.

Plant scaling methodology documents are typically frozen in time. Calculations are performed for a specific cycle at cycle-specific conditions. The CSM uses the input information and existing plant scaling methodology to automatically generate a "living" scaling document. Users can easily follow how changes to the inputs impact the scaling calculations. This "live" documentation will reduce the time required to train a new employee in the system scaling.



CSM Datasheet

System schematic diagrams illustrate the full scope of a specific system. These diagrams are populated with calculated card settings (for example, gains, biases and time constants), and provide convenient representation of the specific system.

Changes to plant scaling directly impact calibration and surveillance procedures, specifically card datasheets. Procedure datasheets are automatically generated using the latest scaling settings. This reduces the time required by procedure writers to generate and incorporate into subsequent procedure revisions, and reduces the introduction of human error into the process.

Most scaling modifications involve tedious and time-consuming calculations that can be error-prone. By using the CSM, impacts to scaling calculations can be easily determined. Resolution of a scaling impact will take minutes from impact discovery to calibration datasheets ready for incorporation into procedures.

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Example CSM sections currently available include:

- Delta T and average temperature
- Overtemperature ΔT and Overpower ΔT
- Turbine impulse pressure
- Steam dump control
- Pressurizer level
- Reactor coolant system flow
- Feed pump speed control
- Rod speed control
- Steam generator level
- Feedwater flow
- Steam flow protection
- Steam break protection
- Accumulator tank level
- RTD linearization

Benefits

The CSM automates the task of scaling the process-control racks and generating calibration values. Other benefits include:

- Reduces human error
- Eliminates manual data manipulations
- Reduces training requirements for new or inexperienced engineers
- More rapidly implements plant changes
- Automatically generates procedure calibration datasheets
- Captures customized plant-design-basis information
- Records scaling history through a living manual
- Allows for 'what-if' evaluations to predetermine the impact of changes on hardware
- Updates scaling information into embedded basis documentation
- Maintains plant ownership of scaling

Cost Benefit

Using the plant CSM will save significant calculation time, reduce the error potential of data manipulation and calculation, and maintain design-basis information that can facilitate training as the organization evolves.

Deliverables

The CSM license includes:

- CSM software
- User's manual
- On-site training

Experience

Westinghouse has provided previous versions of the CSM for several utilities over the past 20 years.

Voltage normalization of the reference Tavg is depicted as follows:

$$E_{Tavg} = (Tavg - Tavg_{min})\left(\frac{Voltage_{max}vdc - Voltage_{min}vdc}{Tavg_{max}{}^{o}F - Tavg_{min}{}^{o}F}\right) + Voltage_{min}vdc$$

For Tavg = 547°F

$$E_{Tno-load} = (547 - 540)\left(\frac{5vdc - 1vdc}{615^{o}F - 540^{o}F}\right) + 1vdc = 1.373vdc$$

Portion of CSM Output with Sample Equation Solved

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