ERGONOMICS IN REPORTING

Simple and Efficient Reporting for Hydro-electric Power Plants with zenon Analyzer

THE INITIAL SITUATION

In times of increasing energy consumption and high burdens being placed on the environment, the generation of power from renewable energies is increasing in importance. Depending on the country and the region, different priorities are set and different technologies used. In Austria, electricity from environmentally-friendly hydro-electric power dominates. The technology has now been developed for a long time and major advances, such as photovoltaics, are no longer conceivable. The investment in hydro-electric power plants is initially relatively high in comparison to other power plants. Only when the long lifecycle of hydro-electric power plants is taken into account does the investment start to make financial sense.

Meaningful reporting aids in realizing the return on investment as soon as possible. Energy reports on the production and consumption of power, as well as maintenance reports that are used for the optimum planning of maintenance, contribute to recouping investment as soon as possible. They also help to design the work more effectively and make it easier.

THE CHALLENGE

The introduction of efficient reporting presents power plant operators who already use zenon with an interesting challenge: the pre-existing zenon project they use for the automation of their power plant is fully developed, works reliably and should not be changed for reasons of stability and security.

In addition, these power plants have generally been in operation for many years and there is a high degree of automation. Much data has already been recorded over a long time period and saved in archives or Chronological Event Lists (CELs). If a new reporting system is put into operation, operators will also want to include the data from previous reports going back years and have access to more than just the data that has been collated since the implementation of the reporting system. With the original conception of the archiving and saving of data, it was of course not yet possible to take a future reporting solution into account. The data is therefore not in optimal format and can comprise of enormous amounts of data, often many gigabytes. At the same time, the reporting should not hinder the current system.

THE SOLUTION

For reporting, there is zenon Analyzer, which is already excellently equipped to work in conjunction with zenon and can automatically take on much data. Certain data, such as the servicing of a generator or the successful replacement of a circuit breaker, must nevertheless be logged manually. Because it is not desirable to change the existing zenon projects, you only need to add an additional zenon Runtime as a client which carries out this task. As a result of this, the expansion can be implemented during ongoing operation, non-invasively. Existing projects are not affected. In addition, the SCADA Runtime Connector is installed on this computer, allowing zenon Analyzer to have access to stored archive data, the CEL or the Alarm Message List (AML).

There is also an elegant solution for the inclusion of historical data that goes back over many years and comprises an enormous amount of data: archive emulation in zenon Analyzer. It is able to search data according to certain, self-selected criteria and, on the basis of this, to create new archives and variables and fill these with data. The data is prepared as required for optimal use in the reporting system. Archives, CEL and AML can be used as a source of data for archive emulation *(see Figure 1)*.

ARCHIVE EMULATION IN DETAIL

The emulated archives and emulated variables are defined in the zenon Analyzer Management Studio (ZAMS). The archives are defined in the same way as in zenon Editor.

There is a particular feature with variable definition which recognizes nine different counter types:

- Absolute time counter (0–∞)
- Relative time counter (restarts at 0 after each cycle)
- Absolute event counter (0–∞)
- Relative event counter (restarts at 0 after each cycle)
- Difference counter
- Sum
- Maximum
- Minimum
- Time-corrected average value

For each variable, it is possible to define which triggering event starts the time calculation and which one stops the time calculation. The result is written in the virtual variable for each archive cycle.

Example: The variable "b_machine_ON" = 1 is set for a machine if it is switched on. If the machine is switched off, the variable "b_machine_ON" = 0 is set. Both events are written to the CEL. With the archive emulation, we now read the statuses of the variable "b_machine_ON" from the CEL and determine for how long the variable was 1, i.e. until it was set back to 0 again. The result is saved in the emulated variable.

This data is collated in a cycle that can be set and can also process historical data that goes back over many years. In doing so, the data can appear in the Runtime project as a zenon archive, AML or CEL data or also be evacuated to external SQL servers.

THE IMPLEMENTATION

The implementation of the reporting solution can be fundamentally broken down into three steps:

- Creation of the zenon Runtime client
- Setting the parameters of archive emulation
- Setting the parameters of the report templates

Because no programming work is necessary in any of the stages, the reporting system can be implemented quickly and without programming knowledge.

In the first stage, the new zenon Runtime client is created to log servicing and the replacement of components. After this, the archive emulation is configured for the desired reports and the parameters for the report templates are set up in ZAMS. Special report templates for hydro-electric power plants are already pre-defined and included with zenon Analyzer.

These include:

- Operating time per operation mode and machine component report
- Operating time per power range report
- Power line frequency report
- Active and reactive power counters report
- Circuit breaker switching cycles report
- Machine event counters report

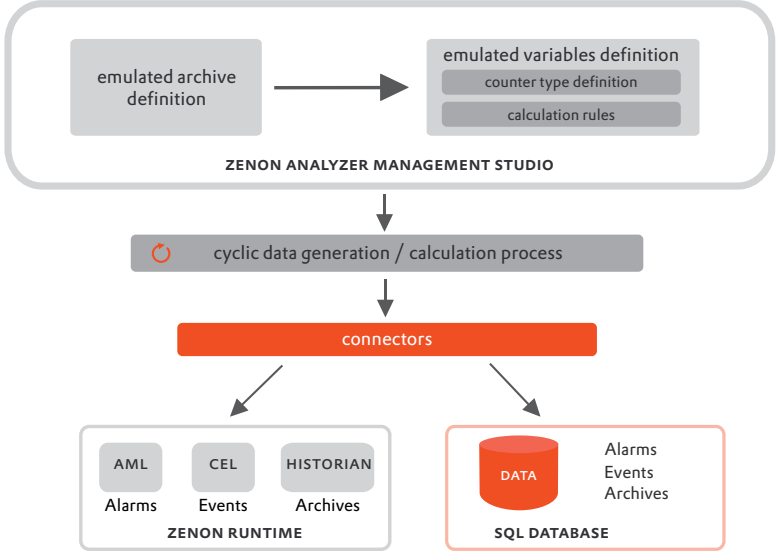

Figure 1: Archive emulation in zenon Analyzer

The individual reports are configured by simply setting the parameters.

OPERATING TIME PER OPERATION MODE AND MACHINE COMPONENT REPORT

In this report, operation modes (primary operation, etc.) and the operating hours of machine sets, their components (generators, excitation systems, turbine and auxiliary systems) or subcomponents (such as the lamination pack of a stator) are recorded and compared with one another.

The circuit breaker of the machine is logged in the CEL. From this data, absolute and relative time counters are derived via archive emulation. In addition, the operation mode of the machine is recorded in the CEL, from which a relative time counter is then derived for each operation mode.

In the next step, the parameters for the corresponding report template are set up in ZAMS. In doing so, it is primarily a matter of allocating the correct variables to the report and selecting the graphical display form.

Because the inspection and replacement events can be logged in the zenon client, the report can be calculated using this data and displayed in a table or as graphics.

OPERATING TIME PER POWER RANGE REPORT

In this report, the amount of hours a machine has been operated and the power range at which it was operated is shown for generator and/or pump operation. The power ranges can be divided into active and reactive power.

The active and reactive power is already logged and written to an archive in the power plant project. From there, the archive emulation reads the data and calculates the operating hours for the desired, freely-selectable active and reactive power ranges. To do this, relative counters are defined in the desired scale in the archive emulation. In the next step, corresponding parameters are set in ZAMS and the corresponding variables are allocated.

POWER LINE FREQUENCY REPORT

In this report, the operating hours for freely-definable power line frequency ranges are shown.

The current power line frequency is logged in the power plant project and written to an archive. From there, the archive emulation reads the data and calculates the operating hours for the desired frequency ranges. The variable allocation for the report template is defined in ZAMS only.

ACTIVE AND REACTIVE POWER COUNTERS REPORT

In this report, the production and consumption of active and reactive power is shown.

The counters for the production and consumption of active and reactive power are logged in the power plant project and recorded in an archive. In ZAMS, the counters that provide the corresponding data for this report template are defined. The report aggregates the counters and displays this in a table and as graphics.

CIRCUIT BREAKER SWITCHING CYCLES REPORT

In this report, the switching cycles of circuit breakers are shown, taking into account inspection and replacement.
The switching processes are recorded for every circuit breaker in the CEL. With archive emulation, relative event counters can be derived from these entries.

Inspections and replacements are logged manually in the zenon Client and recorded in an archive. Then, the parameters for the corresponding report template are set up in ZAMS and the corresponding variables are allocated. The counter of the respective switch is calculated in the report as a summation of the respective relative event counter since the time of the inspection or replacement.

MACHINE EVENT COUNTERS REPORT

In this report, the frequency of certain events for a machine set are shown in order to analyze which loads a machine set is subjected to. The number of starts/stops, changes to set values, types of turbine operation, excess rotation speed and loads being switched off are shown.

Switching on and off, changes to set values, modes of operation and circuit breaker switching are recorded in the archives of the power plant project. In ZAMS, in the corresponding report template, the active power ranges and turbine speed ranges are shown dynamically, the parameters are set and the variables that contain this information are allocated all according to the user's wishes.

THE ADVANTAGES OF THIS SOLUTION

The introduction of a reporting system should constitute an evolution and expansion of the existing automation project. Ultimately, operation should also continue unaffected during implementation. The simplicity of report creation is primarily based on two aspects: (1) Archive emulation, which prepares the data, and (2) the pre-defined report templates in ZAMS, which only need to have the parameters set. In doing so, reports from power plants through to power plant groups can be displayed, and can be expanded dynamically with turbines, power plants, etc. at any time.

Operators of hydro-electric power plants benefit from the combined use of zenon as a visualization and control system and zenon Analyzer as a dynamic reporting system. It is an ergonomic complete solution which supports you in optimizing your operation on an ongoing basis and to quickly recoup your investment.

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