# PROCESS CONTROL AND WEB BASED SOFTWARE SET-UP FOR THE DESY ELECTRO POLISHING INFRASTRUCTURE

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*Abstract*

At DESY an Electro Polishing (EP) infrastructure for single-cell, nine-cell and the proposed double nine-cell superstructure of TESLA/TTF design was set up in 2002. Baseline for the layout of the EP facility is a computerized system to control process parameters, process steering and safety options. Twenty five sensors are installed to maintain high reproducibility of the EP process as well as a high safety level for operation. The supervision and the Human Machine Interface (HMI) of the process are done by a Simatic PLC (Programmable Logic Controller) system using a customized version of the standard WinCC software (Windows Control Center). More than 100 process data and events are archived in the form of process values, alarms and user archives. Process messages and local events can be due to an alarm message frame directly from the automation system or to analog alarms in the case of out-limit conditions. An implemented web server supports full monitoring via internet. We present the network implementation solution applied to the EP process control, the alarm level handling and system reaction chart as well as the extended monitoring and operation options realized in the EP operation and control.

## INTRODUCTION

In order to obtain a high safety operation level, reproducibility of EP treatments combined with a user friendly interface, a computerized system for the EP process, was set up [1]. A solid PLC design with proved visualization software was applied for EP control and monitoring.

## NETWORK STRUCTURE

A S7-300 PLC with 48 digital inputs, 48 digital outputs, 40 analog inputs and 4 analog outputs takes the control of the EP process. The visualization system has direct access to the data from the Simatic controller via the MPI bus. The heart of the visualization is a central server running WinCC (Windows Control Center from Siemens) on which all information converges. Web clients have direct internet access to the process.

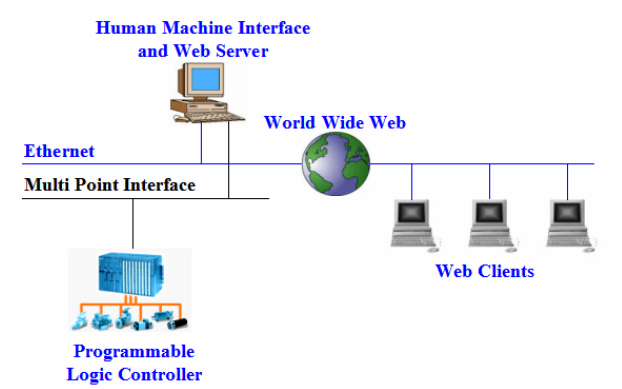


Figure 1: Network structure.

## DEVELOPMENT AND PROGRAMMING

**Controller:** All function blocks were programmed in statement list language (STL) in which the control tasks are described in form of a list using mnemonics abbreviations.

**Visualization:** Special routines and functions are programmed in ANSI-C.

**Program structure:** The program is structured in organization-, data-blocks and functions. More than 170 blocks are networked with each other.

## FLOW PROCESS CHART

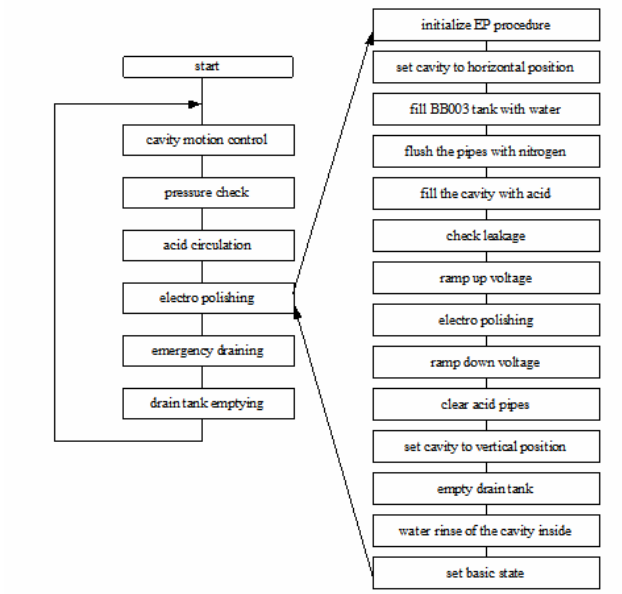


Figure 2: Procedures and sequences of the process [2].

In order to scan the application program cyclically, the system program invokes the organization block *OB 1*. It contains all statements for procedure calls, like cavity motion control, pressure check, etc. The cycle time depends on the load; 20 ms are typical for the EP process. Each procedure is subdivided into sequences and segments. For example, the sequence *electro polishing* contains 12 segments.

At the end of one cyclic execution all results of logic operations are transferred to the periphery addresses and the called devices are activated.

## ALARM HANDLING

| System Response in Case of Alarm Events (Extraction) | |
|---|---|
| gas alarms, door interlocks, PLC diagnostics alarm, current limit alarm, acid leakage | stop procedure immediately and go back to basic state |
| temperature alarms | shut down power supply and run emergency programs trying to cool down the medium and restart the power supply (optionally) |
| nitrogen flow alarm, electric isolation fault, power supply fault | shut down power supply and run emergency programs to dump the acid and rinse the cavity with water |
| pressure level (acid, nitrogen, rinsing water and gas scrubber) | shut down power supply and run emergency programs depending on medium fault |

Figure 3: System response in case of alarm.

System troubles are categorized in *warnings*, *failures* and *alarms*. One of the most important tasks of the automation system is to manage the alarm events. Depending on the working sequence, different emergency programs are called to set the process into a secure state.

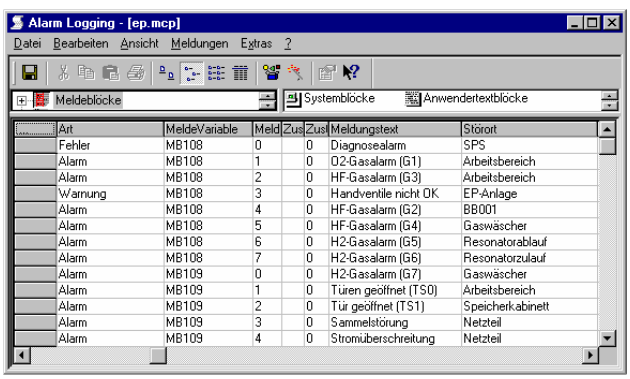


Figure 4: Alarm configuration in WinCC.

## VISUALIZATION

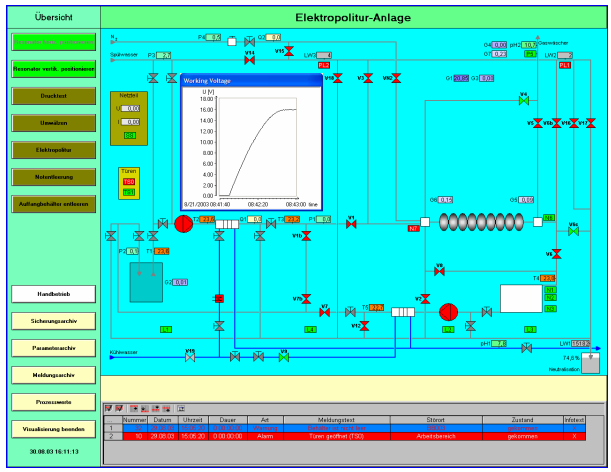


Figure 5: Main window of the visualization.

The general overview of the EP control system contains all control buttons (left side) and medium circuits with sensors, valves, pumps, tanks and pipes. Basic parameters can be set by operators, advanced settings require project manager authorization.

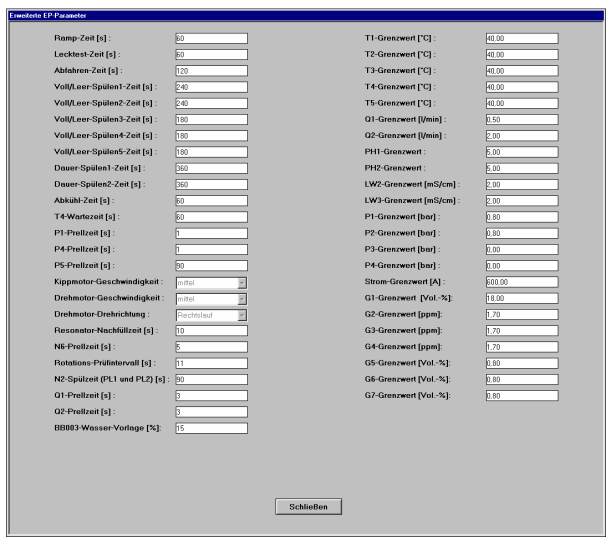


Figure 6: Advanced settings.

## ALARM AND PROCESS VALUE ARCHIVE

**Alarm archive:** The system records process messages and local events. In addition they are stored in short-term or sequence archives. They are accessible selectively on demand. Detailed error messages of the automation system are displayed in info boxes. Messages can be

generated in 3 ways: by derivation from individual bits, as a sequence of telegrams direct from the automation system or as a result of analog alarms if values exceed limits.

| | Art | Meldungstext | Störort | Zustand |
|---|---|---|---|---|
| 24 | Alarm | Türen geöffnet (TS0) | Arbeitsbereich | quittiert |
| 25 | Warnung | Behälter ist nicht leer | BB003 | gegangen |
| 26 | Alarm | Türen geöffnet (TS0) | Arbeitsbereich | gegangen |
| 27 | Warnung | Behälter ist nicht leer | BB003 | quittiert |
| 28 | Alarm | Leck (PL1) | Spülwasserzulauf unten | quittiert |
| 29 | Alarm | Leitwert-Alarm (LW2) | Spülwasserzulauf unten | quittiert |
| 30 | Alarm | Türen geöffnet (TS0) | Arbeitsbereich | quittiert |
| 31 | Alarm | Türen geöffnet (TS0) | Arbeitsbereich | gekommen |
| 32 | Alarm | Leck (PL1) | Spülwasserzulauf unten | gegangen |
| 33 | Alarm | Leitwert-Alarm (LW2) | Spülwasserzulauf unten | gegangen |
| 34 | Warnung | Behälter ist nicht leer | BB003 | gekommen |
| 35 | Alarm | Leck (PL1) | Spülwasserzulauf unten | gekommen |
| 36 | Alarm | Leitwert-Alarm (LW2) | Spülwasserzulauf unten | gekommen |
| 37 | Warnung | Behälter ist nicht leer | BB003 | quittiert |
| 38 | Alarm | PH-Alarm (PH1) | Wärmetauscher | quittiert |
| 39 | Warnung | Behälter ist nicht leer | BB003 | gegangen |
| 40 | Warnung | Behälter ist nicht leer | BB003 | gekommen |
| 41 | Alarm | PH-Alarm (PH1) | Wärmetauscher | gegangen |
| 42 | Alarm | PH-Alarm (PH1) | Wärmetauscher | gekommen |
| 43 | Alarm | PH-Alarm (PH1) | Wärmetauscher | Quit-System |
| 44 | Alarm | PH-Alarm (PH1) | Wärmetauscher | gegangen |
| 45 | Alarm | PH-Alarm (PH1) | Wärmetauscher | gekommen |
| 46 | Alarm | PH-Alarm (PH1) | Wärmetauscher | Quit-System |
| 47 | Alarm | PH-Alarm (PH1) | Wärmetauscher | gegangen |
| 48 | Alarm | PH-Alarm (PH1) | Wärmetauscher | gekommen |
| 49 | Warnung | Behälter ist nicht leer | BB003 | quittiert |
| 50 | Alarm | Türen geöffnet (TS0) | Arbeitsbereich | quittiert |
| 51 | Alarm | Türen geöffnet (TS0) | Arbeitsbereich | gegangen |
| 52 | Warnung | Behälter ist nicht leer | BB003 | gegangen |
| 53 | Warnung | Behälter ist nicht leer | BB003 | gekommen |
| 54 | Warnung | Behälter ist nicht leer | BB003 | Quit-System |
| 55 | Warnung | Behälter ist nicht leer | BB003 | gegangen |

02.09.2003 13:10 | Liste : 2 | Fenster : 1000 | Quit : 2

Figure 7: Alarm archive.

**Process value archive:** On a cyclic or event-controlled basis, process data and values of internal variables are logged and recorded. The results are held on a hard storage medium with recording cycles programmable in intervals up to 500 ms. The data are presented as graphs and tables on screen. 68 process values like analog values, sequence or device states (pumps, valves, etc.) are available. A backup task starts automatically every month to store the internal WinCC database including all archives to a network drive.

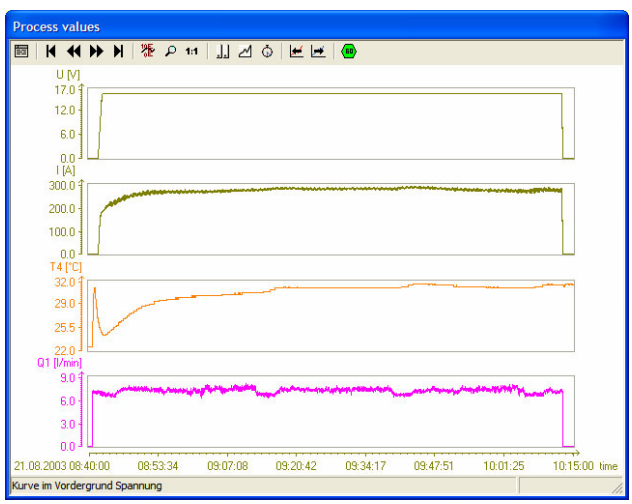


Figure 8: Process value archive.

## INTERNET

**Message system:** The operators are automatically informed about critical conditions of the process by a message service or optionally by e-mail.

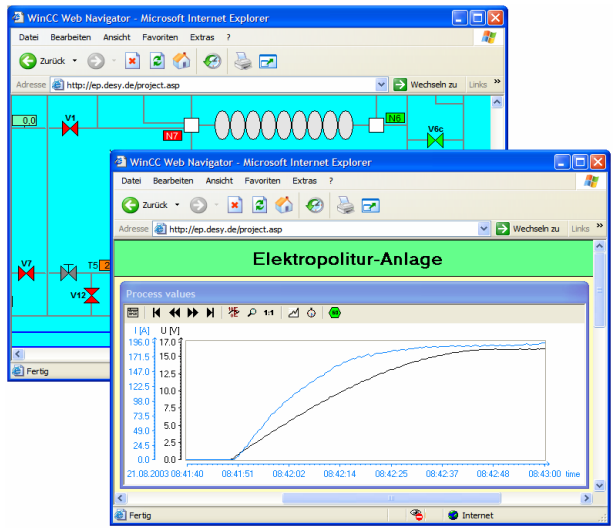


Figure 9: Monitoring the process via internet.

**Web server:** The implemented web server allows the operator team to visualize the process via the internet. The web client is a so-called Thin Client that monitors the running process from an internet browser, without installation of the WinCC base system on the client.

## REFERENCES

[1] K. Escherich et al., “ELECTRO POLISHING AT DESY, A SET UP FOR MULTI-CELL RESONATOR TREATMENT”, SRF 2001, PT015.

[2] A. Matheisen, DESY, “Description of EP Procedures”, private communication.