# Modernization of the Rüdersdorfer cement plant – a quantum leap in technology

**A large-scale modernization programme undertaken by German cement producer Rüdersdorfer Zement GmbH between 1991 and 1996 has made its works one of the most modern in Europe. ABB Automatisierungsanlagen Cottbus GmbH, working closely with ABB Industrie AG of Switzerland, acted as general contractor, with responsibility for the project engineering as well as delivery, installation and commissioning of the electrical equipment. This equipment included the Advant Cement System with CIMS (Cement Information Management Solutions). The Advant Cement System offers special benefits in the key areas of production, quality assurance, power consumption, personnel and maintenance. Experience with the new plant has been good and a sharp reduction in maintenance costs has been recorded.**

A new epoch began at *Rüdersdorfer Zement GmbH* in 1990 with the takeover by the *Readymix Group*. At stake was the rapid adaptation of cement production within the group in order to supply the fast-growing cement markets in the Berlin area with high-grade cement. All investment decisions were driven by the need to increase productivity through innovative production processes and to improve quality using leading-edge technology. From the beginning, top priority was given to high environmental compatibility and to the optimal use of energy. The most modern cement plant in Europe was to be built **1** [1]

A modern control system was to progressively assume control of the production processes. The goal: move operation of the process from the 13 existing decentralized control rooms to a single central control room located next to the planned new kiln line 5 as quickly as possible.

To do this it was necessary to renew the well-maintained but outdated conventional electrotechnical plant. This included all the transmitters for the process signals, as these could no longer be relied upon to fulfil the demands of automated cement production.

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As a first step, and before any initial investments had been made, the electrical department of Rüdersdorfer Zement joined together with ABB to develop a concept for the project. The conceptual planning covered the modernization of the electrical equipment belonging to the existing units, defining how it was to be integrated later into the electrification of the planned new clinker production line.

Beginning in 1991, plant departments had their electrotechnical equipment totally renewed step-by-step. They were equipped with ABB Master/Advant technology and successively networked via the Masterbus 300 with its fiber optic media to build an integrated Advant Cement System [2].

## Modernization of the electrical equipment

The general contractor, with responsibility for the engineering, supply, construction

**Chronology of the key modernization steps**

| | |
|---|---|
| 1991 | Automation of the quarry water retention system |
| 1992 | Cement mill 1<br>New semi-mobile crusher<br>New 6-kV main switchgear equipment<br>New ESP filters<br>Cement mills 2–5: 2 new roller presses<br>Raw meal blending<br>Conveyor system from the quarry<br>Modernization of Lepol kilns 3&4 |
| 1993 | CIMS<br>Cement silos<br>Clinker storage<br>Control systems networked<br>Order for new kiln line 5 with fluidized bed reactor |
| 1994 | Coal mills |
| 1995 | Production start-up of kiln line 5 |
| 1996 | Raw mills 4–7<br>Central harmonics filter and power factor compensation equipment for complete plant |

***The cement plant of Rüdersdorfer Zement GmbH, Germany. Large-scale modernization of the works between 1991 and 1996 have made it a leader in Europe today.*** **1**

and start-up of the electrical equipment, was ABB Automatisierungsanlagen Cottbus GmbH, working closely with ABB Industrie AG of Switzerland. A considerable share of the total investment was consequently placed in the German state of Brandenburg. In accordance with the wishes of Rüdersdorfer Zement GmbH, local firms also participated in the realization of the project. Operating staff at the cement plant worked hand-in-hand with ABB commissioning engineers to put the works into operation.

The installation of the new kiln line and state-of-the-art electrical equipment has made the Rüdersdorfer cement plant a leader in Europe.

### Transformers, medium-voltage and low-voltage switchgear

The modernization of the power equipment included the replacement of a 40-MVA transformer in the 110-kV transformer station.

The new type ZS1 medium-voltage switchgear **2** is equipped with withdrawable vacuum circuit-breakers which can handle fault currents of up to 40 kA at 6 kV. A total of 38 cubicles were installed in the cement mills and new kiln line.

The low-voltage MNS switchgear features fuseless technology. Standardized, exchangeable modules in plug-in tech-

***The new medium-voltage switchgear of type ZS1. The installed withdrawable vacuum circuit-breakers are also suitable for motor-switching.*** **2**


***The rotary kiln is driven by two frequency converter drives with 490-kW motors.*** 3

nology provide a level of flexibility that will allow future extension of the installation while minimizing the replacement parts inventory. More than 250 cubicles were installed in all.

### Drives

All essential drives are equipped with new-generation motors and static frequency converters. During their design, special emphasis was placed on high operating efficiency. Optimal energy-saving was a high priority during the design of the variable-speed drives, which are equipped almost exclusively with ABB frequency converters (voltage-source inverters) from the SAMI-F family at ratings of up to 1,400 kW. The kiln is driven by two frequency converter drives with self-cooled 490-kW motors that easily satisfy the high torque requirements of the kiln 3 during start up.

A sub-synchronous converter cascade 4 rated at 3,300 kW with a 50 % speed control range was selected for the exhaust fan. The new converter units are notable for their high efficiency during speed-controlled operation as well as for their low noise emission levels.

### Field instrumentation

Planning of the process instrumentation, which was delivered by ABB, the customer and other vendors, was carried out by ABB and the equipment jointly put into operation with the staff at the plant. Over 2,000 measurement points were newly installed 5.

### Cabling

Over 700 km of cable were laid in the course of the rebuilding programme and the new construction of production line 5.

## Control equipment

With the new kiln line, Rüdersdorfer Zement GmbH now has three production lines. The entire production facility is operated from a single central control room 6, 7. The installed equipment comprises:

4 large-screen field displays
5 Advant 520 operator stations with a total of 10 screens
6 MasterView 850 operator stations with a total of 10 screens

One console is in the office of the system engineer and functions as the system console.

### Network configuration

All of the operator workplaces are connected to two Masterbus 300 control networks 7. These employ fiber optic technology as a precaution against the influence of possible electromagnetic interference.

*Network 31 – cement production*

2 operator stations (MasterView 850)
11 process controllers (MasterPiece 200/1)

***Sub-synchronous converter cascade rated at 3,300 kW, with a 50 percent speed control range for the exhaust fan*** **4**

*Network 32 – clinker production*

Two segments of this network have been prepared for future extensions:

- Former installations
  5 operator stations (4 MasterView 850, 1 Advant Station 520)
  10 process controllers (7 MasterPiece 200/1, 1 Advant Controller 450, 2 MasterPiece 90)
- New kiln line 5
  4 operator stations (Advant Station 520)
  9 process controllers (8 MasterPiece 200/1, 1 MasterPiece 90)

Today, 26 MasterPiece 200/1 and one Advant Controller 450 with their distributed databases and operator stations, etc, communicate via these network buses.

The built-in flexibility of the Advant Cement System [2] configuration has permitted a step-by-step extension. Remote I/O units **8** communicate with the system over ABB Master fieldbus connections consisting mostly of fiber optic links.

The new Advant Controller 450 is fully compatible with the ABB Master process controllers and operator stations.

The Advant Cement System handles today

- over 2,000 drives and solenoid valves,
- over 2,000 measurement points and
- approximately 20 subsystems via serial data transmission (non-ABB protocols).

In doing so, it accesses over 30,000 digital I/Os, 2,300 analogue I/Os and 20 serial interfaces.

An advantage of the Advant Cement System is that it can be divided into sections. This feature was intentionally util-

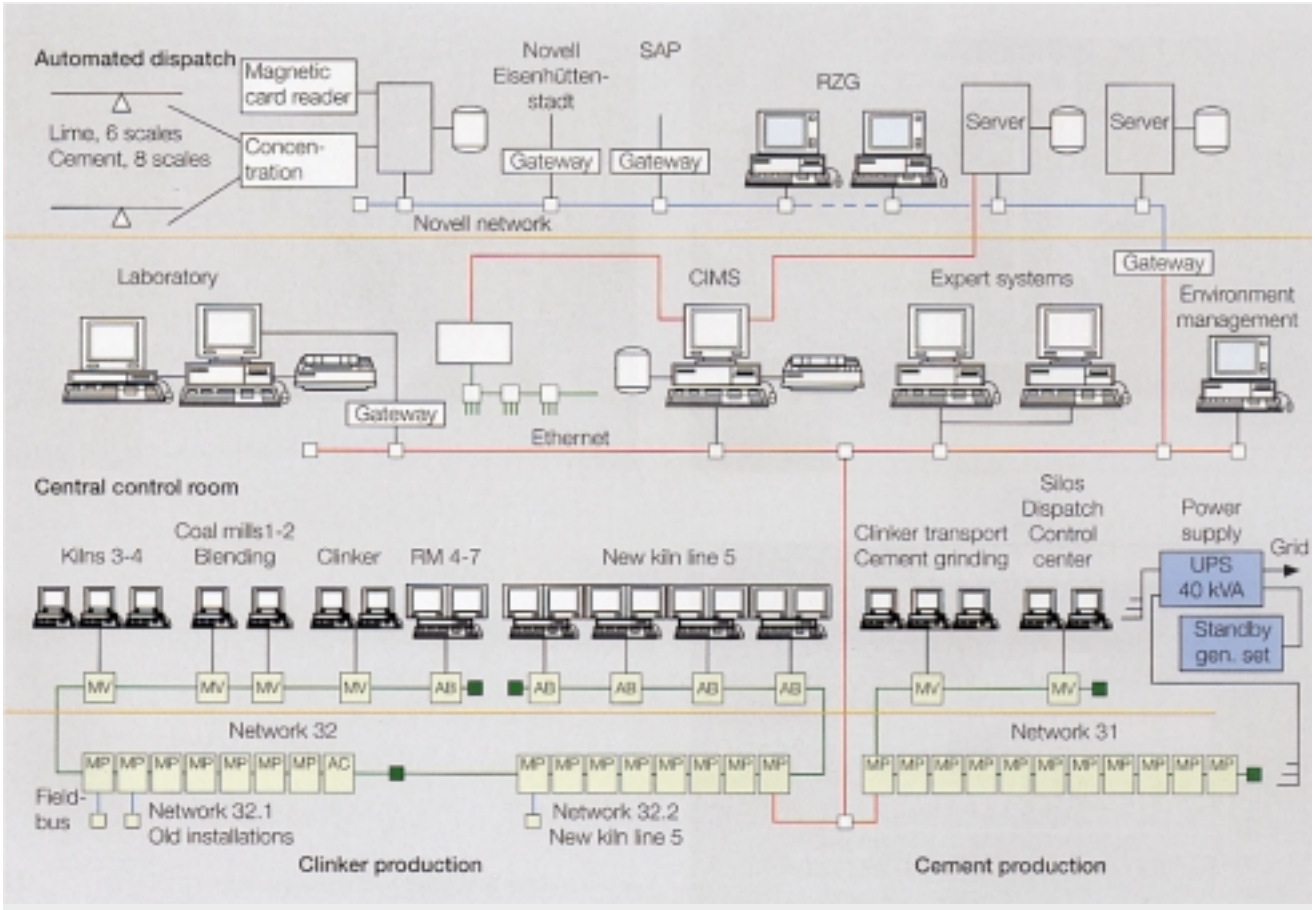
***Installed field instrumentation with a total of over 2,000 measuring points*** **5**

*The new central control room. Located next to the new kiln line 5, it replaces 12 decentralized control rooms.* 6

**Table 1:**
**Step-by-step automation of the production processes at Rüdersdorfer Zement GmbH**

| Year | 1991 | | | 1992 | | | 1993 | | | 1994 | | | 1995 | | | 1996 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control rooms: distributed | 13 | | | 8 | | | 8 | | | 6 | | | 5 | | | 1 | | |
| central | | | | | | | | | | | | | 1 | | | 1 | | |
| Operator stations | | | | 3 | | | 7 | | | 8 | | | 12 | | | 13 | | |
| Process controllers | | | | 3 | | | 14 | | | 17 | | | 26 | | | 29 | | |
| *Plant sections* | CR | OS | PS | CR | OS | PS | CR | OS | PS | CR | OS | PS | CR | OS | PS | CR | OS | PS |
| Control room B–4 | x | – | – | – | 1 | 1 | – | 1 | 1 | – | 1 | 1 | – | 1 | 1 | – | 1 | 1 |
| Quarry water retention | x | – | – | – | 1 | 1 | – | 1 | 1 | – | 1 | 1 | – | 1 | 1 | – | 1 | 1 |
| Gate B–4 | x | – | – | x | – | – | x | – | – | x | – | – | x | – | – | x | – | – |
| Secondary crusher | x | – | – | x | – | – | – | 1 | 2 | – | 1 | 3 | – | 1 | 3 | – | 1 | 3 |
| Raw mills 1–7 | x | – | – | x | – | – | x | – | – | x | – | – | x | – | – | – | 1 | 1 |
| Water retention Stienitz | x | – | – | x | – | – | x | – | – | x | – | – | x | – | – | – | – | 1 |
| Kilns 1 and 2 | x | – | – | x | – | – | x | – | – | x | – | – | x | – | – | – | – | – |
| Granulation | x | – | – | x | – | – | x | – | – | x | – | – | x | – | – | – | – | – |
| Raw meal blending | x | – | – | x | – | – | – | | 2 | – | | 2 | – | 1 | 2 | – | 1 | 2 |
| Cement silos | x | – | – | x | – | | – | | 2 | – | | 2 | – | 1 | 2 | – | 1 | 2 |
| Kilns 3 and 4 | x | – | – | x | – | – | x | 1 | 3 | – | 1 | 3 | – | 1 | 3 | – | 1 | 3 |
| Coal mills 1–4 | x | – | – | x | – | – | x | – | – | – | 1 | 1 | – | 1 | 1 | – | 1 | 1 |
| Cement mills 1–5 | x | – | – | x | 1 | 1 | x | 1 | 3 | x | 1 | 4 | – | 1 | 5 | – | 1 | 6 |
| New kiln line 5 | | | | | | | | | | | | | | 4 | 8 | – | 4 | 8 |
| Automated departments | | | | • Control room<br>• Qarry water retention<br>• Cement mill 1 | | | • Cement mills 2–5, roller presses<br>• Crusher<br>• Conveyor system from quarry<br>• Raw meal blending<br>• 2 Lepol kilns<br>• ESP filters<br>• Cement silos<br>• All process controllers networked | | | • Clinker storage<br>• Coal grinding plant<br>• Mixing bed | | | • New kiln line 5 | | | • Raw mills 4–7<br>• Granulation for 2 Lepol kilns | | |

CR Old control rooms in operation
OS Operator stations
PS Process controllers




***Configuration of the new control system***

AB *Advant Operator Station*
AC *Advant Controller*
MP *MasterPiece*
MV *MasterView*

**7**

ized in Rüdersdorf in order to clearly define the allocation of the operator stations to the key process steps. At the same time, dividing the network into sections makes fault analysis easier. Accordingly, each technological process section of the new line has its own process control section **9**.

### Step-by-step automation

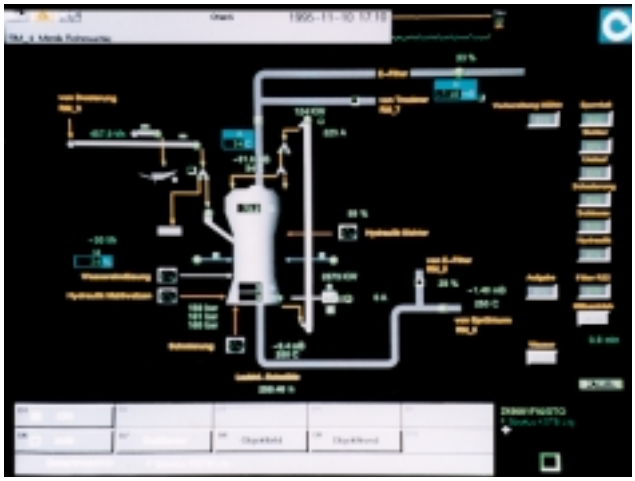
*Table 1* shows the individual steps that were taken to modernize the plant automation system and how the significant rationalization potential was progressively realized.

Most of the modernization work could be carried out either during planned maintenance periods or, when it had to be performed during operation, with minimum production downtimes. The engineers and electricians at the plant worked closely with the ABB commissioning engineers and erection staff at all times. Although cement sales grew continually during this time, production was not affected by the modernization programme.

For example, the transfer of all the operating stations to the completed central control room took place during just one weekend early in the summer of 1995. Neither the existing production nor the start-up work on the new kiln were impaired. Other operator stations performed the functions of these stations for the duration of the change-over. After connection to the equipment bus, the relocated stations took over their old functions. The self-configuring Advant Cement System allows this connection/disconnection of bus participants while the plant is operating. New or reconnected participants are recognized automatically. No breakdowns occurred during the transfer of the stations.

***Remote I/O units in a motor control cubicle***

**8**



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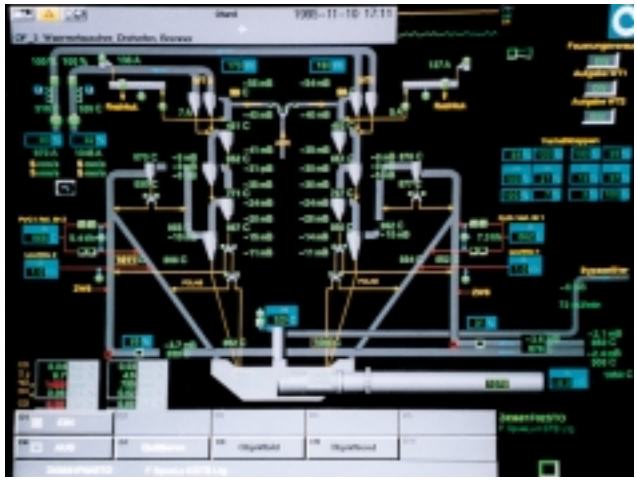

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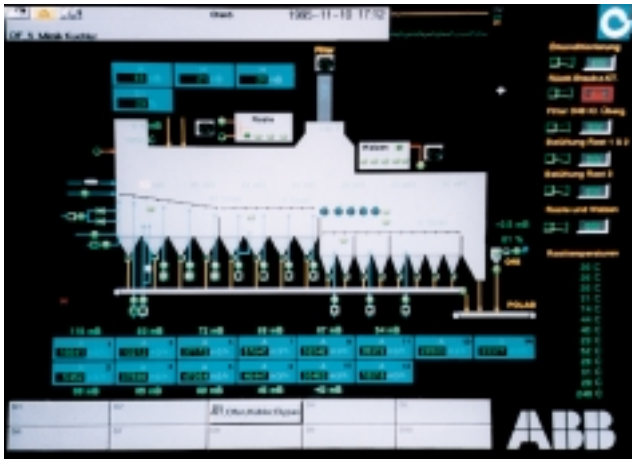



c

***Screenshots of processes taking place in the new line 5*** **9**

a *Overview of raw mill*
b *Plant overview of rotary kiln*
c *Clinker cooler*

**New management information system gives a competitive edge**

From the beginning, Rüdersdorfer Zement GmbH recognized that information management was a crucial factor in the company's drive for competitiveness. The challenge – and opportunity at the same time – was to benefit from information available in the plant. New information arrives continuously from the production and quality assurance areas as well as from office activities. Not everything is stored or easily retrievable. Even when information and data are available, there remains the task of relating it, sometimes correlating it, to the prevailing plant conditions. Without integration of the information systems and sources, little improvement in data processing can be expected.

The decision was taken in December 1993 to install the Cement Information Management Solutions (CIMS) system (see box) from ABB. CIMS now integrates information from plant management and from the controlling, dispatching, process technology, mechanical and electrical maintenance departments. At the plant, 45 users working with 35 personal computers are able to monitor and evaluate production processes, running time reports, maintenance intervals and silo inventories at their desks. With over 2,000 drives supporting three clinker production lines, four coal mills, five cement mills and 20 silos, the demands made on the system represent a major challenge.

In detail, CIMS serves the plant with:

- A plant overview display **10**
- Reports on the main process installations: kiln line 5 production report; 15 operational reports; reports on the individual process sections; maintenance forecasts based on running

**CIMS information management system**

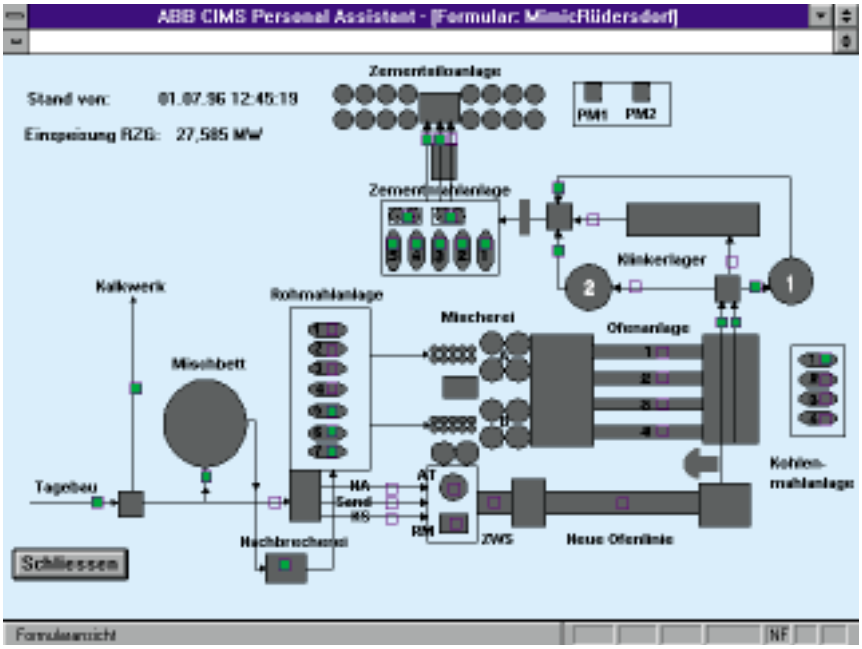
The information system CIMS (*C*ement *I*nformation *M*anagement *S*olutions) allows users to access, via the commercial plant data network, the central CIMS server from all the PCs. This makes data such as configurations, production reports or quality trends available at the click of a mouse to the management, operating, maintenance and process staff. CIMS has been specially tailored by ABB to the needs of the cement industry.

times; event and alarm statistics; cement silo inventories based on cement types; energy reports
- Trend functions: values on a per-minute basis are available for up to 30 days for selected data

To provide the required support for the system users, CIMS is connected to:
- The installed Advant Cement System – one of the largest systems ever to be installed in the cement industry
- The existing Novell network in the plant
- The automated laboratory
- 35 user stations

In addition, CIMS system features include:
- An interface to the automated POLAB laboratory and integral presentation of the quality data and process data in the form of reports and trends
- A gateway function for the exchange of data and recipes between the laboratory equipment and the ABB Advant process stations for the raw mill and cement mill optimization
- Display of quality data at the Advant operator stations, derived from the POLAB information
- An interface to the database server in the information systems department of Rüdersdorfer Zement and the exchange of required data. An interface to the SAP business information system is under consideration.
- Time synchronization for the whole control system through a radio synchronized clock connected to the CIMS system

A preliminary installation of the link between the POLAB cement mill control application and the ABB Master process stations went into operation for the exchange of recipes in March 1994. Phase 1 followed in May 1994. This included the cement mill, cement dispatch and an extension of the POLAB interface. The CIMS 'Personal Assistant' function was installed on the Novell network to allow the CIMS data to be accessed from the PCs of the individual users. Commissioning of phase 2 took place in January 1995, and saw the connection of the second MasterNet of the Advant Cement System in Rüdersdorf to the commercial database server of the information systems department.




***Overview display of the Rüdersdorfer cement plant*** 10

Integration of the new clinker production line 5 began in July 1995. A customized 'line 5' production report was developed jointly by ABB and the customer. Since the extension of the system storage capacity to 5 GB in 1996, users have on-line access to all the significant process values over the previous 30 days.

## A successful investment

Operating experience since 1992 has been good, and the electrical facilities have demonstrated their high availability. The number of interruptions in operation caused by the electrical equipment has been significantly reduced, compared with the older installation. This in turn has allowed a substantial reduction in the cost of trouble-shooting.

The number of control room operators could also be drastically reduced and the process overview improved. The new information management systems permit the full integration of available information and thus better business decisions.

## References

[1] Rüdersdorfer's quantum leap in electrotechnology. World Cement, October 1996.

[2] L. Krings: Advant Cement System – closing the gap between process and business control. ABB Review 6/7-95, 22–31.

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