

LINTH-LIMMERN POWER STATIONS (CH)

HIGH-PRESSURE PUMPED STORAGE POWER STATION

CUSTOMER

Kraftwerke Linth-Limmern AG
CH-8783 Linthal

COMMISSIONED

2004 – 2009

SCOPE OF SERVICE

- Development and overall project coordination
- Hardware and software engineering
- Delivery of a complete control system, hydraulic and electronic turbine governors, voltage controllers and electric safety system for the machine groups at Limmern and Hintersand, and storage pumps for Hintersand
- Delivery of a control system for the Tierfehd cooling water system
- Delivery of a water management control system for the barrages and water catchments
- Delivery of flow meter systems for the Limmern and Hintersand penstocks as well as a penstock monitoring system
- Installation and wiring
- Commissioning

TECHNICAL DATA

TIERFEHD POWER STATION

Limmernboden dam

Impoundment volume: 92 million m³

Limmern unit

Gross head: 1040m

Turbines: 3 horizontal twin Pelton turbines, 87 MW each

Hintersand equalizing reservoir

Net volume: 0.11 million m³

Hintersand unit

Gross head: 481m

Turbines: 2 horizontal Pelton turbines, 20 MW each

Pumps: 2 horizontal, three-stage, high pressure pumps, 17 MW each

PLANT DESCRIPTION

The Linth-Limmern power stations constructed from 1957 to 1968 are a joint venture of the canton Glarus and the Nordostschweizerische Kraftwerke AG (power station corporation of Northeast Switzerland – NOK). Four units process the inflows of the 140 km² Linth headwater region.

With the installed total turbine output of 340 MW the power stations generate an average 430 million kWh annually. At the Tierfehd underground power station two pumps with a total output of 34 MW are installed to pump water from the Hintersand equalizing reservoir in pump storage mode into the Limmernboden dam.

SCOPE OF PROJECT

All seven machine sets were equipped with state-of-the-art control and safety systems and new voltage and turbine controllers. The Tierfehd cooling water system consisting of a new elevated reservoir and the pump house with two band type screens and four pumps received a completely new control and measuring system.

Local operation and visualization of each machine set at the Tierfehd underground power station is facilitated by an independent RITOP process control system with touch panel and a mosaic schematic. As overriding control and monitoring system of all machine sets at the Tierfehd underground power station, the associ-

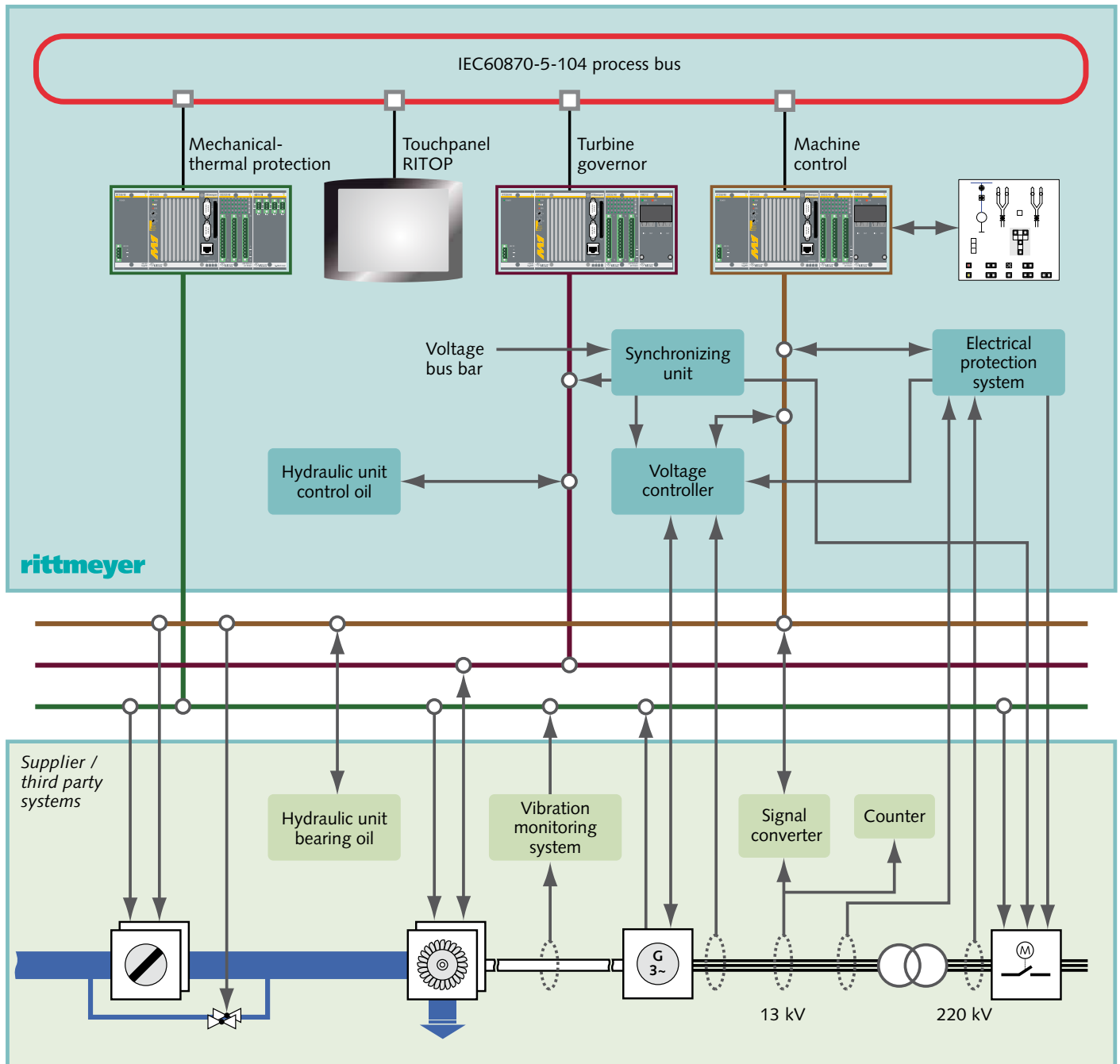
ated secondary systems, and the water catchments in the watershed, the Tierfehd power station process control system was installed, which comprises a one server system with a cold standby server and one operator station in the control center building.

For overriding control and visualization of all the Linth-Limmern power station installations a process control system with two redundant servers and two operator stations was installed at the regional control center (KSS). The KSS process control system controls the processes of the underground hydroelectric power station, the pumped storage plant, and the Tierfehd substation. Future expansion plans in-

clude the integration of the Linthal power station and substation, and the Limmern power station (Linthal 2015). All operating data and actions are captured, recorded, and displayed centrally via the KSS control system. Data communication between all system components is facilitated through a highly available Ethernet network.

The Limmern-Tierfehd and Hintersand-Tierfehd penstocks and the individual machine sets at the Tierfehd underground control center were equipped with accurate RISONIC acoustic discharge flow meters. An independent process station monitors the Limmern and Hintersand penstocks for overvelocity and differential flows.

SCHEMATIC OF THE MACHINE GROUP CONTROL



MACHINE CONTROL MECHANICAL-THERMAL SAFETY

For machine control and mechanical-thermal safety two independent RIFLEX M1 automation systems are installed per machine group. Comprehensive local operation is made possible via the touch screen panels installed on each machine panel which ensure uniform visualization and user-friendly control of all machine group components, aggregates, sequences, turbine and voltage controllers, etc.

With the three process stations a clear function structure can be achieved for a machine group of this size. The machine control contains the startup/shut down sequence, the aggregate control and the processing function for local operation, visualization and alarm notification. The mechanical-thermal safety covers all safety relevant functions.

TURBINE GOVERNORS

A RIFLEX M1 process station is also used as electronic turbine governor. It controls the control oil system, speed, and opening sequence and, via a control loop, the nozzles and jet deflectors of the turbine. The complex controller and limiting functions in idle, network, and isolated operation mode, and the dynamic transitions in case of load shedding and emergency/shut down or trip require quick processing cycles and a highly reliable control system performance.

DECENTRALIZATION

The different process stations are based on the modular RIFLEX M1 system and a uniform software solution. In case of a component failure the decentralized configuration guarantees the availability of the remaining system.

As far as possible, signal detection is realized with decentralized I/O bus rails. The inputs and outputs located at distances of up to 200m are connected to the process station with a quick FAST bus via fail-safe fiber optic cable connections.

TIERFEHD PUMPED STORAGE PLANT

The Tierfehd pumped storage plant was constructed from 2005 to 2008.

The pump turbine has a pump and turbine output of 140/110 MW and pumps or turbines water from the Tierfehd equalizing reservoir to the Limmernboden dam and vice versa.

A RIFLEX-M1 as gateway was integrated into the Ethernet network of the process control system. It communicates via IEC 60870-5-104 protocol with the process stations of the pumped storage plant and transfers filtered data to the KSS process control system and to the superior control center (ENL Baden).



"A multi-stage project of this scale can only be tackled with a competent and reliable partner. With Rittmeyer we chose the right control system supplier."

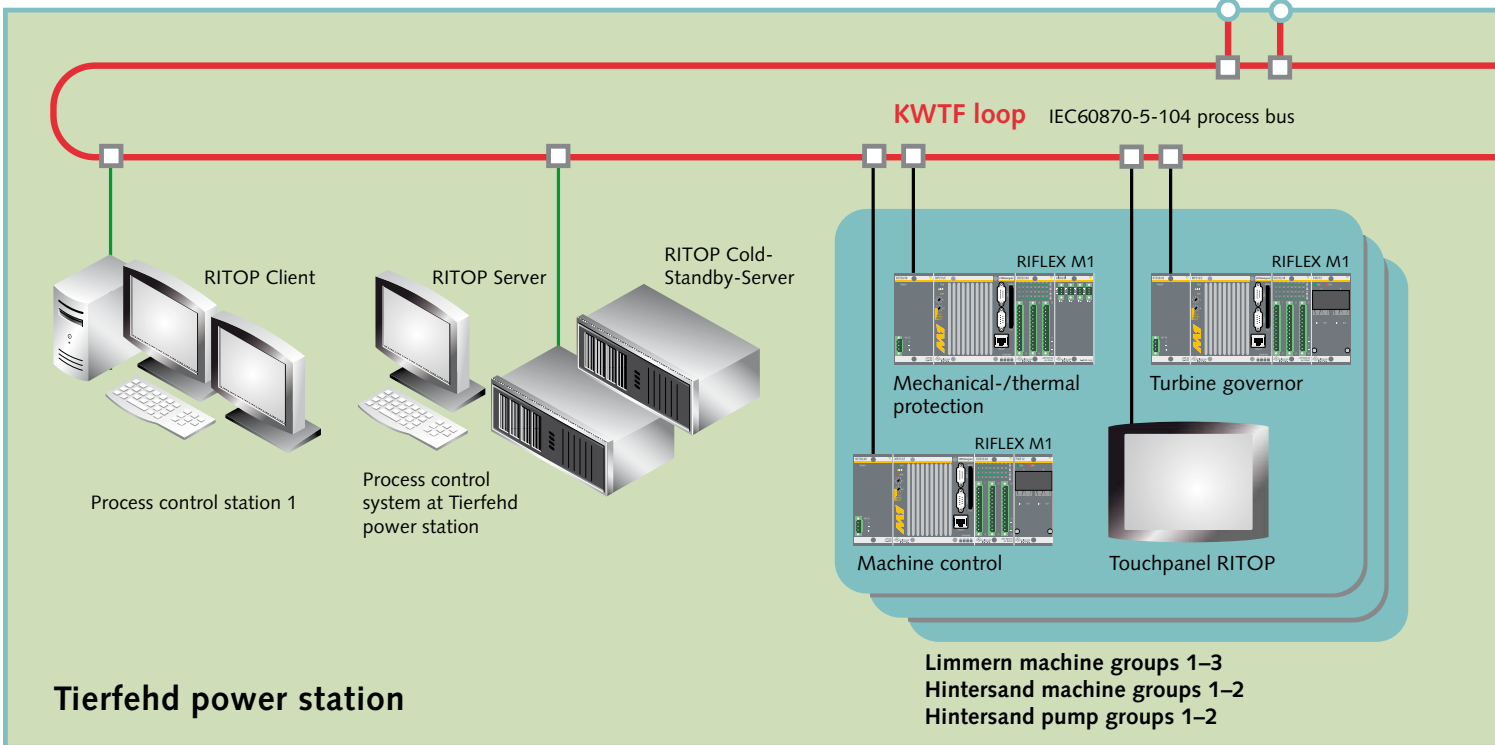
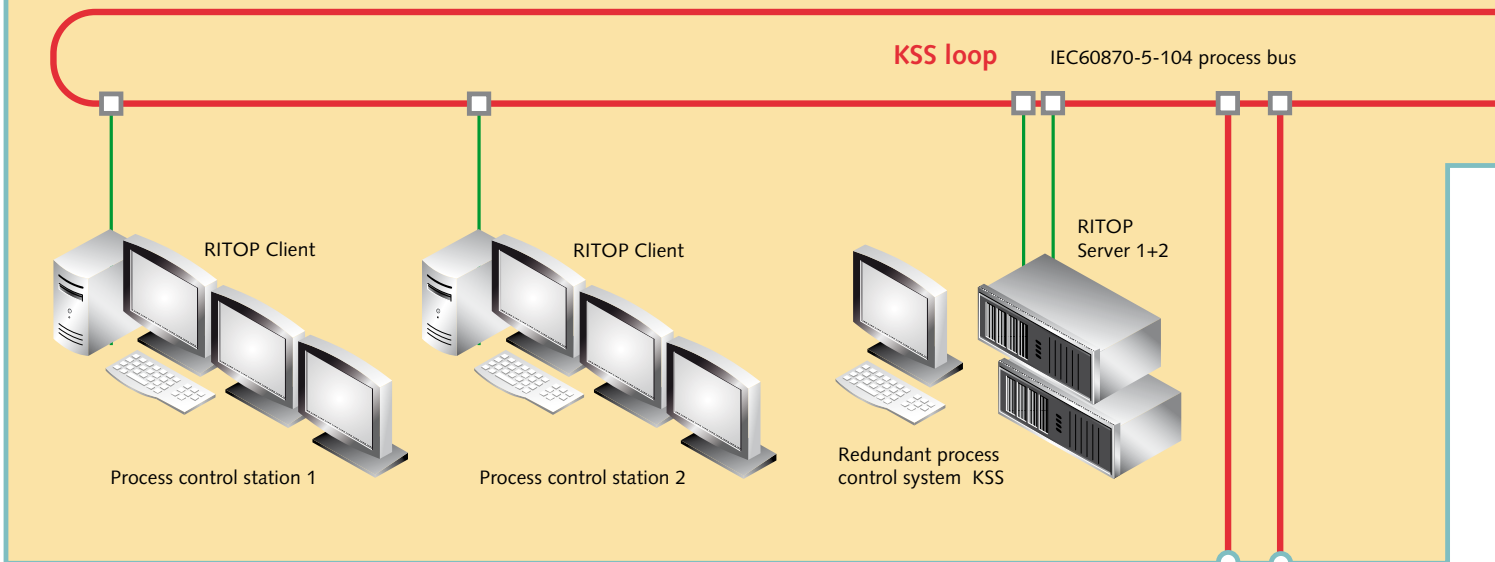
Heinrich Baumgartner,
plant maintenance / electrical system manager
Kraftwerke Linth-Limmern AG



"The Tierfehd power station was equipped with a state-of-the-art control system and is now well prepared for the future."

Martin Wolf, project manager
Rittmeyer AG

KSS (regional control center)



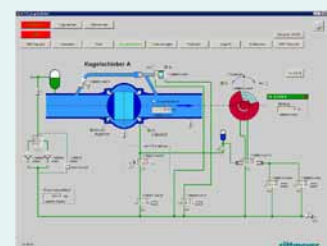
OPERATION

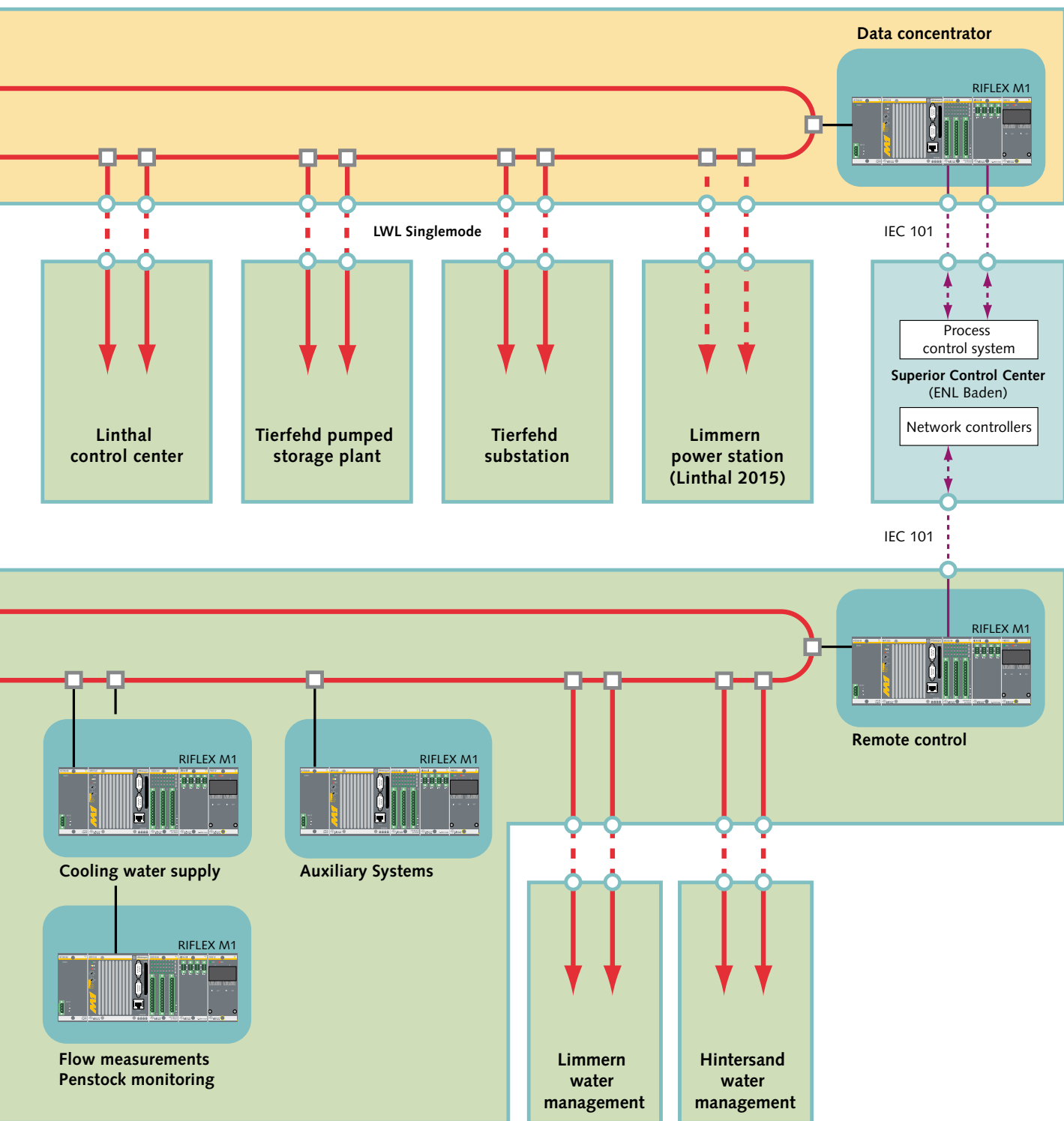
A hierarchically structured operating concept (higher operating authority with increasing process proximity) and a uniform software solution guarantee reliable control of the entire complex. In addition to the touch screen panels, mimic diagrams are installed to facilitate local control and visualization of the machine sets at the Tierfehd underground power station and the cooling water system in the pump house.

On three operating levels independent RITOP process control systems with different configurations are set up. On all levels the same processes are displayed

as identical process screens, providing the operator with a uniform and universal process display and operating concept.

The process graphics tree is structured so that each process screen can be accessed with no more than three operating steps. The system-specifically designed process screens provide unit-based information and control options. With clearly structured user interfaces the RITOP system allows for intuitive and safe operation of all system components, and all operation data and actions are logged and archived.





NETWORK CONTROL SYSTEM

For the most part the process control system is a decentralized installation both with regard to hardware and software. For process control very compact and highly available RIFLEX M1 automation systems are used.

The sub-circuit of the Tierfehd substation is redundantly coupled to the KSS central communication circuit. The other sub-circuits to the Linthal control center, the pumped storage plant, and the Tierfehd substation are also redundantly connected to the central communication circuit.

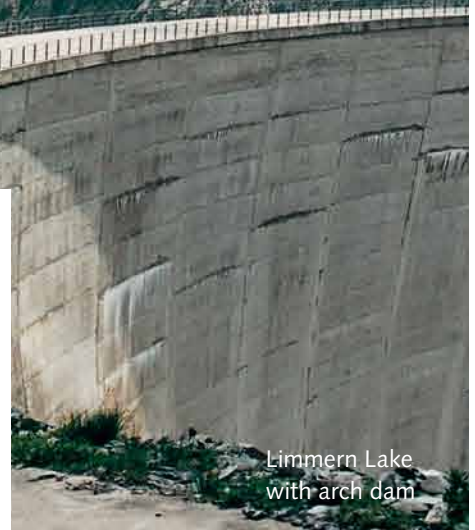
The KSS circuit and all sub-circuits are based on a fiberoptic Ethernet network.

Communication between the process stations and the process control systems is facilitated via IEC 60870-5-104 protocol.

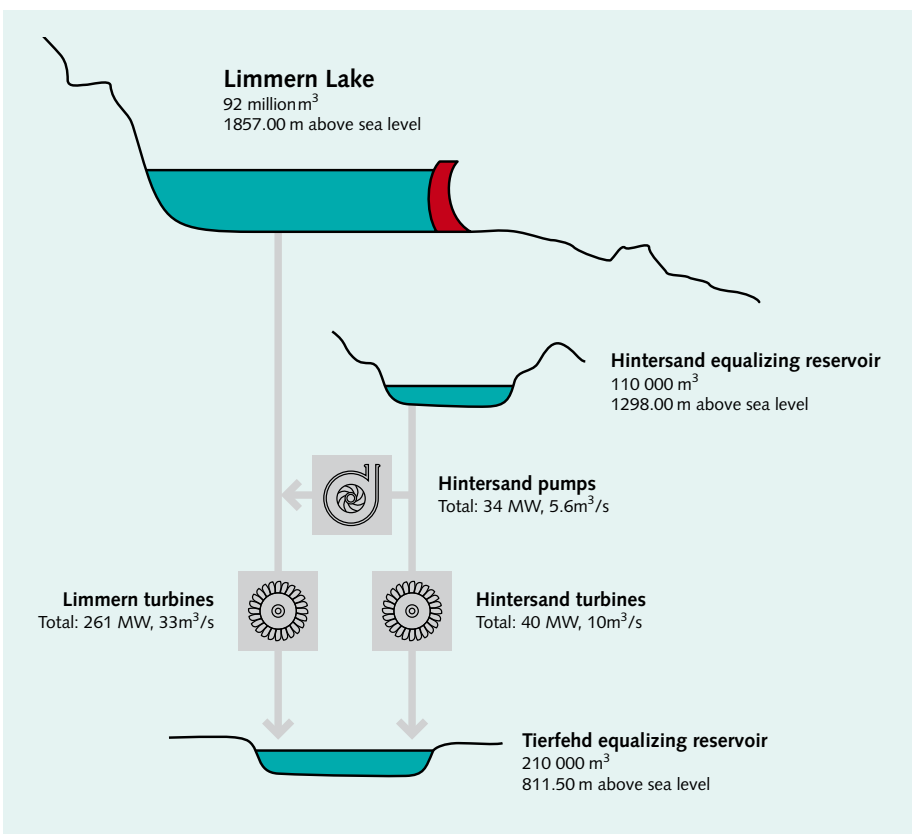
The corresponding configuration of the routers ensures optimal data flow allocation to the sub-circuits that are installed as independent networks, thus guaranteeing high availability and excellent network stability.

All RIFLEX process stations and RITOP process control systems are synchronized via a central time master (radio clock) to establish a uniform system time.

The overriding process control system at NOK and ENL Baden is integrated via a redundant remote control connection (IEC 60870-5-101 protocol).



Limmern Lake with arch dam



EXPANSION 2015

In 2015 a new underground pumped storage hydroelectric power station with a turbine and pump output of roughly 1 000 MW is scheduled to go into operation which will nearly quadruple the output of the Linth-Limmern power stations.

The required connections to the central KSS were already provided for in the present project.

0082207.E01

Subject to change without prior notice

200905 Fab,Wo,TUM 11.040.4000300.001.01.4.4

www.rittmeyer.com

SWITZERLAND (Headquarters)
Rittmeyer AG
Inwilerriedstrasse 57
P.O. Box 464
CH-6341 Baar
Tel. +41 41 767 10 00
Fax +41 41 767 10 70
E-Mail info@rittmeyer.com

Subsidiaries in
Stuttgart (Germany), Vienna (Austria), Bergamo (Italy), Lyon (France), Zagreb (Croatia), Bratislava (Slovakia). Sales office in Spokane WA (USA).