

# Rheinfelden Hydroelectric Power Plant, 1898–2010

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**Technical and historical significance of  
the original Rheinfelden hydropower plant**

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## The original Rheinfelden hydroelectric power plant symbolizes:



- 1) Early large-scale generation of hydroelectric power in Europe
  - 2) Promotion of the three-phase alternating current system
  - 3) Implementation of 50 Hertz as a general-purpose frequency
  - 4) Initiation of joint operation with other power stations
- ↳ Outstanding features, pointing the way into the future

The original Rheinfelden hydroelectric power plant symbolizes:  
1) Early large-scale generation of hydroelectric power in Europe

A selected project  
prior to Rheinfelden ↓

Picture 1900

Lauffen/Neckar 1891  
Germany 600 HP

*Key player in the long-  
distance transmission to  
the International  
Electrical Exhibition in  
Frankfurt/Main 1891*

# Early large-scale generation of hydroelectric power in Europe

Other selected projects  
↓ prior to Rheinfelden ↓

Picture 1900

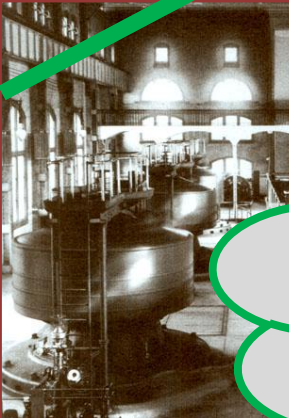
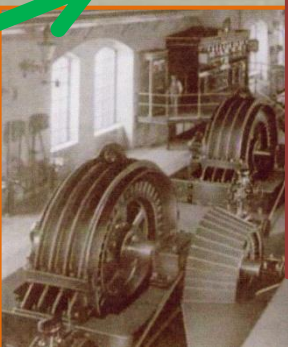
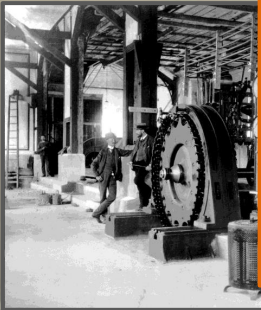


Niagara Falls 1895  
15,000 HP

Wynau/Aare 1896

Lauffen/Neckar 1891

600 HP



Rheinfelden 1898  
Germany/Switzerland 17,000 (!) HP



Rheinfelden:  
The top achievement in Europe  
- in both size and output

## The original Rheinfelden hydroelectric power plant symbolizes:

### 2) Promotion of the three-phase alternating current system

*Situation: When the Rheinfelden power plant was being planned, the question of current system was completely open.*

**“Battle of the current systems” during the 1890s:**

**1) Direct current DC** (Edison)

Deployment range below 1 km

**versus**

**alternating current AC !**

For larger supply areas and longer transmission distances

(Westinghouse)

**2) Single-phase**

Sufficient for electric lighting

**or**

**polyphase AC ?**

Essential for self-starting motors

**3) Two-phase**

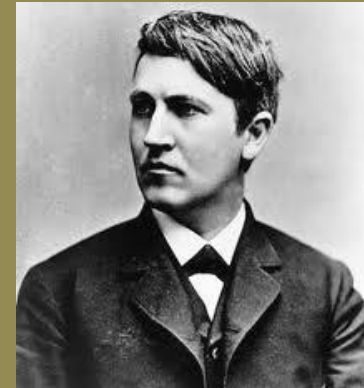
Decisive factor:

**or**

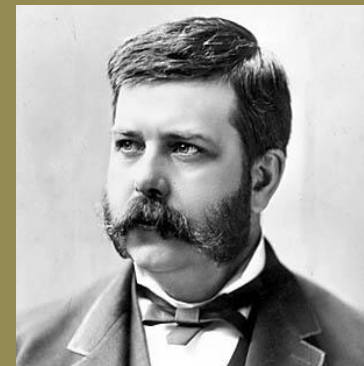
**three-phase AC ?**

Number of wires for

connection and transmission

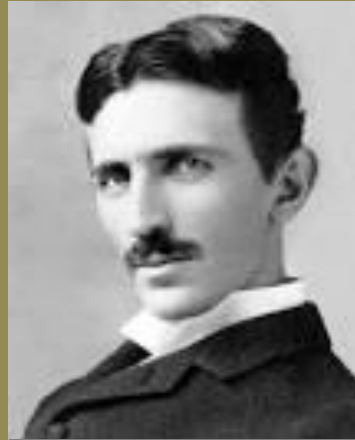


Thomas A. Edison



George Westinghouse

# Promotion of the three-phase alternating current system



Nikola Tesla

## Two-phase AC

Favorite of Tesla  
e. g. Niagara Falls

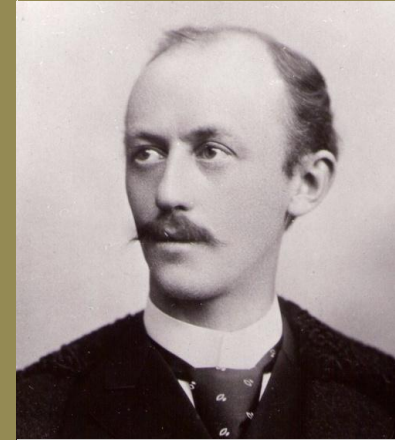
Needs 4(3) wires

## Three-phase AC

“would need 6 wires” ?

The interlinked three-phase AC  
Favorite of Dolivo-Dobrowolsky

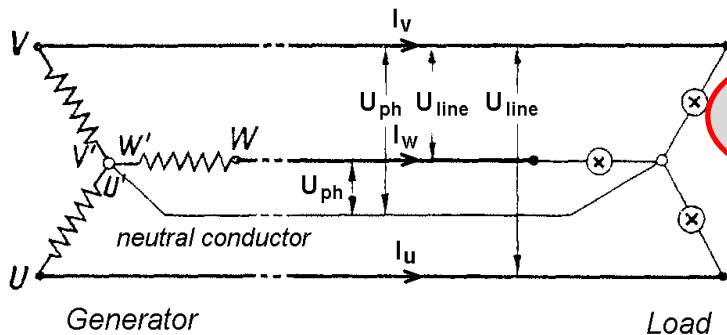
- Requires no return conductors
- Needs 3 wires only !



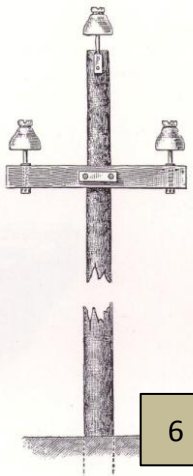
M. Dolivo-Dobrowolsky

**Challenge for Rheinfelden:** *Find a multi-purpose current system !*

**The decision of AEG:** *“The advantages of the interlinked three-phase ac ... were in their totality decisive for applying this current system ...”*



**Rheinfelden:**  
**Flagship station for three-phase ac which, later, was adopted around the world**



## The original Rheinfelden hydroelectric power plant symbolizes:

### 3) Implementation of 50 Hertz as a general-purpose frequency

*Situation: When the Rheinfelden power plant was being planned, widely different cycle numbers were in use.*

#### *“Battle of the frequencies”:*

- **133 $\frac{1}{3}$  125 83 $\frac{1}{3}$  70 Hz** *Best for electric lighting & distribution*
    - 66 $\frac{2}{3}$  65 60 50 Hz
    - 45 $\frac{1}{3}$  42 41 $\frac{2}{3}$  40 Hz
  - **40 30 25 16 $\frac{2}{3}$  Hz** *Best for power generation & transmission*
- First ac generator 1886 (Westinghouse)
- Hochfelden 1892 (MFO)
- Frankfurt/Main 1894 (BBC)
- Lauffen/Neckar 1891 (MFO)
- Niagara Falls 1895 (Tesla, Westinghouse)

**Challenge in the case of Rheinfelden:**

*Break away from the jungle of cycles !*

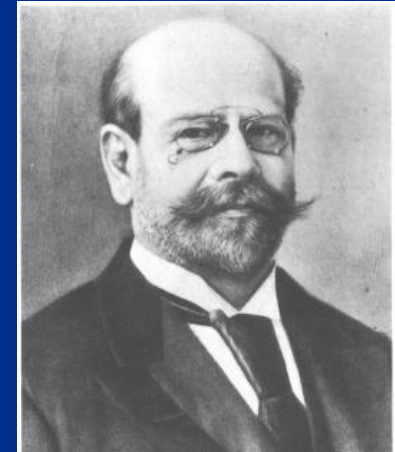
*Find the best frequency value !*

## Implementation of 50 Hertz as a general-purpose frequency

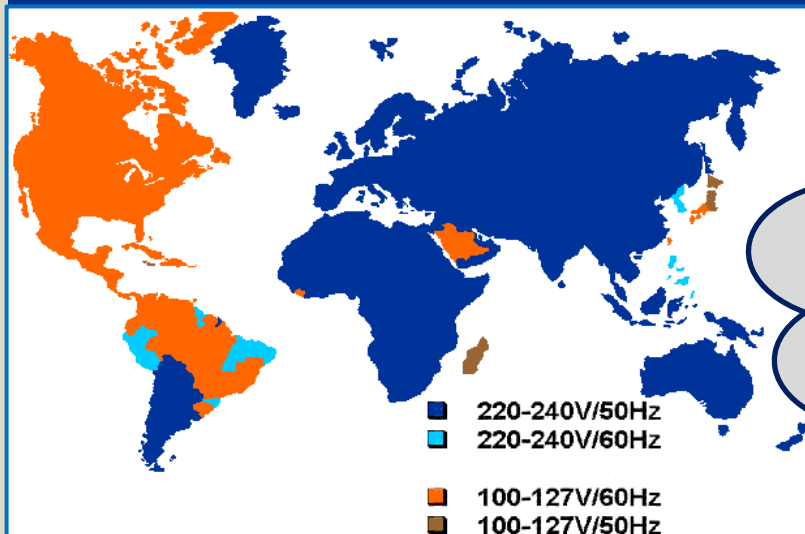
Emil Rathenau, general manager of the company  
Allgemeine Elektrizitäts Gesellschaft AEG in Berlin  
and director of the Rheinfelden Preparation Company, in 1896:

*“... After thorough investigations  
we decided for 50 periods per second.”*

*“... For the operation of transformers, motors and  
electric light bulbs this alternation number appears to be the best suitable ... .”*



Emil Rathenau



**Rheinfelden:**  
**Promoter of 50-Hz frequency**  
**which became the standard**  
**in most countries**



# The original Rheinfelden hydroelectric power plant symbolizes:

## 4) Joint operation with other power stations

*Rheinfelden entered into*

*joint operation with*

**1) Beznau in 1903**  
*(transborder power exchange!)*

*and gradually with other plants, e.g.:*

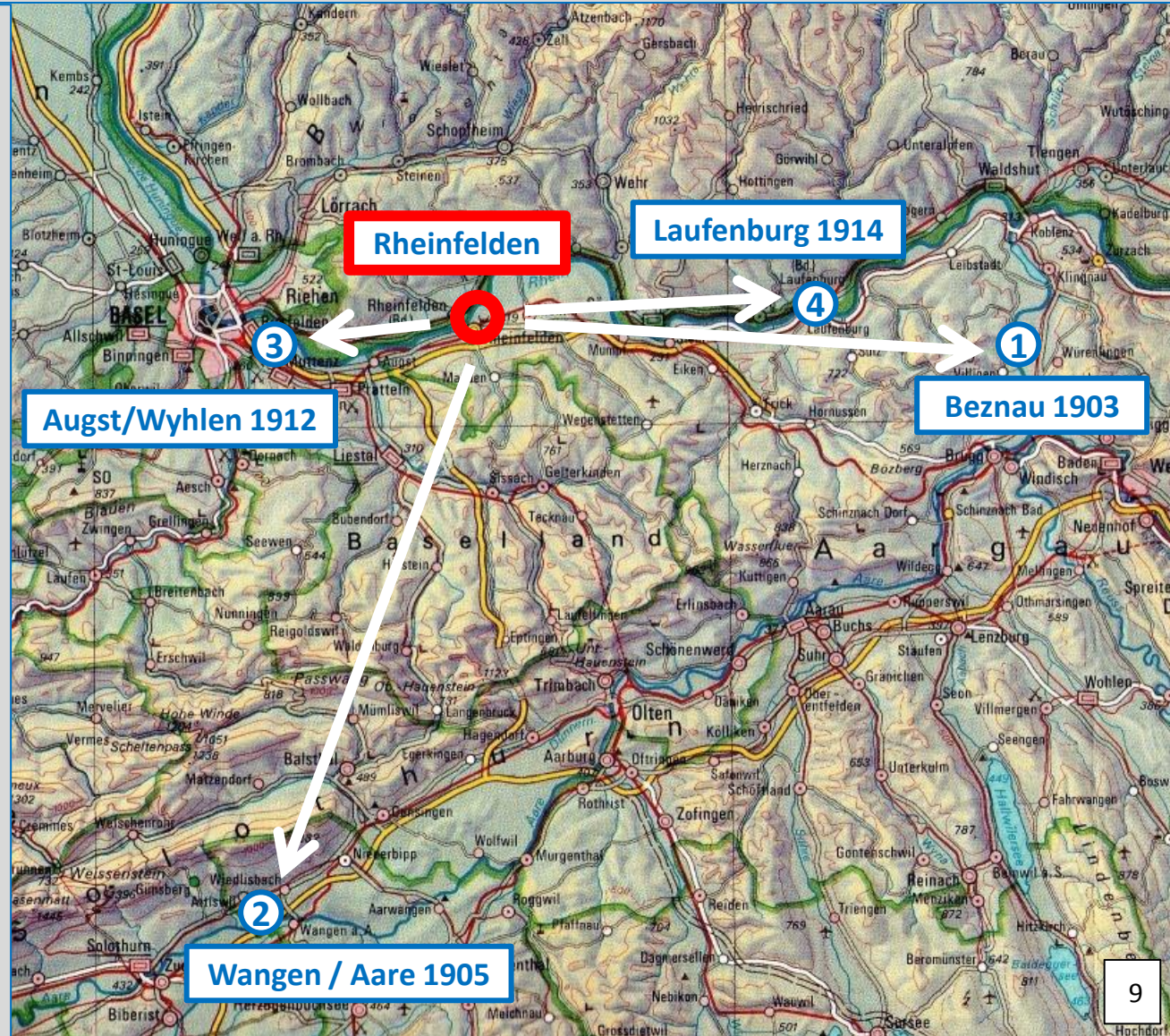
**2) Wangen / Aare 1905**

**3) Augst / Wyhlen 1912**

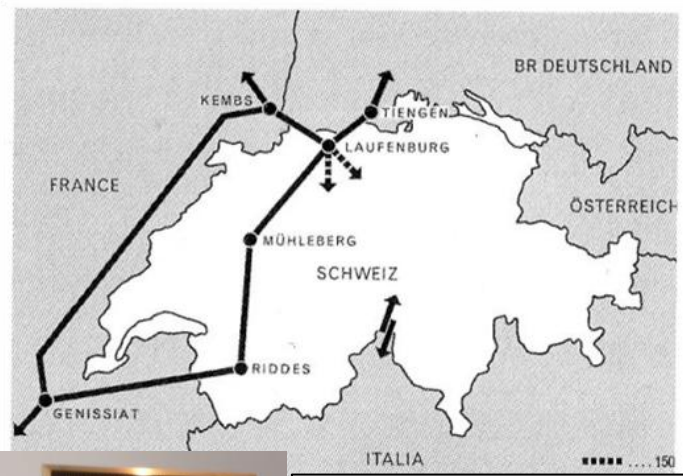
**4) Laufenburg 1914**

...

...



## Joint operation with other power stations ...



*In 1958  
the French,  
German  
and Swiss  
220-kV  
networks  
were  
interconnected*



**IEEE Milestone 2010:  
Star of Laufenburg  
Interconnection, 1958**



*... Rheinfelden:  
Nucleus of the  
continental European  
interconnected network*



The Rheinfelden power plant scenery in 2008

New power plant  
for operation from 2010

Original power plant  
operated 1898–2010

# The Rheinfelden power plant scenery in 2014

New power plant  
in operation since 2010



← ↑  
Fish ascent and  
spawning waters



↑  
Exhibition pavilion and  
Milestone plaque site

## Photo credits

- Foil 1 Henri Leuzinger Rheinfelden
- Foil 2,3,4 Deutsches Technikmuseum Berlin DTMB, AEG-Archiv: Rheinfelden (background) Archives ABB Switzerland: Lauffen Archives Siemens Switzerland: Wynau DTMB: Rheinfelden
- Foil 11,12 Energiedienst Holding AG Rheinfelden

