C·A·C

ALWAYS AN IDEA AHEAD

PRACTICAL EXPERIENCE

CONVERSION PROJECTS FROM Hg- to Mem- ELECTROLYSIS TECHNOLOGY

CloroSur 2022

COSTA DO SAUÍPE

PRACTICAL EXPERIENCE

CONVERSION PROJECTS FROM Hg- to Mem- ELECTROLYSIS TECHNOLOGY






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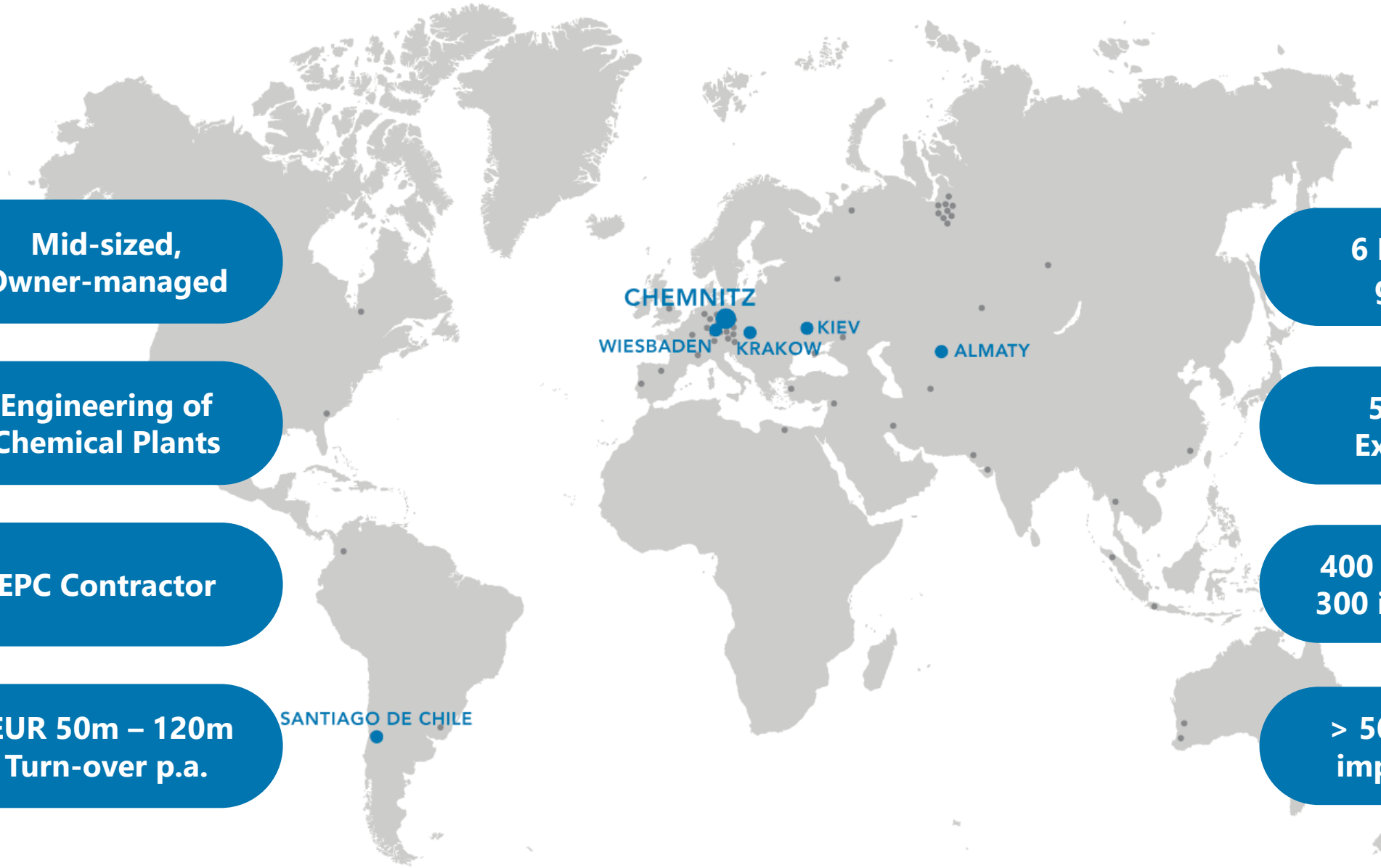
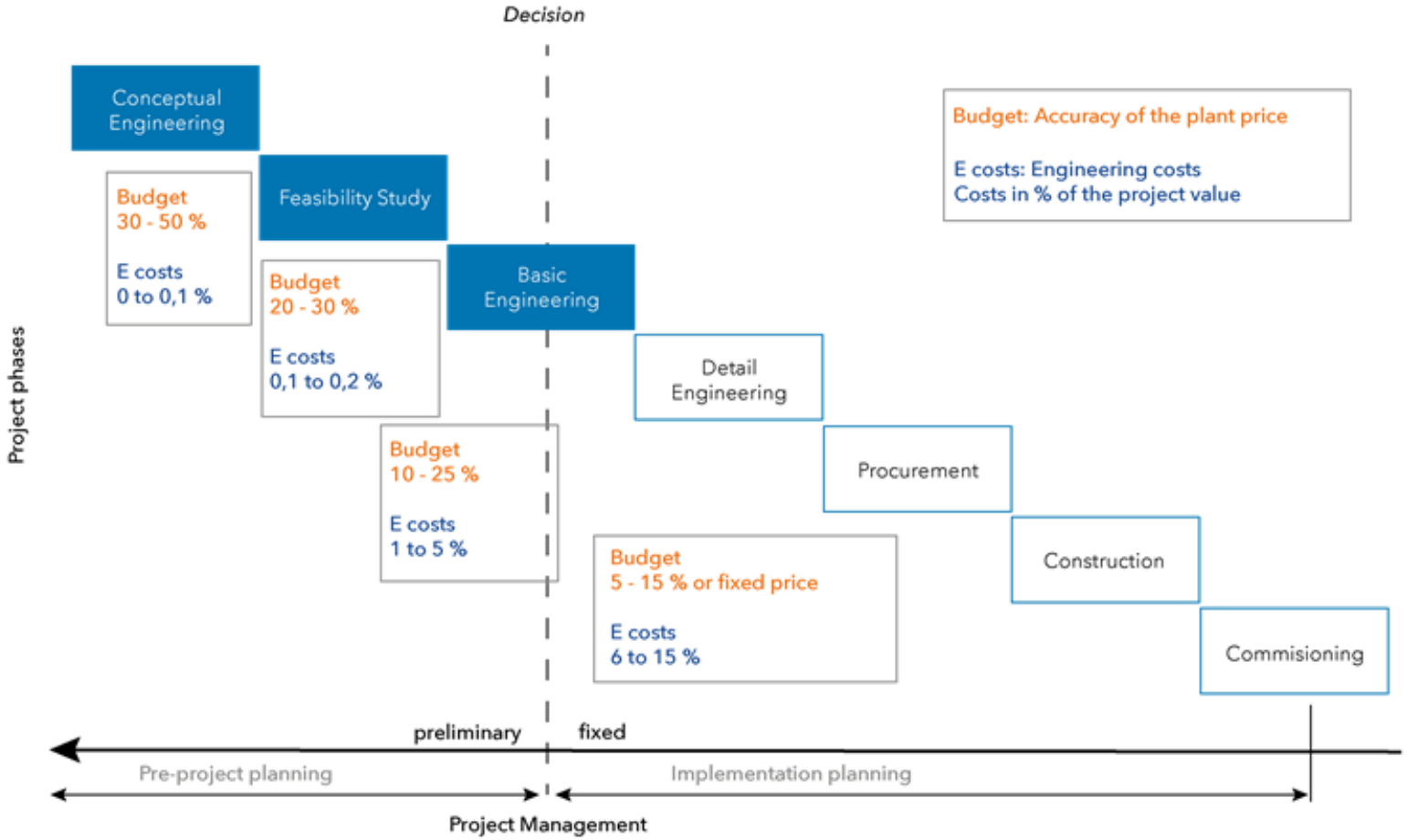
Overview



- Mid-sized, Owner-managed
- Engineering of Chemical Plants
- EPC Contractor
- EUR 50m – 120m Turn-over p.a.
- 6 Locations globally
- 55 years' Experience
- 400 Employees, 300 in Chemnitz
- > 500 Projects implemented

Service Portfolio

- Feasibility Studies
- FEED
- Basic and Detail Engineering
- Project Management
- Authority Engineering



- Financial Engineering
- International Purchasing & Contracting
- Provision of Technology
- Construction Management
- Commissioning

Major Targeted Industries & Market Segments

Chlor-Alkali Solutions

- Brine Treatment
- Electrolysis
- Chlorine Treatment
- Ferric Chloride
- Polyaluminium Chloride

(Green) Power-to-X Solutions

- Water Electrolysis
- eMethanol
- CO_2 Recovery
- Synthetic Fuels / eFuels
  -- Methanol to Fuel
  -- Methanol to Jetfuel

Hydrocarbon Solutions

- Refinery Technologies
- Expandable Polystyrene
- Butadiene
- Maleic Anhydride
- Cumene
- Natural Gas Underground Storage
- Gas Compressor Station

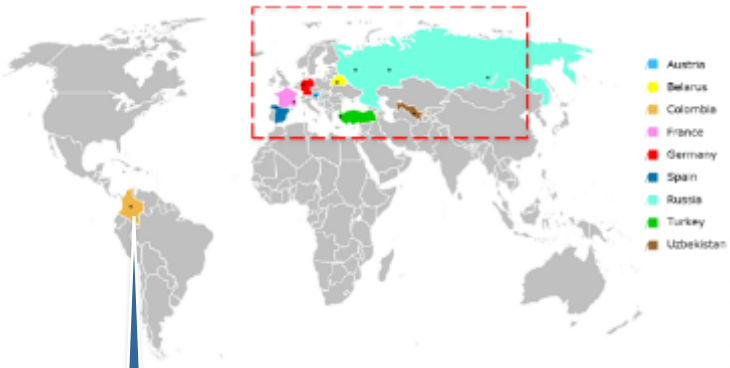
Chemical Solutions

- Sulphuric Acid
- Production Facilities for Catalysts and Intermediate Products
- Other Batch and Multipurpose Plants
- Nitrogen derivatives

Milestones of CAC in Chlorine Business

1st chlorine plant	**1964**	1st chlorine alkali electrolysis (mercury) built for BASF AG, Germany
1st Membrane Electrolysis	**1983**	1st chlorine plant (membrane) built for United Srichai Chemicals, Thailand
# of C-A plants implemented	**2000 - Today**	11 projects in 9 countries 8 conversions projects Running Capacity 650.000 t/a Cl2 > 30 projects in Cl2 industry

CAC's proven track record in the Chlor-Alkali Industry



2. Conversion from Mercury to Membrane






Membrane vs. Mercury process - Advantages

- **Environmental impact & improvements**
  - Complete reduction of the mercury emissions to the air
  - Exclusion of contamination of mercury to the soil
  - No waste water and waste disposal contaminated with mercury

- **Significant reduction of electrical power consumption – up to 30% less!**

- **Essential savings of operational costs due to:**
  - No further mercury treatment & disposal required
  - Up to 50% less operational staff required
  - Less maintenance costs

Re-usable Equipment

Possible

- ✓ Salt dissolver, tanks, heat exchangers
- ✓ Gas treatment sections (coolers, drying towers, blowers, compressors...)
- ✓ Filters and columns: usually too big, but no problem (more retention time)

Possible but Not Recommended

- X Pumps: not recommended – especially brine pumps are usually too big
- X Transformer/rectifier: not recommended – different requirements for current & voltage

Based on our experienced...

- Equipment & piping have to be checked carefully
- Cleaning of filters, tanks, pumps etc. has to be done properly with water or with diluted hypo solution
- Check for elementary mercury at low points
- Additional equipment to protect electrolyzer

Location for the conversion

New equipment can be installed:

- Greenfield, next to old plant
- In old building → re-use cell room after decontamination

Decontamination (EuroChlor TSEM 05/311, TSEM 11/378, TSEM 11/389):

- Mercury is everywhere → concrete structure & ground need to be removed or not touched at all
- Sand should not be brought back in place → to be removed & decontaminated
- Protective equipment, cleaning and hygiene is of high importance (TSEM 05/305 Housekeeping Do´s and Don't´s)

Space requirements:

- Membrane electrolysers require higher cell room
- Space required underneath membrane electrolysers

3. Selected conversion projects and experiences






Bondalti Cantabria S.A. (Member of Bondalti Group, Portugal)

Location: Torrelavega, Spain

Plant: Chlor-Alkali Electrolysis

Capacity: 65,000 t/y Chlorine
72,000 t/y Caustic Soda

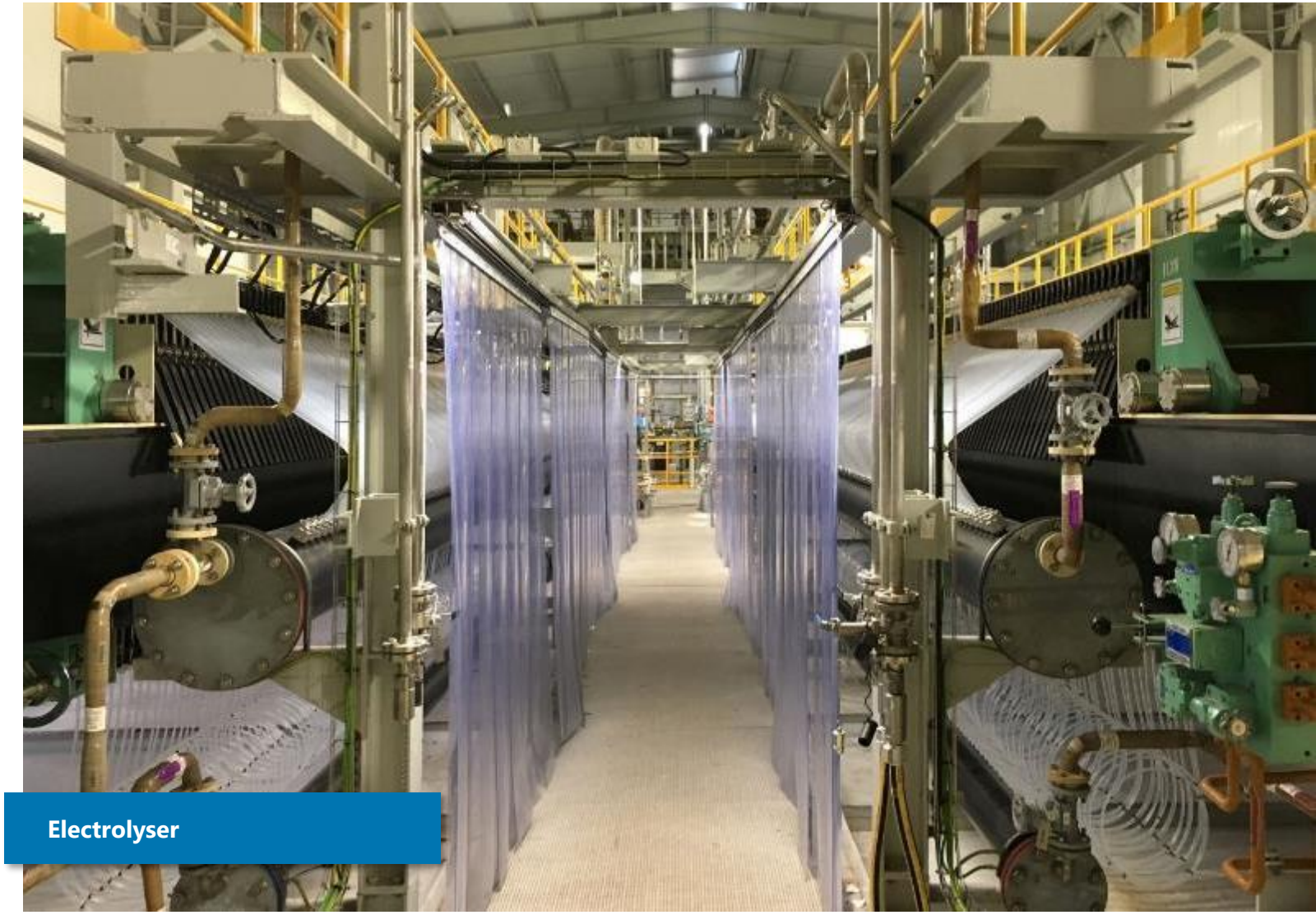
Contract type: EPC

Services:

- Project Management
- Basic and Detail Engineering
- Procurement and Supplies
- Construction Management
- Construction
- Commissioning and Start-up Assistance
- Training

Project Completion: 2020

Electrolyser Technology:
Asahi Kasei Corporation, JPN



Electrolyser

Neolyse Ibbenbüren GmbH

(Production Joint Venture between Nouryon/Akzo Nobel Industrial Chemicals GmbH and Evonik AG)

Location: Ibbenbüren, Uffeln, Germany

Plant: Chlor-Alkali Electrolysis

Capacity: 130,000 t/y Caustic Potash
82,000 t/y Chlorine

Services:

- Project Management
- Basic and Detail Engineering
- Procurement Services
- Construction Management
- Commissioning and Start-up Assistance
- Training

Project Completion: 2017

Electrolyser Technology: Asahi Kasei Corporation, JPN

Neolyse – Location

Brinsa S.A.

Location: Zipaquirá, Republic of Columbia

Plant: Conversion of the existing Chlor-Alkali Electrolysis

Capacity: 29,600 t/y Caustic Soda
27,100 t/y Chlorine

Services:

- Project Management
- Basic and Detail Engineering
- Procurement and Supplies
- Construction Supervision Assistance
- Commissioning and Start-up Assistance
- Training

Project Completion: 2017

Electrolyser Technology:
Chlorine Engineers Corporation, JPN

Revamp of the existing Chlor-Alkali Electrolysis

Potasse et Produits Chimiques SAS

Location: Thann, France

Plant: Chlor-Alkali Electrolysis / Bromine Recovery Unit

Capacity: 68,400 t/y Caustic Potash
43,200 t/y Chlorine
4,000 t/y Bromine

Contract type: EPC

Services:

- Project Management
- Basic and Detail Engineering
- Procurement and Supplies
- Construction Management
- Construction
- Commissioning and Start-up Assistance
- Training

Project Completion: 2016

Electrolyser Technology: Chlorine Engineers Corporation, JPN

Cellroom – Electrolyser Section

Parallel operation of Hg & Mb electrolysis

Advantage: minimise downtime by establishing

- one combined brine loop for treatment of brine to/from Hg electrolysis as well as membrane electrolysis and
- proper tie-in points for common product handling

Disadvantages:

- requires more time for planning and establishing of tie-in points
- possibly creates unwanted interferences from one system to the other (e.g. back pressure, interlocks, Hg contamination...)
- requires additional step(s) for removal of mercury (precipitation and/or ion exchanger)

Separation of contaminated area

Example:

wooden wall for separation of Hg electrolysers (in operation) and construction site

JSC Sayanskchimplast

Location: Sayansk, Russia
Plant: Chlor-Alkali Electrolysis
Phase 1: Conversion
Phase 2: Expansion

Capacity: 169,000 t/y Caustic Soda
150,000 t/y Chlorine (Phase 1)
180,000 t/y Chlorine (Phase 2)

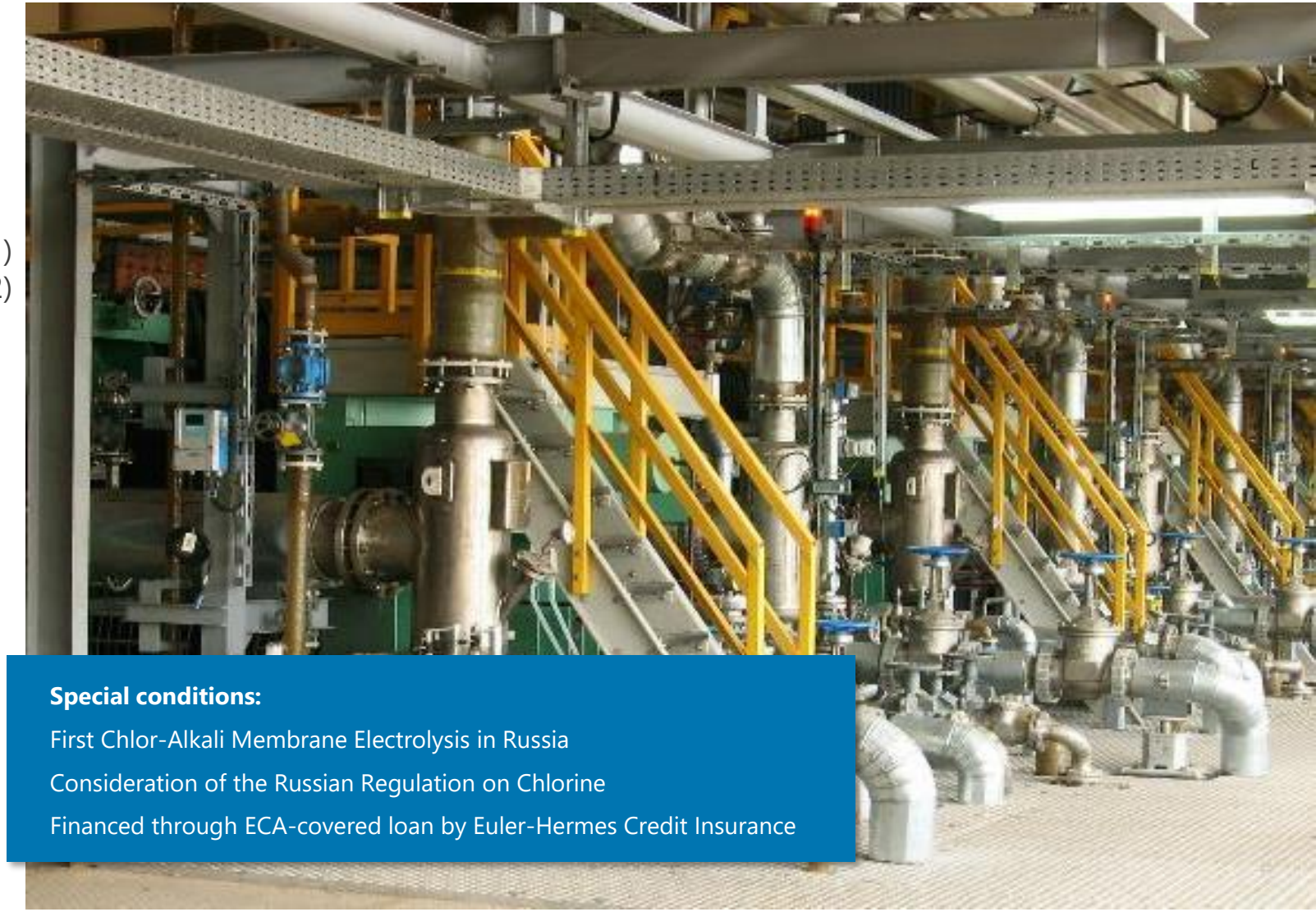
Completion: **Phase 1**: 2006
Phase 2: 2013

Services:

- Project Management
- Extended Basic and Detail Engineering
- Design specification for civil works, steel structure, HVAC
- Procurement and Supplies
- Construction Supervision Assistance
- Commissioning and Start-up Assistance
- Training

Electrolyser Technology:

Asahi Kasei Corporation, JPN



Special conditions:

First Chlor-Alkali Membrane Electrolysis in Russia

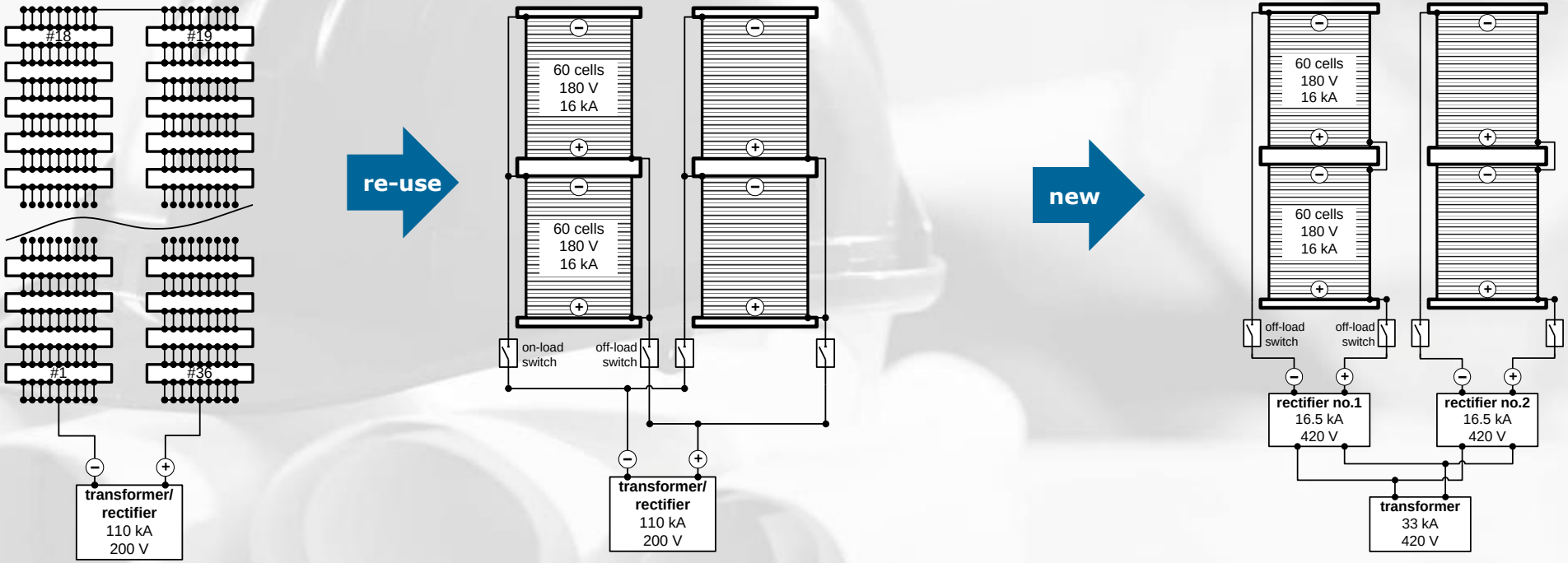
Consideration of the Russian Regulation on Chlorine

Financed through ECA-covered loan by Euler-Hermes Credit Insurance

Re-use of equipment: Transformer / Rectifier

- Lower Capex
- Less Operational Flexilibity - Maintenance

- Traditionally Hg electrolysis requires relatively high current and low voltage
- Area of membrane cells is smaller and current density is smaller than in Hg cells
- More cells connected in series – resulting in higher overall voltages



Donau-Chemie Expansion Project

Location: Brückl, Austria

Plant: Expansion of the existing Chlor-Alkali Electrolysis

Capacity: 35,700 t/y Caustic Soda
31,600 t/y Chlorine

Services:

- Project Management
- Extended Basic Engineering
- Detail Engineering
- Procurement and Supplies
- Construction Management
- Commissioning and Start-up Assistance
- Training

Project Completion: 2015

Electrolyser Technology: Asahi Kasei Corporation, JPN

Chlor-Alkali Electrolysis

Conclusion & Summary

Conversion from Hg- to Membrane Electrolysis Technology

- Conversion from mercury to membrane technology is beneficial in terms of operating costs and from environmental point of view
- Re use of equipment after decontamination to reduce investment costs
  - Cell room building
  - Brine treatment equipment
  - Transformer rectifier
  - Evaluation and scheduling
- CAC´s experience shows alternative solutions depending on each clients specific conditions.

MUCHAS GRACIAS

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THANK YOU

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