

A cluster of water droplets of various sizes, some overlapping, set against a light blue background. The droplets are rendered with realistic highlights and shadows, giving them a three-dimensional appearance.

# EMF in industrial activities

## Electrolysis units

JEAN-POL DEBELLE

October 7, 2009

# Structure of the presentation

- Introduction
  - Electrolysis processes
  - Electrolysis equipment ... and cells room
  - Electrolysis processes and EMF (types and frequencies)
- Problems arising from the Directive 2004/40/EC
  - Impact of EMF on electrolysis workers?
  - Impact of the limits defined in the Directive
  - Consequences
- Possible improvements of the Directive
  - Action of our industry
  - Position versus proposed options



# Introduction

# Electrolysis processes

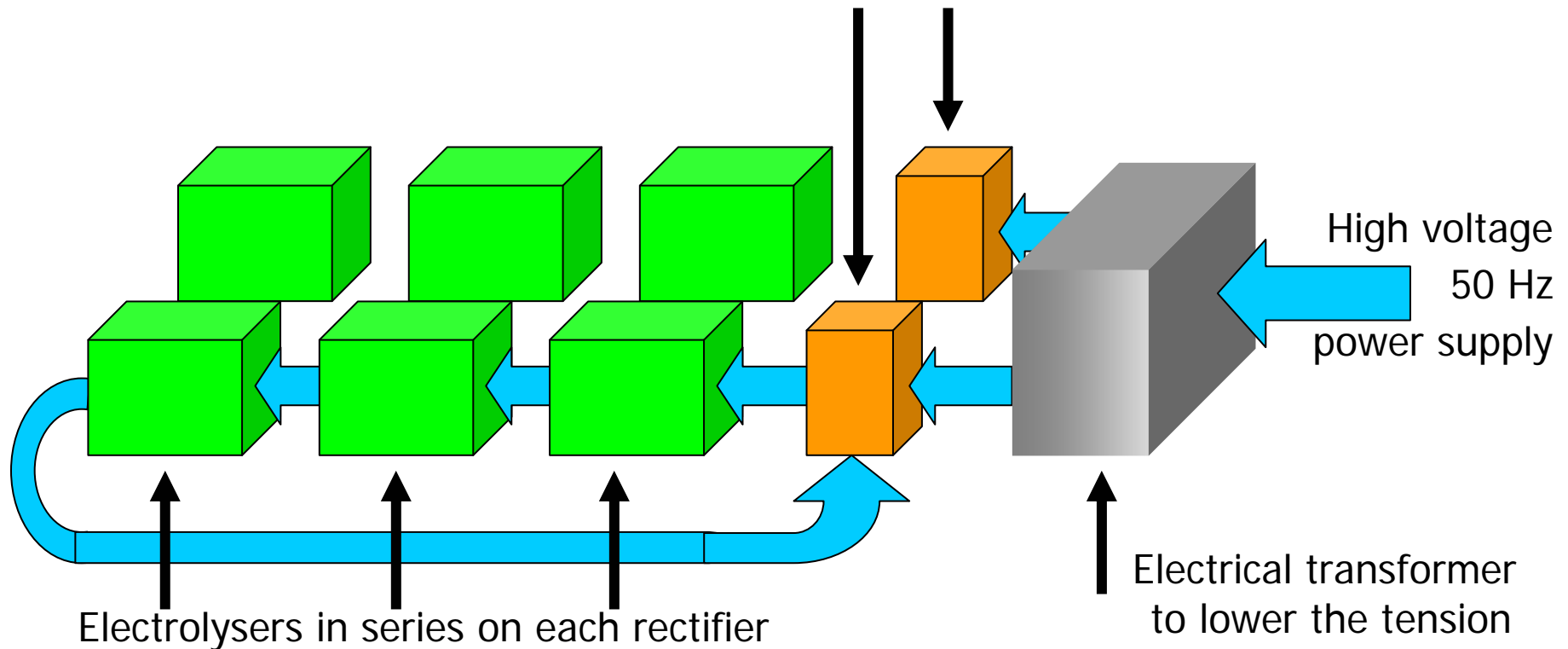
- Electrolysis industry:
  - Using electricity to “split” molecules and produce aluminium, magnesium, sodium ... and chlorine
  - Basis industries deserving many different downstream producers
  - More than 30 aluminium and 80 chlorine units in Europe ... (about 3 to 4000 persons “exposed” to EMF ?)
- Other electrochemical processes using continuous high electric current are not considered here (electro-refining, electro-plating ...)

## Electrolysis equipment ...

- Electrolysis cell = a couple of electrodes immersed in the chemical bath (one of the electrodes can be constituted of several elements in parallel)
- An electrolyser can be composed of one or several cells, connected in series or in parallel on the electric current
- Several electrolysers are connected (in series or in parallel) on a electricity supply unit (transformer/rectifier)

## ... and cells room

Rectifiers to produce direct (continuous) high electrical current



Several similar groups in one building (several tens of meters dimension)

# Example of cell room in aluminium industry



# Example of cell room in chlorine industry



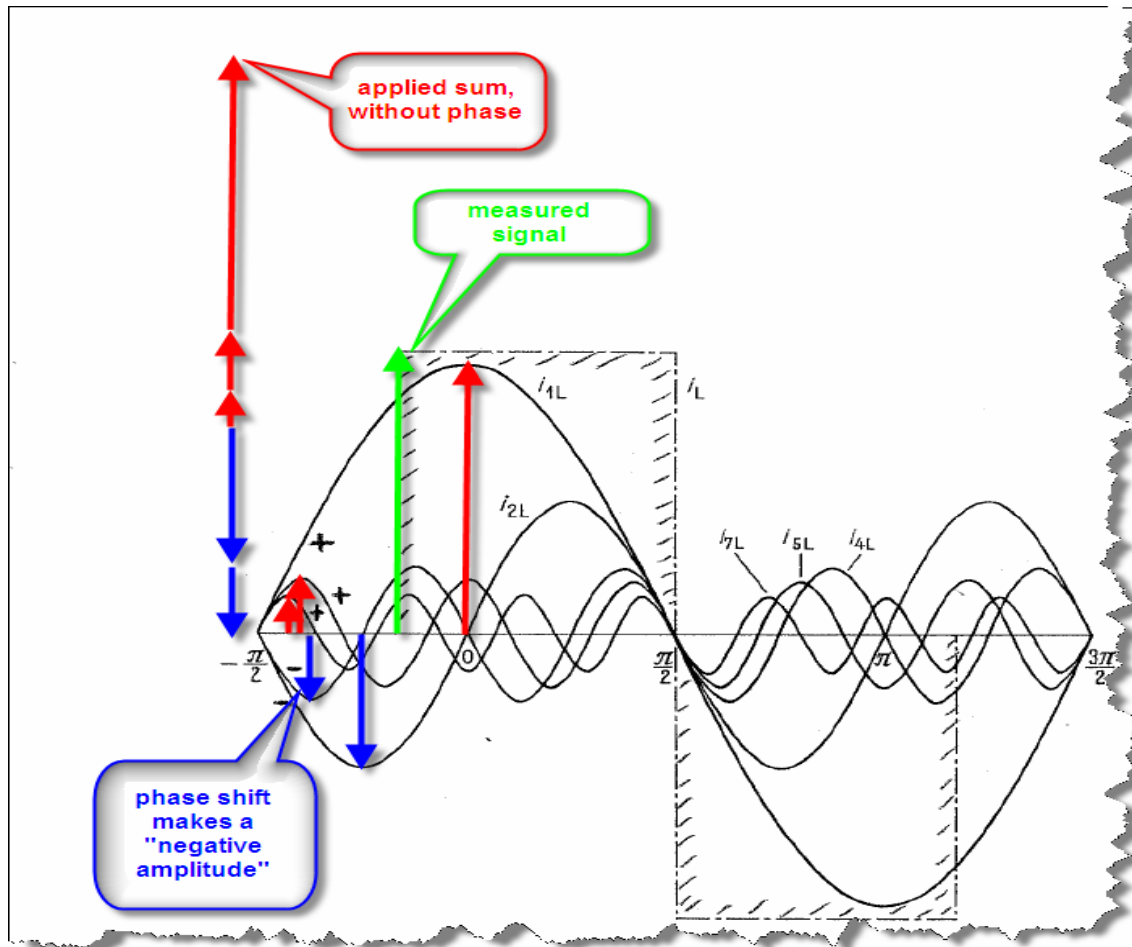
## Electrolysis processes and EMF (types)

- Necessary electrical energy produced by transforming and rectifying high voltage / low intensity power supply (several thousand of Volts, 50 Hz) to give
  - Relatively low tension (some hundreds of Volts)
    - ⇒ low electric field
  - Several continuous current circuits in parallel, with very high intensities (several 10 000 or 100 000 Amperes)
    - ⇒ high static magnetic field

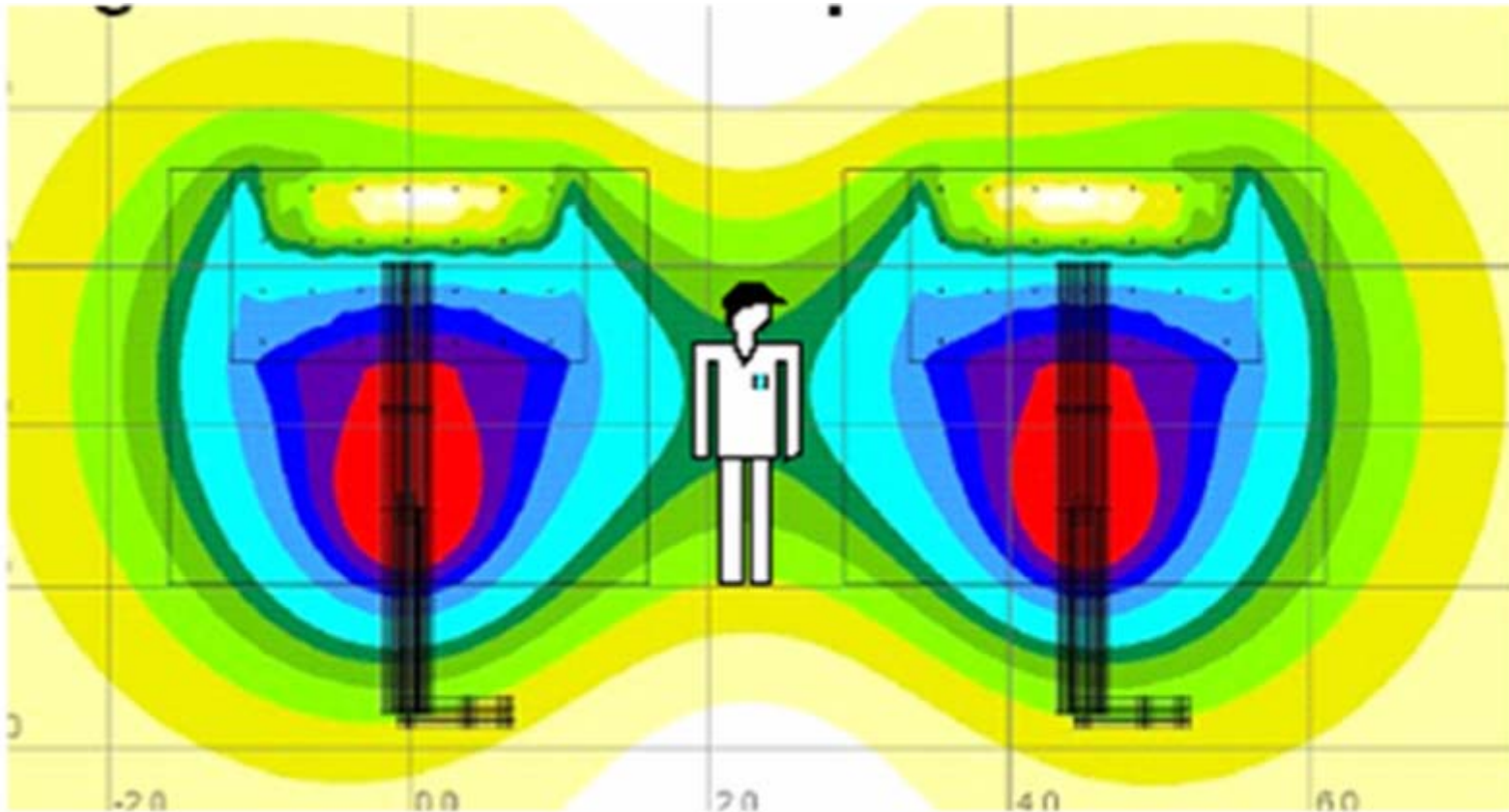
# Electrolysis processes and EMF (frequencies)

- A basic static field, with an additional time-varying field because
  - The supplied alternating current is not purely sinusoidal
  - The rectification process is not perfect
- But, the frequency range concerned is limited to a few 1000 Hz maximum, with peaks usually multiples of 300 Hz (50 Hz x 6 from rectification process)

# EMF in electrolysis units



# Exposure to EMF in electrolysis unit



A graphic of a water splash with many bubbles, rendered in shades of blue, set against a light blue background. The splash is centered in the upper half of the slide.

# Problems arising from the Directive 2004/40/EC

# Impact of EMF on electrolysis workers?

More than 100 years of production and


- Epidemiological studies in electrolyses made for other purposes (chlorine, mercury in the chlor-alkali) showed no evidence of EMF adverse health effects
- Similar studies in aluminium smelters shows no evidence of adverse health effects linked to EMF exposure
- No links observed between EMF and any adverse effects on worker's health

## Impact of the limits defined in the Directive

- Exposure limits include **ALL** effects; only adverse risks should be considered
- Too high safety factor taken to define action values (especially for very low frequencies)
  - These “triggering” levels are over-protective (too rapidly reached)
    - ⇒ **very heavy tools** (assessments via models...) to demonstrate we are not above the exposure limits
- There exists no personal protective equipment for use against the very low frequencies EMF

# Consequences

- The strict application of the existing Directive would lead to
  - Implementation of costly technical (and organisational) measures in several cases (including heavy investments and/or process shut down to allow access to some areas)
  - Threat from non-European plants that are not limited in current (productivity)
  
- Without any known health benefits

A dynamic splash of water droplets in various sizes, rendered in shades of blue and teal, set against a light blue background. The splash is positioned in the upper left quadrant of the slide.

# Possible improvements of the Directive

## Actions of our industry (1)

- Analysis of the scientific literature and check the possible implications for our industry (publication of a “FOCS”)
- Realisation of measurements in production units
- Redaction of a technical guideline sharing the experiences to recommend the best practices

## Actions of our industry (2)

- Collaboration with Cenelec to define an appropriate measurement standard
  - Have a realistic evaluation method (taking into account the correlations between harmonics: time domain analysis)
  - Insure a level playing field (common methodology)
- Collaboration with BusinessEurope to propose improvements to the Directive
  - Ask for realistic exposure limits and action values
  - Propose realistic reference values to limit the unnecessary burden of complicated assessments
  - Introduce “zoning” for trained personnel

## Position versus proposed options

- A binding European directive will facilitate aligning the countries' policies
- The existing directive needs to be updated and improved on several points
  - Reasonable protection level kept
  - But avoid excessive burden from unnecessary assessments
  - Review exposure and action values and avoid unnecessary safety factors where no adverse health effects can be documented



Thank you very much  
for your attention

JEAN-POL DEBELLE