Workshop on Mercury Management
Almaden 2013

Decommissioning planning and management in the chlorine- alkali industry

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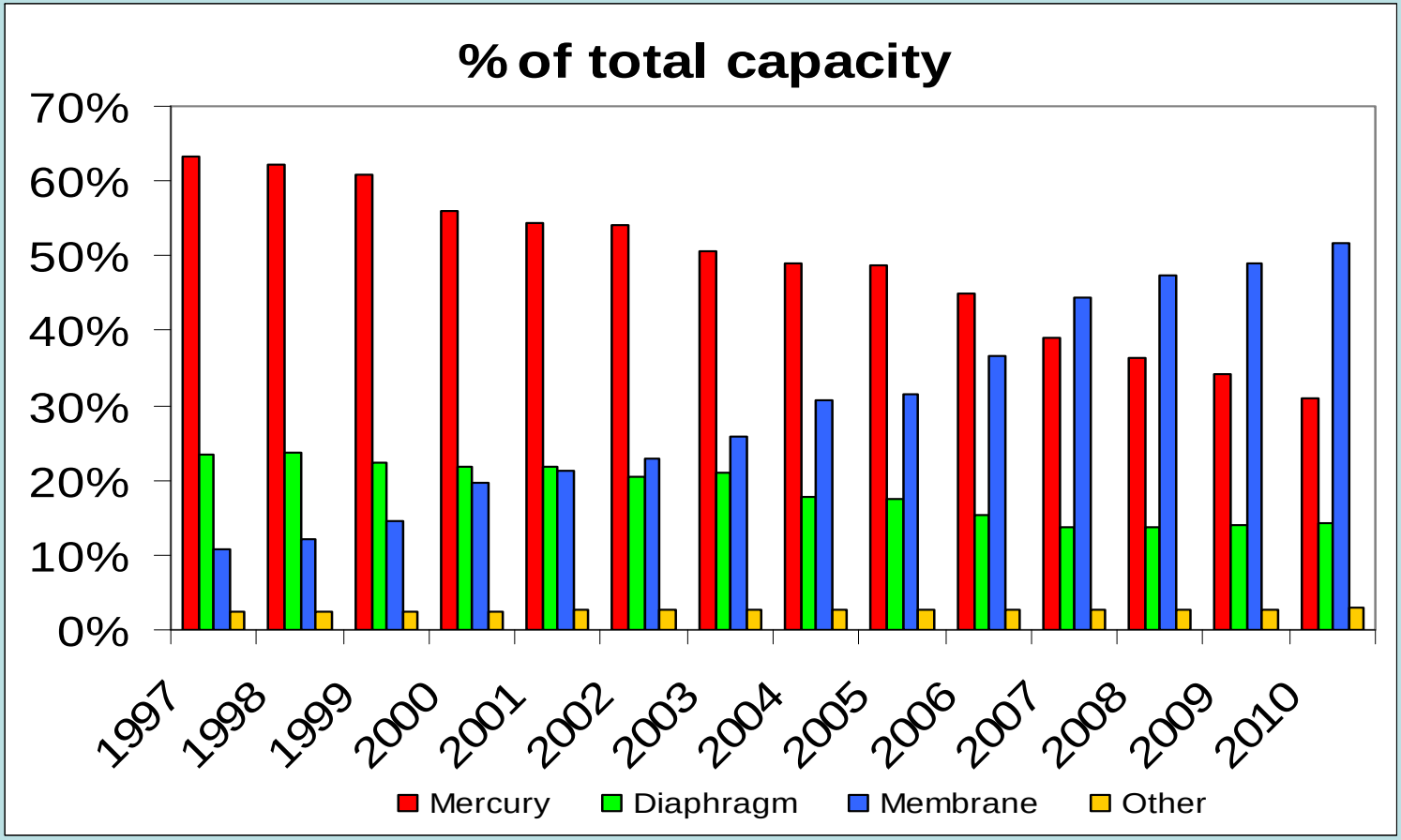
INTRODUCTION

- **Commitment of the European chlor-alkali industry to shut down cell rooms using Hg cell technology by 2020 (at the latest)**
  - Mercury based capacity represents today ~30% of the total chlorine production capacity.
  - Beginning of 2013, still 31 chlorine cell rooms using mercury cell technology in Europe.

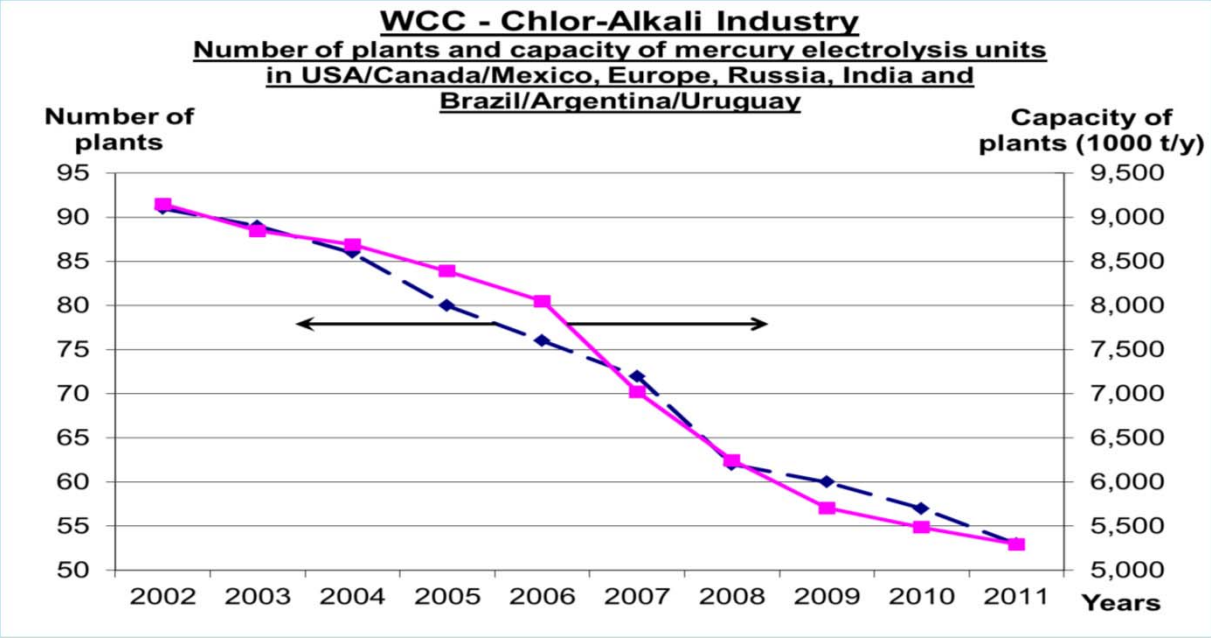
- **In some of the EU countries, strong pressure to speed up the shut down :**
  - National or regional legislations (interdiction of technology or limitation of emissions)
  - Local permits

INTRODUCTION
Manufacturing Processes EUROCHLOR 1997 - 2011



Conversion mercury cells

- **Eurochlor document of reference**
  - Conversion from Mercury to Alternative Technology in the Chlor-Alkali Industry (updated June 2012) .
  - World chlorine production capacity in mercury plants (WCC 2002-10)



Factors influencing conversion

- **Energy prices and efficiency**
  - Membrane cells consuming less electrical energy, but consuming steam for caustic concentration.
- **Production capacity**
  - If the market demand more production, membrane installation or conversion can be the opportunity
  - Selection of current density : lower density requires more electrolysers
- **Product quality**
  - Membrane needs a higher quality of brine
  - Chlorine membrane has lower quality
  - Caustic need to be concentrate
- **Market conditions**

Investment and payback

In 2008 Prochemics, an independent consultant company made a study for Eurochlor to evaluate the conversion costs, taking to account data of 2007.

Recently UNEP article about this theme :

Story of the month - August 2012 :**Converting to a Cost-Effective Mercury Free Technology in the Chlor-Alkali Industry**

- **To convert an existent mercury plant into membrane**
  - **New electrolysers**
  - **Replacement or adapt rectifiers**
  - **Purification brine**
  - **Caustic concentration**
- **Cost**
  - **Cost 550- 700 USd/ton capacity**
  - **Time schedule for conversion: 18 – 24 months**
  - **Pay back: 10 – 14 years**

SOLVAY EXPERIENCE

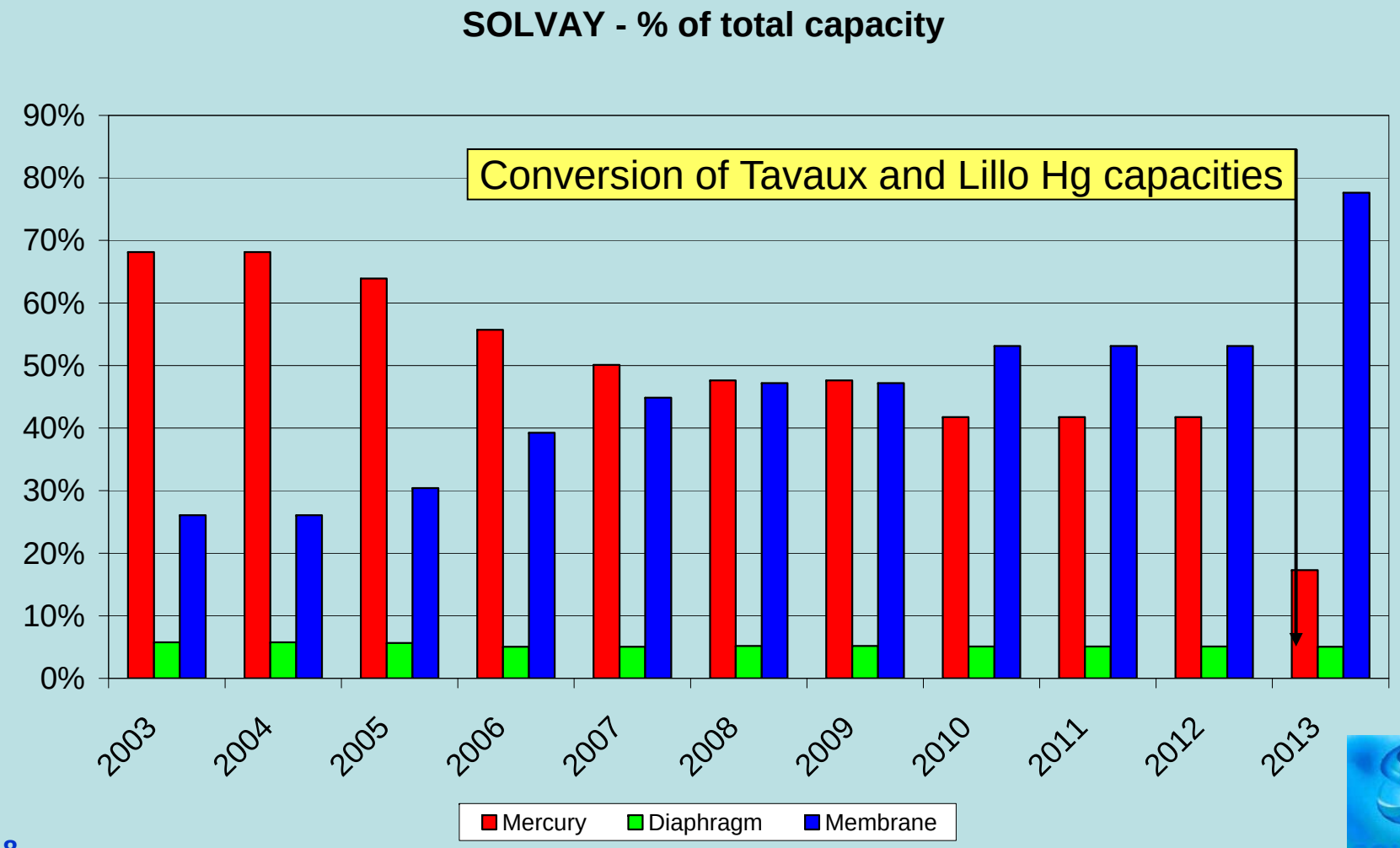
- SOLVAY plants around the world (at 01.01.2013)
  - 13 plants, more than 2 Mt Cl_2/y
  - 4 plants with mercury technology (2 in Spain + 1 in Belgium + 1 in Argentine)

- SOLVAY Mercury plants conversion (2006 – 2011) :
  - 2006 - Rosignano (I)
    - 1 cellroom – 120 ktCl_2/y
  - 2007 : Bussi (I)
    - 1 cellroom – 80 ktCl_2/y
  - 2009 : Santo André (BR)
    - 4 cellrooms – 106 ktCl_2/y

- SOLVAY Mercury plants conversion projects
  - Lillo (B) : 2012 (done 02/12/12)
    - 1 cellroom – 180 ktCl_2/y
  - Tavaux (F) : 2012 (in execution)
    - 2 cellrooms – 240 ktCl_2/y

INTRODUCTION

Manufacturing Processes SOLVAY 2003 - 2013



Focus of the presentation

- Reference documents to be used for preparing the decommissioning
- Management of decommissioning activities within Solvay
  - Central decommissioning project team (Hermes Project)
  - Local management in the plants
- Experience in Europe Rosignano plant to be transferred to Lillo and Tavaux plants. Experience in Brazil plant.
- Main lessons & highlights

Reference Documents

- EUROCHLOR :
  - Env. Prot. 3 – Guideline for Decommissioning of Mercury Chlor-Alkali Plants
  - Env. Prot. 19 – Guidelines for the preparation for permanent storage of metallic mercury above ground or in underground mines.
- LOCAL DOCUMENTS :
  - e.g. French S.H.D – “Protocole de démantèlement de salle d’électrolyse à cathode de mercure”
- COMPANY INTERNAL DOCUMENTS (if any)
  - Procedures
  - Chronogram, plans

Management of the decommissioning

- Solvay "Hermes Project"
  - Objectives :
    - Definition of the process to be followed for Hg cell rooms decommissioning in the Solvay Group
    - Preparing a technical database for Hg contaminated equipments.
  - Project Team
    - Project Leader "Process" (former Hg Cell room production manager)
    - Specialists of HSE and Corporate Purchasing Departments
    - Local Team on site for management of the decommissioning
  - Starting date : 2006

Decommissioning Management on site

- Early estimation of the different contaminated wastes to be disposed of, and definition of the equipments to be maintained in operation for Hg exposure concern.
  - SOLVAY experience : 1.000 to 6.000 t of contaminated materials per unit.
  - Contaminated materials (not exhaustive) :
    - Steal, other metals (Copper, Aluminium)
    - Mercury
    - Graphite, carbon
    - PVC, FRP, other plastics
    - “Hard Rubber” from rubber-lined equipments
    - Gaskets
    - Sand, sludge
    - Electrical equipments
    - Concrete, bricks
    - …

Decommissioning Management on site

- Definition of the treatment/disposal solutions for each contaminated equipment/waste, based on the techniques listed by the "Hermès team".
  - Provision of the containers for metallic mercury storage/transportation
  - Treatment/disposal solutions for each waste can depend on national regulation.
- Early discussions and ITB with subcontractors for dismantling activities.
  - Technical solution proposed for each type of waste
  - Solutions for disposal
- Well documented action plan for discussions with local authorities
- Definition of people management during dismantling
  - Needs (local, external)
  - Medical and environmental monitoring
- Cost control

Decommissioning Phases

- Phase 1 : Health and Safety preliminary actions
  - Emptying of the equipments (mercury, other fluids)
  - Cleaning of the different equipments, tightening, covering with water if needed.
  - Dismantling of non-Hg equipments (incl. anodes, cell covers,…)

  → Skilled people from the plant (e.g. people in charge of the operation of the Hg cell room)
- Phase 2 : Dismantling of the equipments
  - Dismantling of all the equipments, except equipments kept in operation for HSE concerns

  → Can be subcontracted if no skilled people available.
- Phase 3 : Dismantling of all remaining equipments
  - Electrical equipments
  - Treatment units,…

  → Subcontracted in the most of cases.

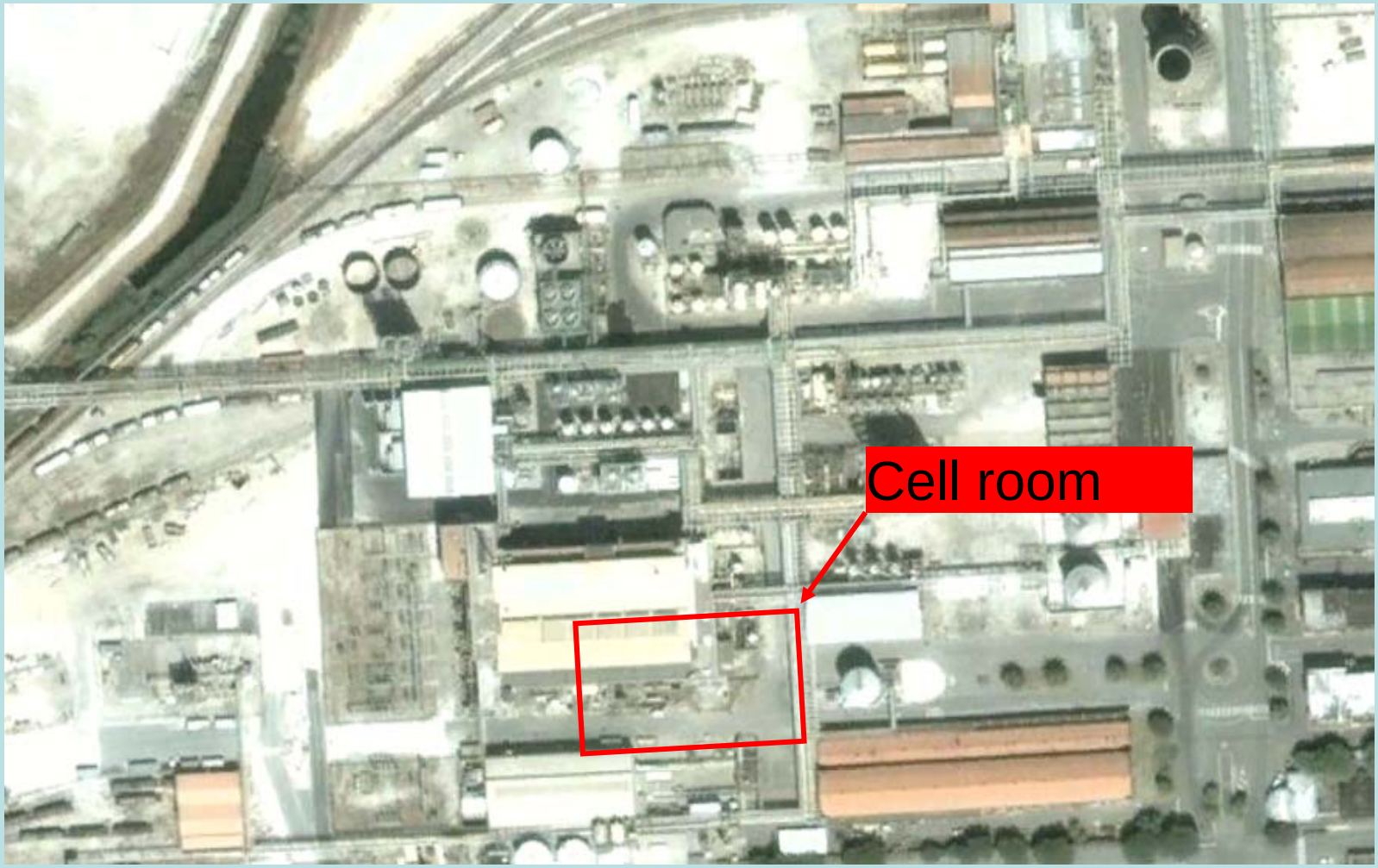
SOLVAY Rosignano (Italy)

SOLVAY Santo Andre (Brazil)

Rosignano - Main figures

- Mercury Cell room
  - Chlorine capacity : 120 kt/y
  - Number of cells : 50 of 30 m^2
- Decommissioning activities
  - Shut down : May 2007
  - End of Safety Preliminary actions : March 2008
  - Dismantling plan accepted by local authorities in August 2008.
  - End of dismantling activities : end 2009

Rosignano – Plant overview



Cellroom after the Health & Safety preliminary actions

Cells dismantling

Cells dismantling

Cell « confinement » for dismantling
(connected to air treatment unit)

Working area for safe handling of the contaminated equipments

Working area connected to Hg effluents treatment unit and regularly washed

Specific zone (connected to air treatment) for some Hg equipments dismantling

Floor of the cell room regularly washed

Santo Andre - Main figures

- Mercury Cell room
  - Chlorine capacity : 106 kt/y
  - Number of cells : 52 of 12 m^2 + 49 of 10 m^2
- Decommissioning activities
  - Shut down : February 2009
  - End of Safety Preliminary actions : December 2009
  - Dismantling plan accepted by local authorities: December 2008.
  - End of dismantling activities : end 2011

Cellroom dismantling phases

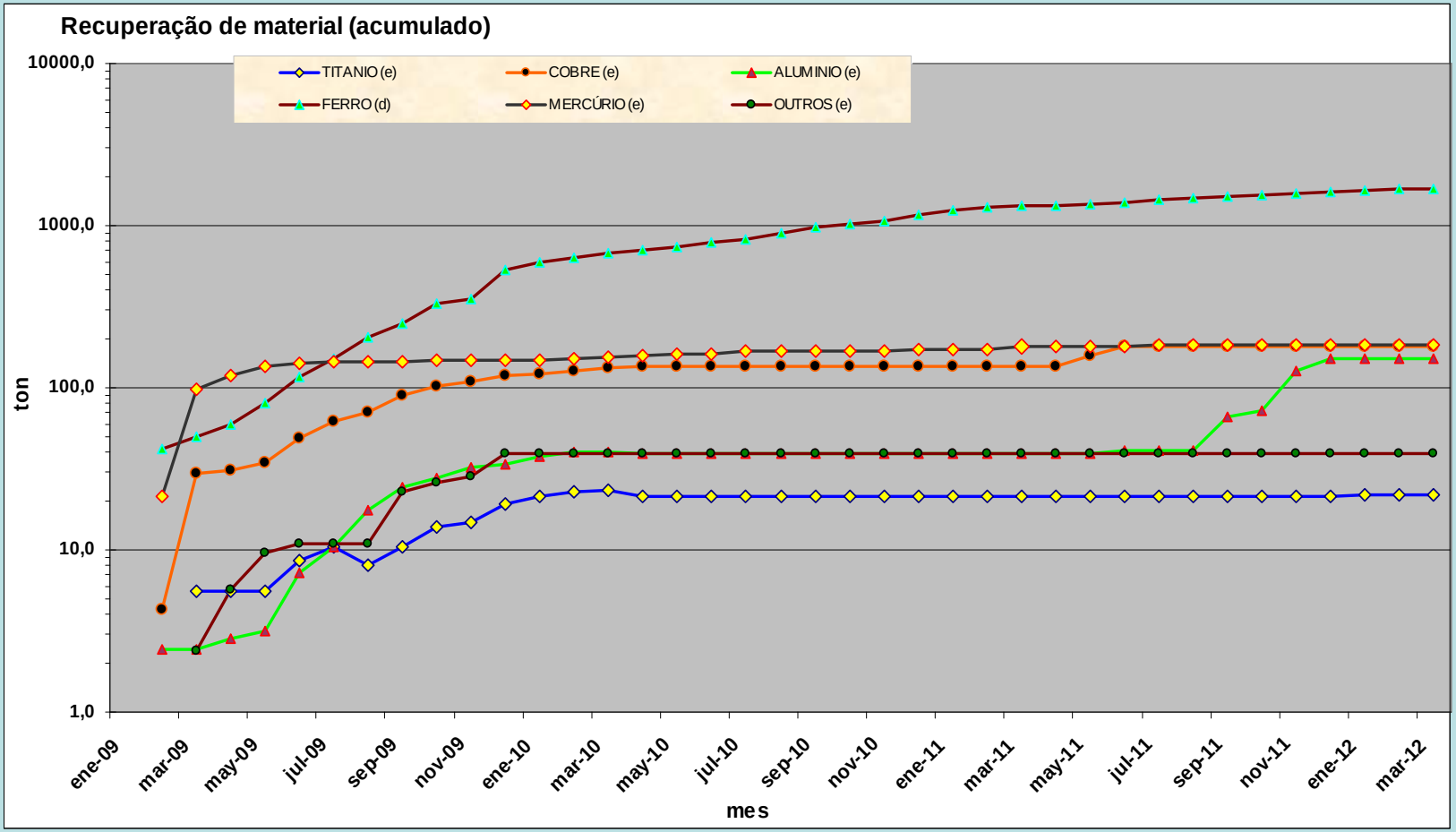

In process of Health & Safety action


End of Health & Safety action

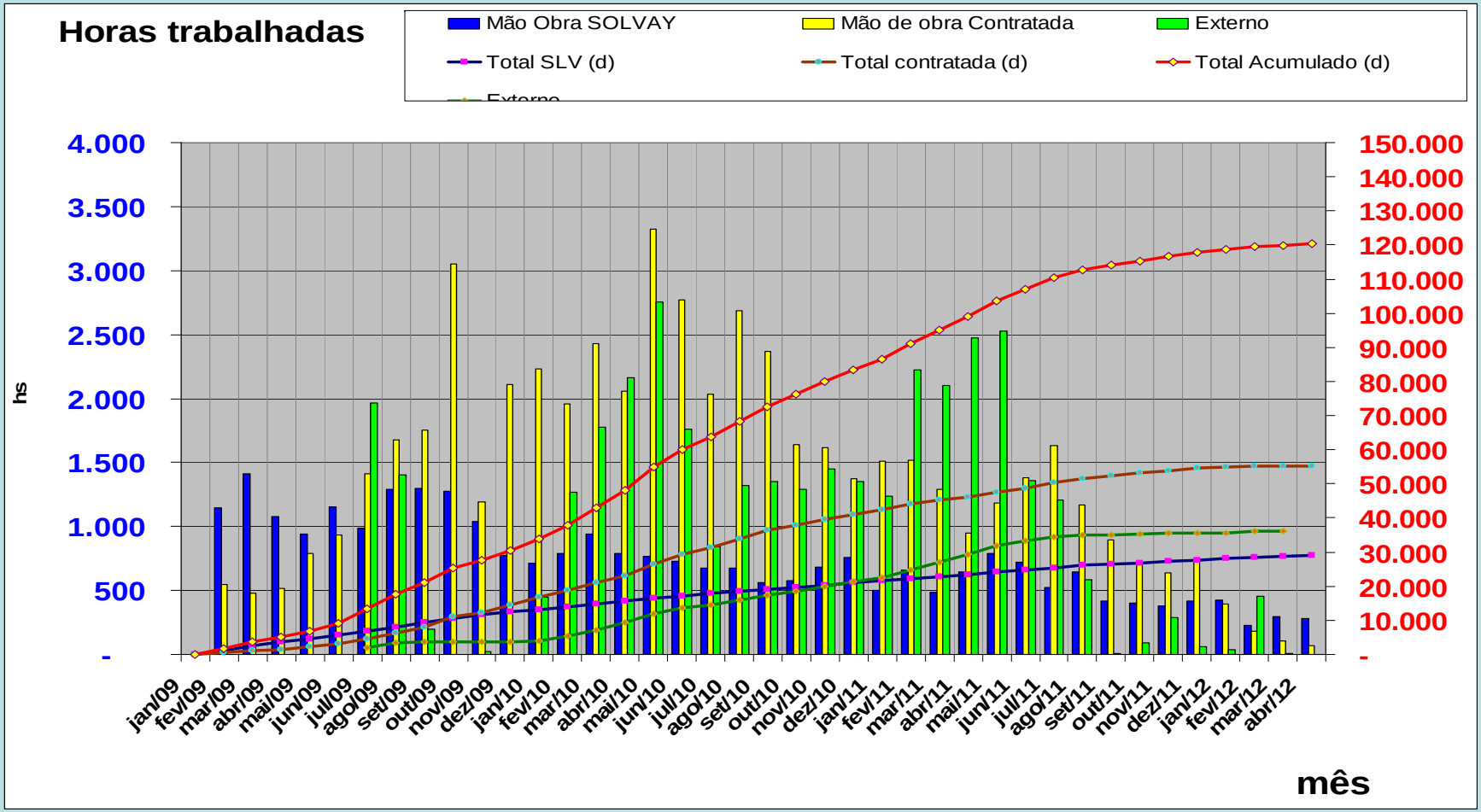

End of cells dismantling

Cell room after the Health & Safety preliminary actions

Material recuperation: example of tendency



Teams and time for dismantling



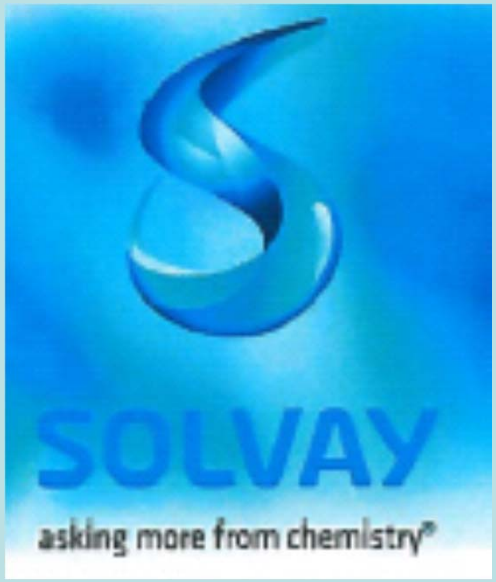
Main lessons & highlights

- **Decommissioning of a Hg cell room has to be managed as a specific project :**
  - **Dedicated project team**
  - **Project to be structured carefully**
  - **Study to be started at an early step**
    - **the Hg cell room shut-down strategy can affect the conversion start-up schedule - *in case of a conversion*)**
    - **Early definition of the equipments to be maintained in operation during decommissioning**
    - **List of contaminated equipments/wastes and treatment solutions to be prepared for further discussions with subcontractors and local authorities.**

Main lessons & highlights

- **Health of workers :**
  - Has to be considered at an early step (definition of the equipments to be maintained in operation for Health concerns)
  - Work with skilled people (e.g. from Hg cell room operation team) when possible, at least for safety preliminary actions.
  - Regular monitoring of Hg exposure (air and biomonitoring)

- **Key points :**
  - People engaged: internal and external (contractors)
  - Creativity and Innovative solutions.
  - Controls: to have indicators of evolution



Thank you for your attention

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