

UCC RUSAL

Innovative approaches to business in RUSAL

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and Industrial Safety*



UC RUSAL



More than 40 facilities of RUSAL in 13 countries, represent a complex of interrelated industrial facilities integrated into a single process chain.

The company has 72 000 employees.

Aluminium production (as of 2013):

- 15 facilities – 4,5 mil. t/year;
- 9% global production.

Alumina production:

- 11 facilities – 11,5 mil. t/year;
- 8% global production.

Home science and technology infrastructure:

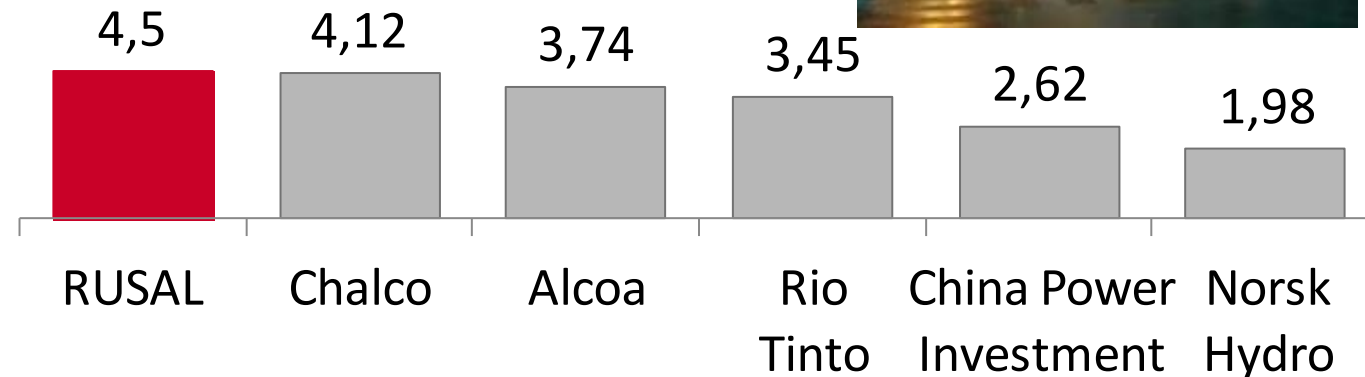
- RUSAL's Engineering and Technology Centre, National Aluminium-Magnesium Institute in Saint Petersburg and Irkutsk

Proprietary aluminium production technologies:

- RA-300, RA-400, RA-500 (under development), inert anode (under development).

Proprietary Alumina production technologies:

- Alumina production from bauxites, nephelines, alunites; kaolins (under development), processing of red mud (under development).



EFFECTIVE SYSTEM OF MANAGING INDUSTRIAL SAFETY



- ❑ Adherence to the industrial safety legislation
- ❑ Commitment to safe operation of the industrial equipment of all employees, starting from TOP managers
- ❑ Being up with best international practices in the field of industrial safety
- ❑ Proactive risk management in the field of industrial safety is stipulated in the Risk Management Regulation

Our objectives:

- Strive for the elimination of injuries and risk of accidents and fires
- Ensure the equipment as well as production technology comply with regulatory requirements of H&S and industrial and fire safety
- Ensure occupational safety and health of the personnel, continually improving working areas to increase the safety level
- Prevent occupational diseases

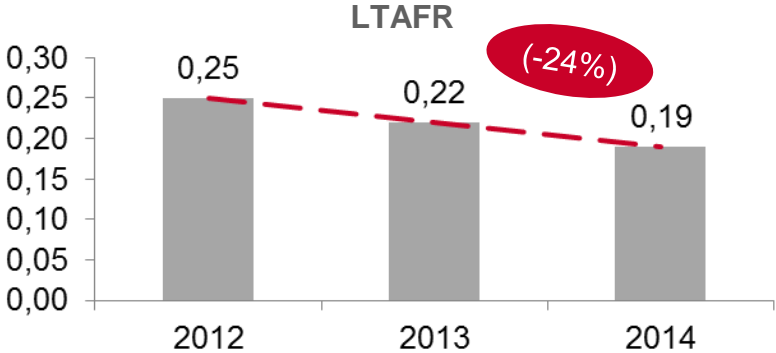


CONTINUOUS SAFETY IMPROVEMENTS



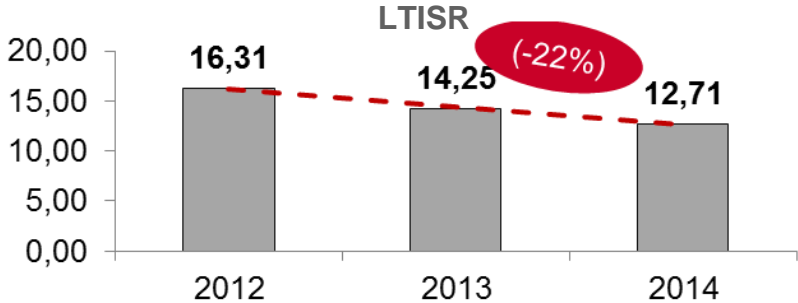
LTAFR

Injury rate decreased by 24% in contrast to 2012



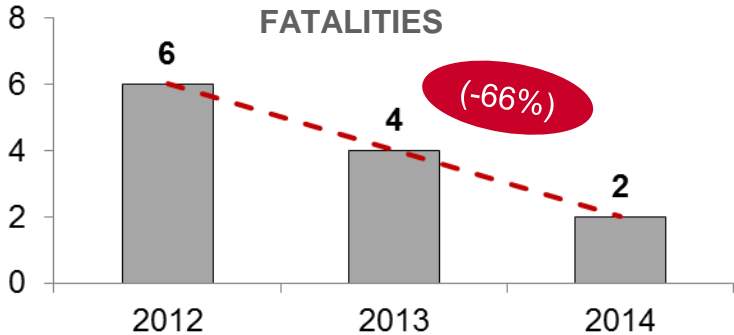
LTISR

Severe injuries decreased by 22% in contrast to 2012



Fatalities

Fatalities decreased by 67% in contrast to 2012

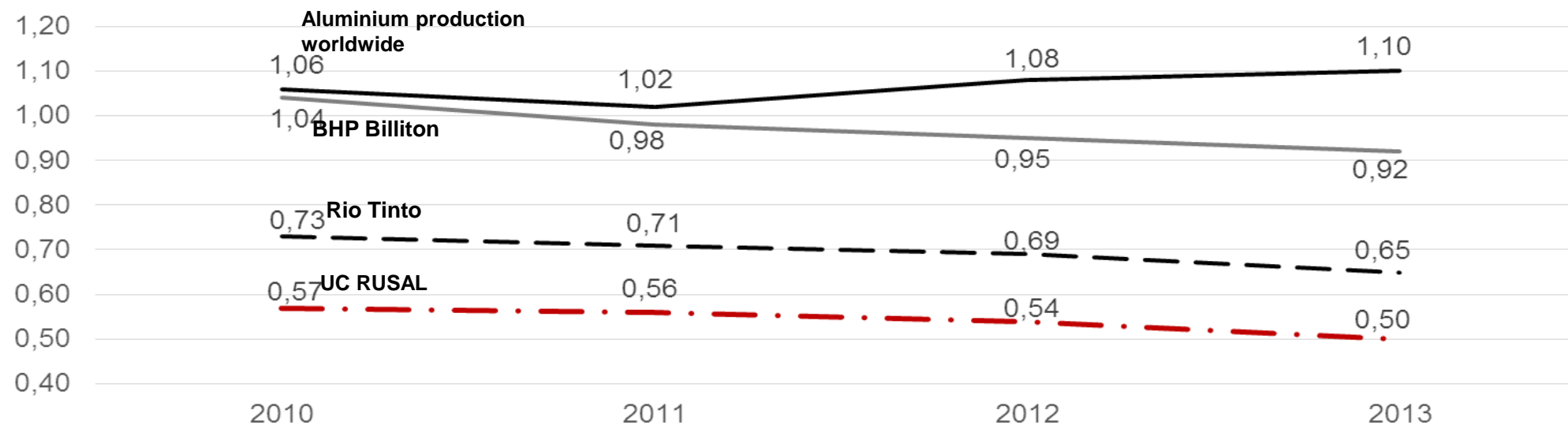


Source: Company's data

INJURY ANALYSIS FOR 2014



AIFR (ALL INCIDENT FREQUENCY RATE)



Safety performance of UC RUSAL as regards injuries is conforming to the highest ones in the aluminium industry*.

Occupational safety management system is certified to OHSAS 18001

Already certified facilities: Krasnoyarsk, Bratsk, Novokuznetsk, Zaporozhe, Sayanogorsk, Khakas, Volgograd, RIK Achinsk, SC Metallurg, Achinsk AOP, Nikolaev

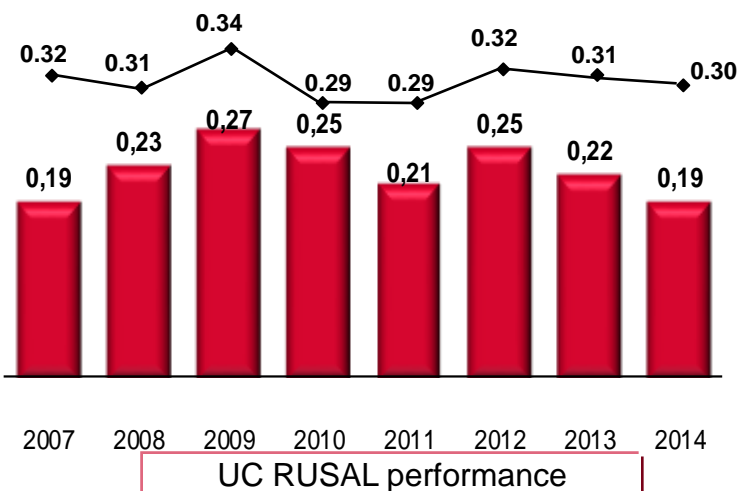
* Sources: Reports on sustainable development of companies 2010-2013 and information from the International Aluminium Institute AIFR calculated per 200 000 worked man-hours

INDUSTRIAL INJURY RATES



LTAFR – amount of injuries followed the loss of labor capacity/years per 200 000 man-hours

Aluminium industry (according to International Aluminium Institute)



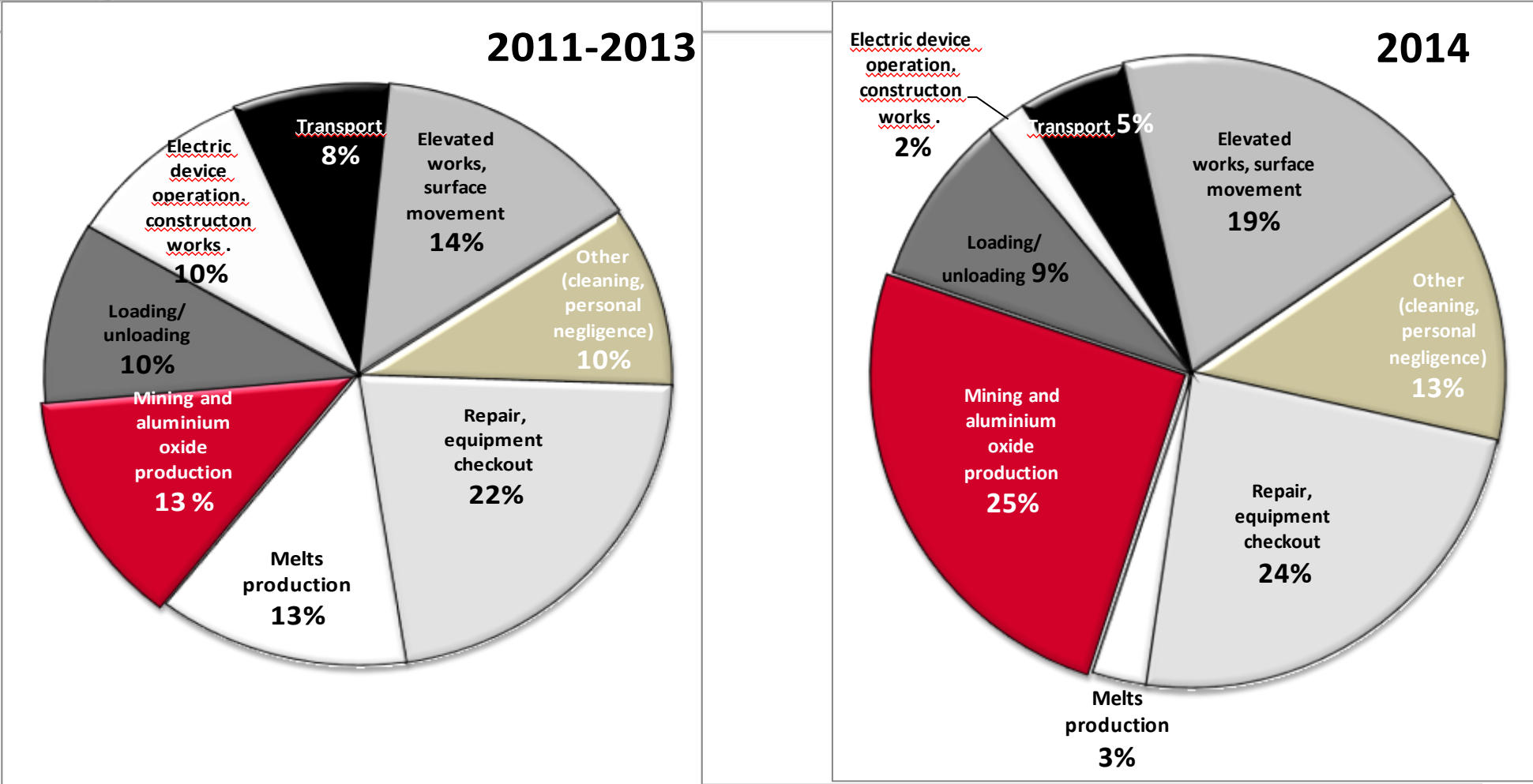
№	Type of fatalities	2011	2012	2013	2014
1.	Industrial	16	8	9	6
1.1.	employees	11	6	4	2
1.2.	contractors	4	1	4	3
1.3.	third parties	1	1	1	1
2.	Non-industrial	14	9	14	9
2.1.	employees	12	6	8	6
2.2.	contractors	2	3	6	3
2.3.	third parties	0	0	0	0
3.	Other (non included into the total statistics)*	41	36	23	16

Commentaries

Causes: wrong actions of employees, non observance of H&S requirements, personal negligence.

Proactive actions: raise commitment to the safe work culture, strengthen the control over high-hazard operations, standardization of operations

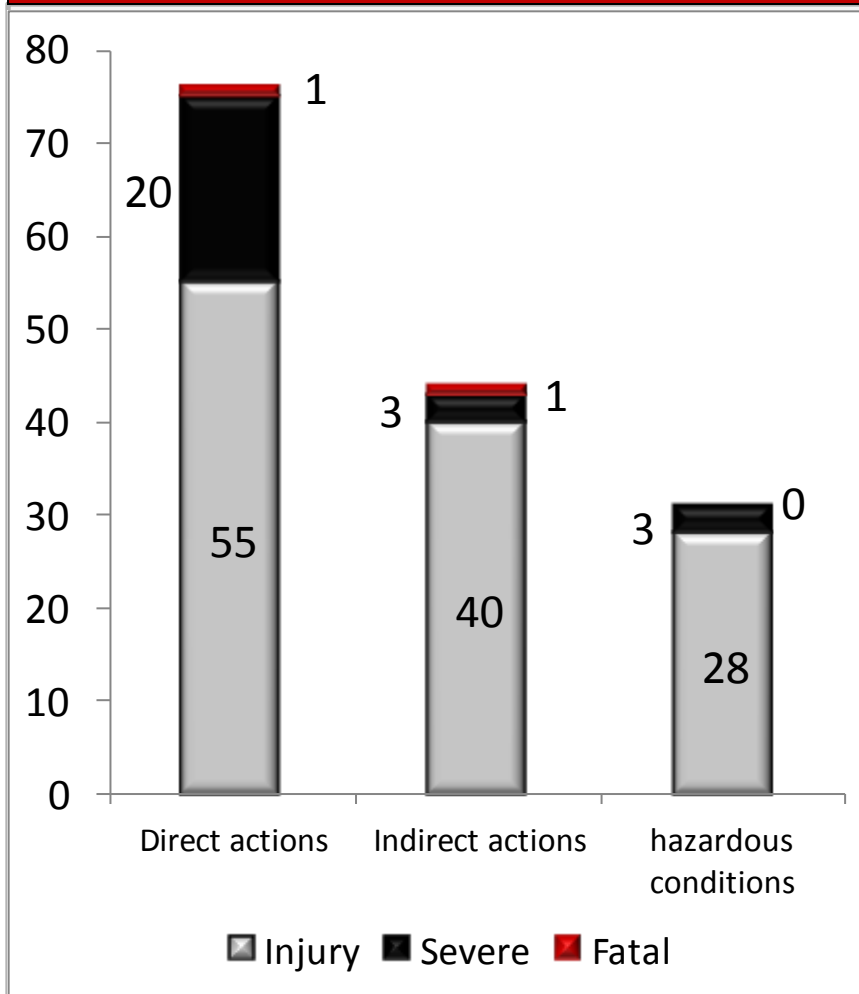
INJURY CAUSES IN TYPES OF OPERATIONS



- Focus on:**
- ✓ Identifying systematic (root) causes in the internal investigation of an injury;
 - ✓ Sharing lessons learnt from incidents;
 - ✓ Strengthening control by managers, specialists and officials over elevated operations and in course of mining works and alumina production.

INJURY ANALYSIS ACTIONS AND TRIGGERS

Injury triggers break-down in 2014



The overwhelming majority out of 151 injuries is consequent to **wrong actions of the employees.**

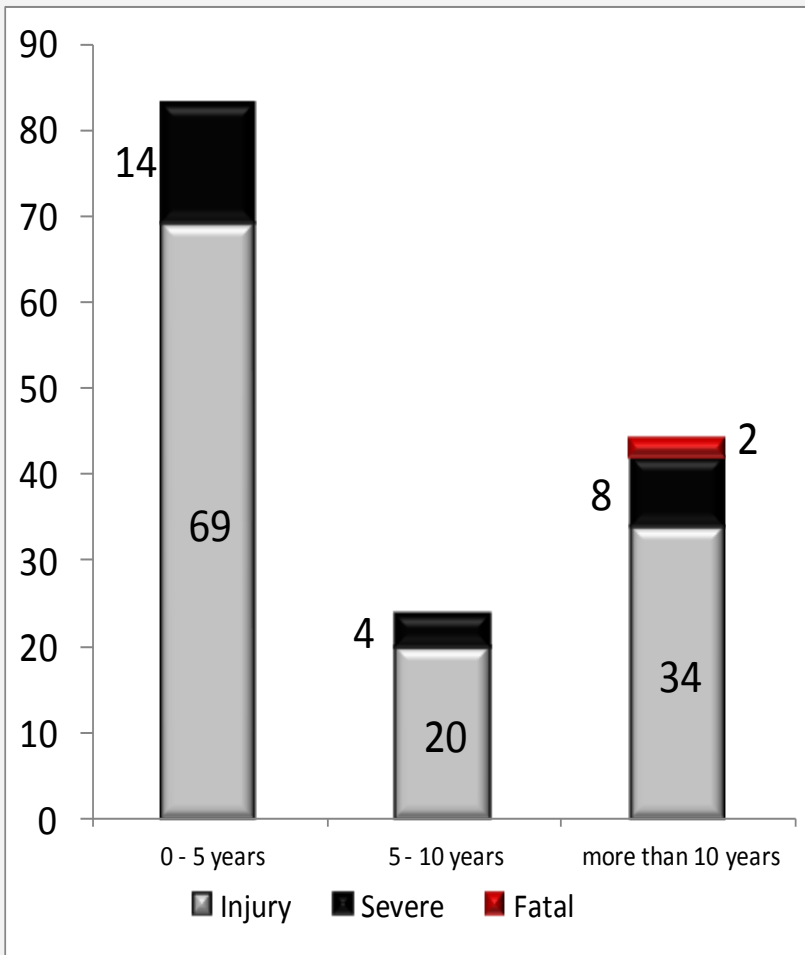
Key areas of proactive activity of the HSEA services, production system and personnel for 2015:

- 100% standardization of working areas within the production system, incl. occupational conditions and safe operations
- Creation and development of the leadership culture and personal adherence to the safe labor
- Identifying and handling the precursors

INJURY ANALYSIS SERVICE RECORD



Incident break-down by the service record, 2014

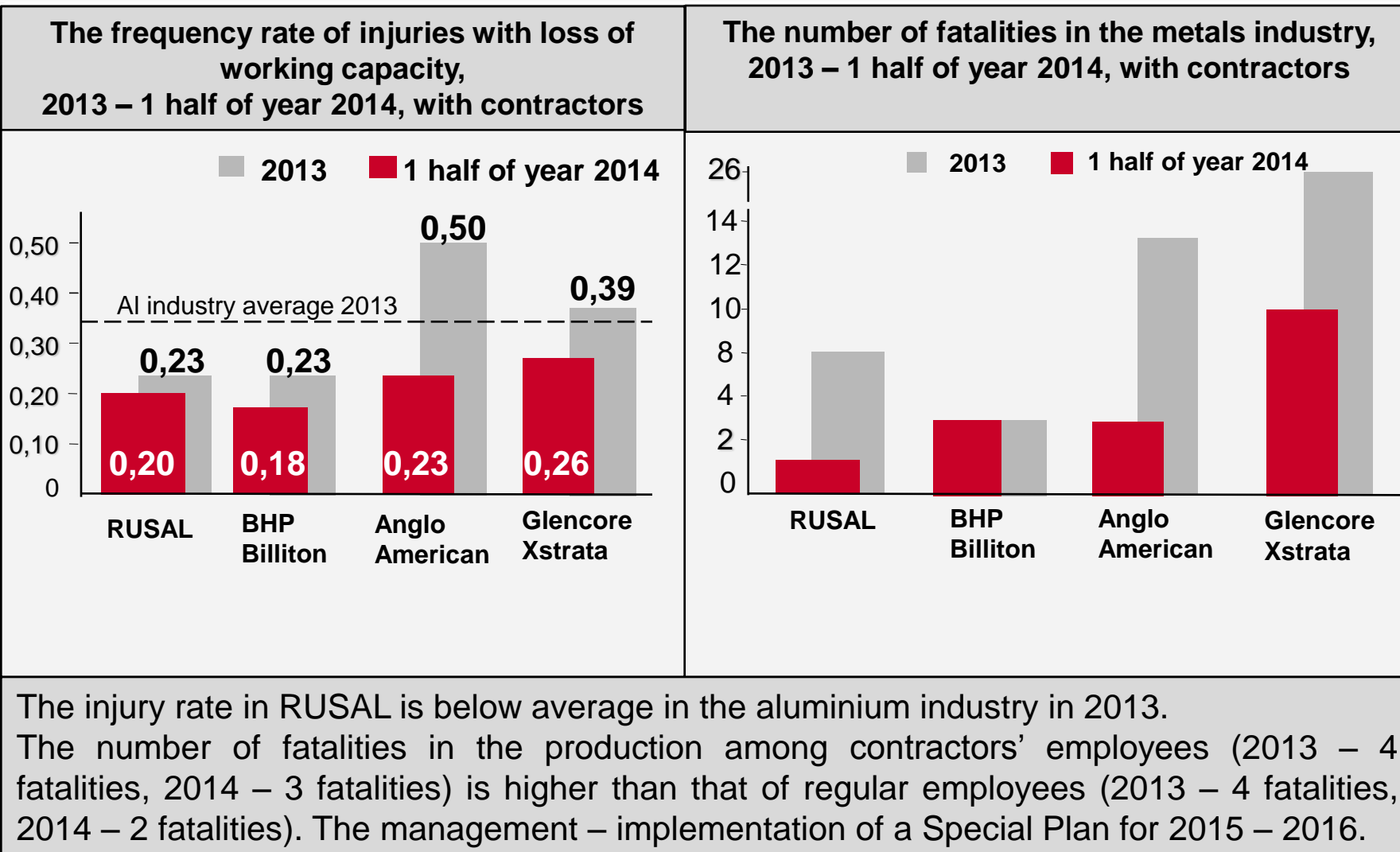


The relation of the number of injured to the length of work for employees:
0-5 years of service – not enough experience and expertise
10 years and more – «habit» syndrome

Focus on:

- Teaching personnel reserve tools of safe work and training to obtain a clearance to work unsupervised for newcomer employees («Smena+»)
- «Renovation» of the briefing system and the procedure of clearance to high-risk operations

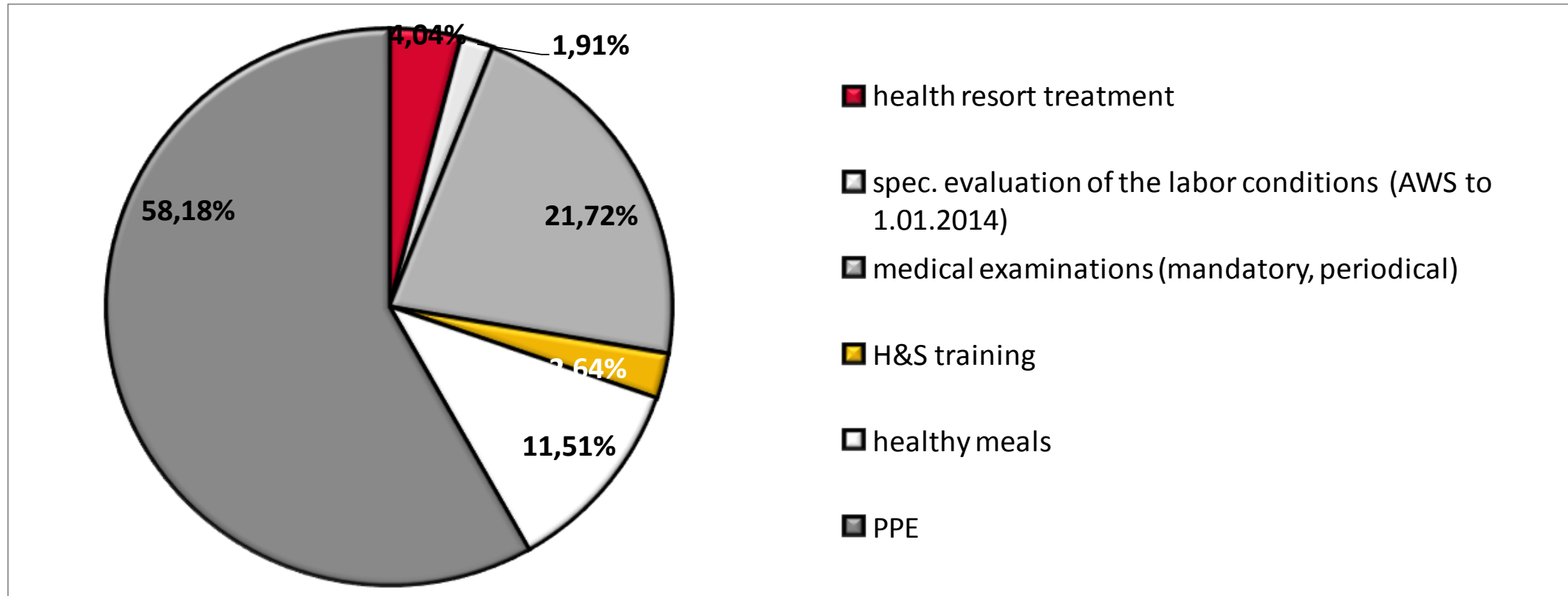
INJURY ANALYSIS CONTRACTORS



PREVENTIVE MEASURES TO REDUCE OCCUPATIONAL INJURIES AND DISEASES (on the expenditure side), 2014.



Total – \$ 38 979 thou.



All UC RUSAL employees are supplied with advanced and safe personal protection equipment

ACTION PLAN TO REDUCE THE INJURY RATE FOR 2015 – 2016



1) Proactive actions

(20.06.2014 the Plan has been approved by the HSE-Committee under Company's Board)

- 100% standardization of working areas within the production system, including the labor conditions and safety of operations conducted
- general behavioral audit of safety
- creating and developing a leadership culture and personal commitment to safe labor
- identifying systematic (root) causes in the internal investigation of injuries, implementation of activities
- responsibility enhancement (and encouraging) of managers, specialists and general staff for control of high hazard operations

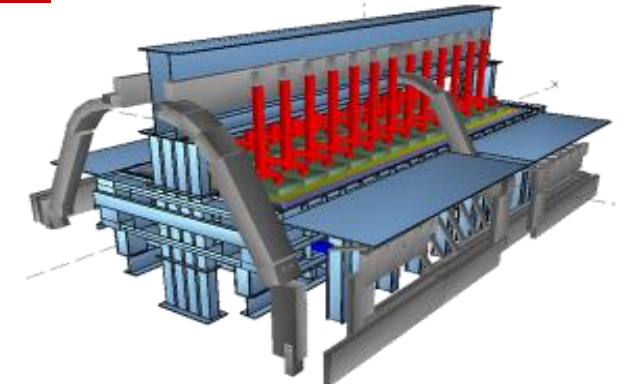
2) Conduct a special labor conditions evaluation study at working areas of the key personnel until 31 December 2016

3) Review motivation mechanisms of the personnel for the purposes of occupational H&S

4) An industrial competition “Company Leader of Occupational H&S»

Basic areas of implementation of the technical and environmental strategy :

- Introduce **advanced technologies** at newly commissioned capacities;
- **upgrade** of the existing production cycle at the operating facilities (Ecosoderberg, transition to the baked anode);
- **replacing** of outdated gas-purifying equipment;
- building **closed-loop** water recycling systems or building modern treatment facilities;
- building **modern** waste storing and recycling facilities to ensure long-term and reliable storing;
- **remediation** of disturbed lands



ADVANCED TECHNOLOGIES, DEVELOPMENT AND UPGRADE PROJECTS

✓ Building new plans :

- ❖ Boguchny aluminium plant – **600 thou. t/year** – current rate **320 kA**;
- ❖ Tayshet aluminium plant – **750 thou. t/year** – current rate **440 kA**.
- ❖ Anode works in Tayshet – **870 thou. t/year**



✓ Scaling-up production of calcinated coke at aluminium plants at Krasnoyarsk, Bratsk and Sayanogorsk by **232 thou. t/year**

✓ Using the unified anode (upgrading AMO) at Irkutsk aluminium plant

✓ Transition to the slot-anode at Sayanogorsk and Khakas aluminium plants



IMPORT PHASE-OUT

Best technologies and innovations, adapted at Company's facilities, comply with industrial safety requirements in full



A multitask process machine



provides for reduction of manual work and the time to complete process electrolyzer maintenance (sledging for metal tapping, technological measuring; eliminating alumina extrusion on the flange sheet, destruction of cakes, side ledge picking, destruction of electrolyte crust near the nozzle and punch alumina point feeder, alumina self-loading, flotation, sodium carbonate, crushed electrolyte from storage in the pot room; front load of "raw material" into the electrolyzer, transportation and unloading moulds with coal foam; fatigues)

IMPORT PHASE-OUT

Best technologies and innovations, adapted at Company's facilities, comply with industrial safety requirements in full



Crust punch machine MPK-RIK-01 is designed for punching the electrolyte crust at the electrolyzers in the potrooms using the Soderberg technology.

CE output_____	34.1 kW
Total mass_____	~5400 kg
Punch depth_____	250 mm
Crushing member overhand_____	700-900mm
Punch freq._____	110-190 per min



Off-gas system cleaning machine MCS-RIK-01 is designed for cleaning, with a special rotary cutter, of the internal surface of vertical and horizontal sections of pipelines D_y 120mm of the electrolyzer off-gas system through the access hole.



IMPORT PHASE-OUT

A project «Baked anode manufacture» – organize domestic manufacture of baked anode blocks



Project goal: organize domestic manufacture of baked anode blocks (BAB) in the amount of 104 thou. t/year on the basis of the main operating production capacities of **VgAZ-SUAL** (hereinafter VgAZ), subsidiary to **OJSC SUAL**.

The project “Baked anode manufacture at VgAZ” can enable:

- Minimizing capital expenditures for establishing BAB manufacture through involving the VgAZ infrastructure and unengaged production capacities;
- Decreasing the dependence on outside suppliers of BABs thanks to domestic manufacture of BAB, which will strengthen raw material independence of the Company;
- Covering the need of Company’s aluminium plants in BABs up to 104 thou. t/year;
- Decreasing circulating capital for replenishing the minimum BAB supply level of consumers through streamlining the logistics between the Manufacturer and Consumer



Anode baking furnace



Press-station



Goods storage

ENERGY EFFICIENCY IMPROVEMENT

Of all equipment without compromising safety



Energy efficiency improvement from the beginning of the process cycle (centralized alumina distribution system - CAD system (air-slide based)) to the ending (small-sized pig casting line, stacking, packaging, weighing and mass transportation of pigs).



UPGRADING AND AUTOMATION

Best technologies and innovations, adapted at Company's facilities, comply with industrial safety requirements in full



4. Electronic simulators of process cranes. Introduced at Krasnoyarsk and Sayanogorsk plants. The project was launched to improve the qualification of process crane machinists.

Crane-related incident analysis has shown that:

- ✓Some incidents were triggered by breakdowns,
- ✓Some stemmed from direct violation of rules,
- ✓The majority were occurred due to poor attention or skills of crane machinists.



ADVANCE TECHNOLOGIES, DEVELOPMENT AND UPGRADE PROJECTS



Development of technologies on the basis of the inert anode:

- Inert anodes allow to completely cut down on greenhouse gas emissions;
- A material of the inert anode developed to produce Al of **99,5%** fineness;
- A full-scale semi-industrial electrolyzer prototype with inert anodes was tested; switch to industrial site is underway.



Development of acid alumina production technology:

- A laboratory-scale hydro chemical technology of low-grade ore processing was developed at the cost of **280 \$/t** of alumina;
- In 2015, the technology is planned to be streamlined and proved at a large laboratory installation of the full cycle;
- Aluminium production cost reduced at Siberian plants by **~ 300 \$/t** due to alumina transporting cost reduction.



Technology scope – development of bauxite ores in Siberia with potential resources exceeding **20 bil. tons**

PROSPECTS:

Innovative aluminium production technology using inert anodes



Carbon anode technology



In production of **1 t** of Al, a **0,5 t** of C is combusted resulting in **1,4 t** of greenhouse gases (CO+CO₂)

Inert anode technology



In production of **1 t** of Al, **0,9 t** of oxygen will be produced

➤ In **2004**, UC RUSAL initiated a project of inert anode technology development



➤ In **2011–2012**, UC RUSAL became a member of a joint project together with the Skolkovo Foundation.
➤ The project budget is **300 million**. rubles.



INERT ANODE TECHNOLOGY BENEFITS

➤ Complete elimination of greenhouse gases and tar substances

➤ Pollution emission reduction:
Fluorides - **58%**; dust - **40%**; sulfur dioxide, carbon monoxide, tar substance **100%**

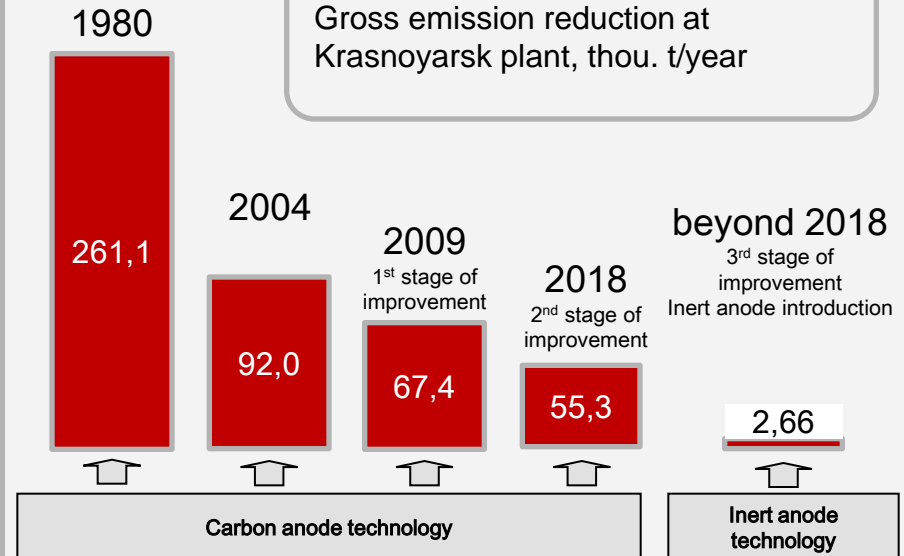
➤ Energy consumption reduction by **10%** of the current consumption in Krasnoyarsk plant



Environmental improvement at OJSC «RUSAL Krasnoyarsk»



Gross emission reduction at Krasnoyarsk plant, thou. t/year



Thank you for attention!

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