UNECE Safety Guidelines and Good Practices for Tailings Management Facilities and lessons learned from past tailings accidents in the UNECE region, including in view of NaTech risks

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Motto

Satellite imagery has lead us to the realization that tailings facilities are probably the largest man-made structures on earth.

Their safety, for the protection of life, the environment and property is an essential need in today’s mining operations.

These factors, and their relatively poor safety record revealed by the numbers of failures in tailings dams have led to an increasing awareness of the need for enhanced safety provisions in the design and operation of tailings dams.

ICOLD 2001
History of major tailing dams accidents

Number of TSF Failures/Accidents

Decade

Sources:
ICOLD (2001)
WISE (2015)
Wei et al. (2012)
Rico et al. (2007)
Other (see data base)
Some examples and case studies in Europe

- Kolontár (Aika) 2010
- Stava 1985
- Baia Mare 2000
- Los Frailes 1998
- Atik 2000
On 4 October 2010, a “red mud” spill had occurred following a tailings pond failure at an aluminum processing plant in Hungary. Red mud driven by the pond water flooded downstream 2 villages and travelled through a creek leading to the Danube River, approx. 160 km.

Source: Dr. C. Zanbak, TCMA report
Kolontár (Ajka), Hungary
Effect of sludge

Kolontár (Ajka), Hungary
Lessons learned from Ajka accident

• The information that content of the tailing is not characterized as „hazardous“ does not assure safety

• Behaviour of sludge as pH, particulates, viscosity, inertial force etc. must be evaluated as well

• Signs of coming accidents were overviewed and neglected

• Without real emergency plan, efficiency of accident mitigation may be very limited
Case study: STAVA

On July 19, 1985, a fluorite tailings dam of Prealpi Mineraia failed at Stava, Trento, Italy. 200,000 m³ of tailings flowed 4.2 km downstream at a speed of up to 90 km/h, killing 268 people and destroying 62 buildings. The total surface area affected was 43.5 hectares.
Stava accident

• The tailings dam consisted of two basins built on a slope. The failure with a collapse of the up-slope basin. The inflow of the released material caused the overtopping and subsequent collapse of the lower basin.

• Dams were constructed with an unacceptably low factor of safety and that the failure probably was triggered by a blocked decant pipe located within the tailings.
Stava lessons learned

• Tailing location had been badly chosen in view of the vulnerability of the downstream town and hotels.
• Bad safety management
BAIA MARE

January 30, 2000 in Baia Mare (Romania)
the biggest freshwater disaster in Central
and Eastern Europe.

Nearly 100,000 m³ of cyanide and heavy
metal-contaminated liquid spilled into the
Lupus stream, reaching the Szamos, Tisza,
and finally Danube rivers and killing
hundreds of tones of fish and poisoning the
drinking water of more than 2 million
people in Hungary.
VARIABILITY OF CAUSES OF ACCIDENT

• Inadequate management
• Lack of control of hydraulical system
• Error in site selection and investigation
• Unsatisfactory foundation, lack of stability of downstream slope
• Seepage
• Overtopping
• Earthquake
• Landsliding

MAIN ROOT CAUSE:

RISK ANALYSIS AND MANAGEMENT NEGLECTED
Distribution of causes of tailing dams accidents

Tailings dam incident cause comparison with incident type for active dams.

Source: ICOLD Bulletin 121

TAILINGS 2019, Almaty
VARIABILITY OF CONSEQUENCES

1. Flooding, wave of slurry
2. Contamination of surface water, living organisms intoxication
3. Drinking and irrigation surface water contamination
4. Drinking and irrigation underground water contamination
5. Soil contamination
6. As consequence of 2),3),4)ad.5 : Food chain contamination

» FREQUENTLY INVOLVES TRANSBOUNDARY EFFECT
CONSEQUENCES II:

- Consequences to human lives, health and well being. Evaluation of consequences with stakeholders necessary
- Direct costs (remediation, compensation, ...)
- Social disturbance
- Consequence to environment – short time and long time impacts
- Economical consequences and operability
- Indirect costs
Costs of TMF Failures

**Physical failure:** recent large failures $30 to $100 millions in direct costs

**Environmental failure:** some recent clean-up liabilities to several $100’s of millions

**Closure liability:** some recent examples in $500 million to $4 billion range

**Industry/investor impacts:** Shareholder value losses and industry imposed constraints and costs amounting to many billions of dollars
Emergency preparedness needs

• Preparedness to accident, even with low probability
• Early warning system necessary
• Training and not only desktop one
• Information of all subjects potentially involved
• Crisis management including training
• Open and honest communication with municipalities, emergency response teams, government bodies (inspection...)
• Communication with media
What is needed in the case of accident?
One mythus:

We will manage accident by improvisation…
Another mythus:

„We operate it long time without any accident, so safety is prooved“
What is it „NATECH“?

Natural hazard triggered technological accident

Flood
Earthquake
Lightning
Landslide
Wind
Tsunami
Etc.

Fire
Toxic Release
Environmental contamination
Explosion

Source: JRC Ispra
NATECHs and TMF accidents

example: Baia Mare

- Flood
- Earthquake
- Landslide
- Tsunami
- Etc.

Toxic Release

Environmental contamination

Source: JRC Ispra
French experience – database BARPI /MoE

- Represent about 5% of the known industrial accidents in France
- The BARPI lists 920 NaTech accidents between 1992 and 2012 in its ARIA database.

![Pie chart showing weather-related accidents in France](image)

- Lightning: 17%
- Wind: 7%
- Snow: 4%
- Extreme temperatures: 17%
- Earthquakes & landslides: 3%
- Heavy rain & floods: 52%
Near-miss: Ostramo waste deposit
Some international actions

• The OECD Guiding Principles on Chemical Accident Prevention, Preparedness and Response: Chapter 18 Natechs (2nd Addendum 2015)

• UNDRR (formely UNISDR) actions
Exchange of experiences and good practices

Seminar on Land-Use Planning & Industrial Safety
16-17th May 2018 in Mechelen, Belgium. Co-organized by UNECE, the government of Flanders (Belgium) and the EIB, with participation by UNISDR.

Seminar on Risk Assessment Methodologies under the Convention on the Transboundary Effects of Industrial Accidents
4th December 2018. Organized by UNECE, with participation by UNISDR.
Development of UNECE guidance materials
available usually in Russian language as well

- Safety Guidelines and Good Practices for Tailings Management Facilities
- Improving the safety of industrial tailings management facilities based on the example of Ukrainian facilities
- Guidance on Land-Use Planning, the Siting of Hazardous Activities and related Safety Aspects
- Overview of Methodologies for Hazard Rating of Industrial Sites
- Sectoral Checklist for Preparation and Inspection of a Safety Report
- Guidelines (to the Sectoral Checklist) for Preparation and Inspection of a Safety Report
Conclusions

• Tailing facilities are necessary for industrial development, but without proper safety management they can cause major accidents
• To ensure safety, overall process of risk management including both prevention and preparedness should be applied and continuously improved
• International experience sharing, good practices exchange and cooperation is one from keys for success
Thank you for your kind attention