SAFETY GUIDELINES AND GOOD PRACTICES FOR TAILINGS MANAGEMENT FACILITIES

Pavel Danihelka

CONFERENCE OF THE PARTIES TO THE CONVENTION ON THE TRANSBOUNDARY ACCIDENTS, Geneva, 25–27 November 2008

CONTENT:

- Examples of historical tailing management facility (TMF) accidents
- Causes and consequences of TMF accidents
- UNECE action – Safety Guidelines
- Structure of document
- Conclusions

EXAMPLES OF HISTORICAL ACCIDENTS

At least 221 serious tailing management facilities accidents reported by UNEP*:

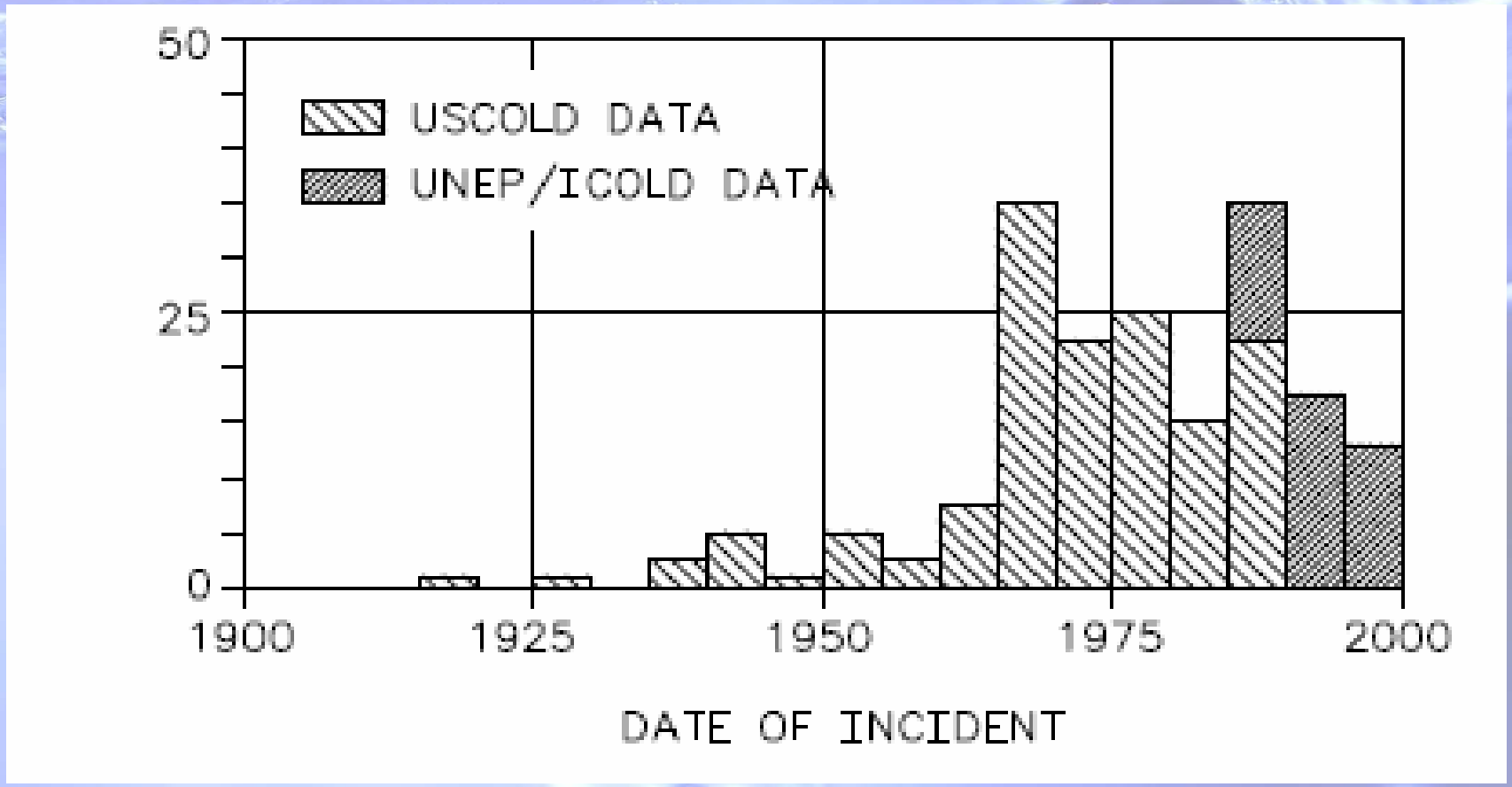
Mine name/ Location	Incident Date	Impact
Baia Mare, Romania	30.01.2000	100,000 m^3 cyanide contaminated water with some tailings released
Baia Borsa, Romania	10.03.2000	22,000 t of tailings contaminated by heavy metals released
Merriespruit, South Africa	22.02.1994	17 deaths, 500,000 m^3 slurry flowed 2 km

* http://www.mineralresourcesforum.org/docs/pdfs/Bulletin121.PDF

Major TMF accident review – cont.

Mine name/ Location	Incident Date	Impact
Buffalo Creek, USA	26.02.1972	125 deaths, 500 homes destroyed
Mufilira, Zambia	25.09.1970	89 deaths, 68,000 m^3 into mine workings
Omai, Guyana	19.08.1995	4.2 million m^3 cyanide slurry released
Placer, Philippines	02.09.1995	12 deaths, 50,000 m^3 released
Los Frailes, Spain	24.04.1998	released 4-5 million cubic meters of toxic tailings slurries
Stava, Italy	19.07.1985	269 deaths, tailings flowed up to 8 km
Aitik mine, Sweden	09.08.2000	1.8 million m^3 water released

History of major tailing dams accidents



Tailings dam incident history summary: number of incidents per 5 year period.

Source: „ICOLD Bulletin 121“

Case study:

BAIA MARE

January 30, 2000 in Baia Mare (Romania)

the biggest freshwater disaster in Central and Eastern Europe.

Nearly 100,000 m^3 of cyanide and heavy metal-contamined 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.

LOS FRAILES

April 25, 1998

tailings dam failure of the Los Frailes lead-zinc mine at Aznalcóllar near Seville, Spain,

released 4-5 million cubic meters of toxic tailings slurries and liquid into nearby Río Agrio, a tributary to Río Guadiamar.

The slurry wave covered several thousand hectares of farmland, and it threatens the Doñana National Park, a UN World Heritage Area.

STAVA

On July 19, 1985, a fluorite tailings dam of Prealpi Mineraia failed at Stava, Trento, Italy. 200,000 m^3 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.

AITIK

On September 8, 2000, the tailings dam of Boliden's Aitik copper mine near Gällivare in northern Sweden failed over a length of 120 meters. This resulted in the spill of 2.5 million cubic meters of liquid into an adjacent settling pond. Boliden subsequently released 1.5 million cubic meters of water from the settling pond into the environment to secure the stability of the settling pond.

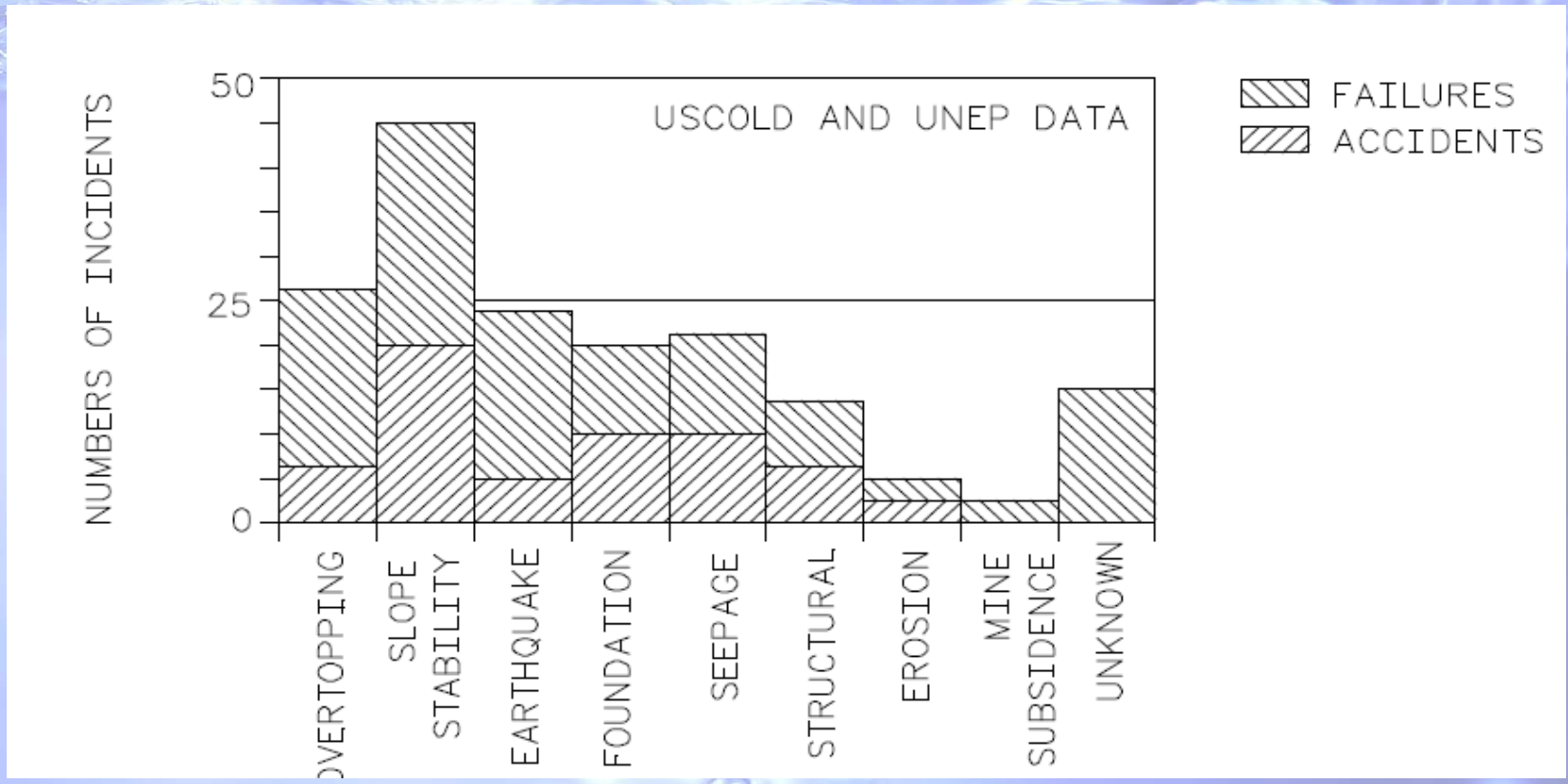
VARIABILITY OF CAUSES OF ACCIDENT

- Inadequate management
- Lack of control of hydrological system
- Errors in site selection and investigation
- Unsatisfactory foundation, lack of stability of downstream slope
- Seepage
- Overtoping
- Earthquakes and landslides

MAIN ROOT CAUSE:

RISK ANALYSIS AND RISK MANAGEMENT NEGLECTED

Distribution of causes of tailing dams accidents



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

Source: ICOLD Bulletin 121

VARIABILITY OF IMPACTS

1. Flooding, wave of slurry
2. Contamination of surface water, living organisms (biota) intoxication
3. Drinking and irrigation water contamination (surface waters)
4. Drinking and irrigation water (ground water) contamination
5. Soil contamination
6. As consequence of 2 to 5 →: Food chain contamination

FREQUENTLY TRANSBOUNDARY EFFECTS

Failure Consequences - enterprise:

- significant costs for a company for items such as:
  - emergency response
  - clean-up and repairs
  - disruption of operation
  - damages claims
  - law suits
  - unscheduled closure works
  - loss of company's share value

Costs of Failure

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

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

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

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

Failure Consequences - social:

- Impact the social acceptance for all other operations of the company concerned
- Impact the regulatory frameworks
- Impact the mining industry reputation in general
- Negative impacts of accidents can be severely exacerbated when transboundary effects are involved

UNECE action

- The **Conference of the Parties** to the Convention on the Transboundary Effects of Industrial Accidents and the **Meeting of the Parties** to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes **mandated the Joint Expert Group (JEG)** to draw up safety guidelines and a summary of good practices for tailings management facilities.
- This mandate is reflected in the Conventions' workplan for the JEG on Water and Industrial Accidents that was adopted by both Conventions meetings (2006).
- JEG prepared safety guidelines which constitute a minimum set of requirements to ensure a basic level of safety for TMFs.

UNECE action (cont.)

- Guidelines based directly upon the body of work produced by the global community of dam safety scientists, professional bodies and inter-governmental agencies:
  - European Commission
  - International Commission on Large Dams (ICOLD)
  - UNEP
  - International Council on Metals and Mining (ICMM)
  - Others…

Definitions

- **Tailings** are the fine-grained waste material remaining after the metals and minerals extraction. Particle size ~ 10 µm to 1.0 mm.
- **Tailings management facility** (TMF) is set of structures required for the handling of tailings including:
  - **tailing storage facility (TSF)** includes a tailings dam (impoundment and pond), decant structures and spillways. A TSF can also be open pits, dry stacking, lakes or underground storages
    - ***tailings dam*** *encompasses embankments, dam walls or other impounding structures, designed to enable the tailings to settle and to retain tailings and process water, which are constructed in a controlled manner.*
    - ***tailings impoundment*** *is the storage space/volume created by the tailings dam or dams where tailings are deposited and stored.*
  - **Auxiliary facility as clarification ponds, delivery pipelines**, etc.,

Principles for Tailing Management Facilities' Safety

- Governments should provide leadership and frameworks to facilitate the development, safe operation and decommissioning of TMFs.
- The operators of TMFs have the primary responsibility for ensuring safety
- All parts of TMF and all live-cycle *(planning – construction – operation – closure – rehabilitation)* of TMF should be considered
- Abandoned TMF involved

Principles for Tailing Management Facilities' Safety (2)

- Only competent, properly certified and trained personnel should be engaged in the planning, design, construction, operation/management and closure of TMFs
- TMFs should be operated in accordance with the construction, safety and environmental norms and best practices
- Risk assessment is part of TMF operation
- Risk management including emergency planning has to be applyied

Recommendations to UNECE member countries:

- To identify competent authorities that are given access to the necessary resource
- UNECE member countries should adopt and enforce adequate legislation
- UNECE member countries should ensure existence of national inventories TMFs that may constitute a risk to human health or the environment
- Experience and best practices should be shared

Recommendations to competent authorities (CA)

- All relevant authorities involved in TMF safety should cooperate
- CA should notify their counterparts in neighbouring countries
- CA should introduce authorization and/or a licensing procedure to permit the construction of a TMF
- CA should control all parts of safety management and emergency preparedness of TMF, including traning

GUIDELINES ANNEX - TECHNICAL AND ORGANIZATIONAL ASPECTS

- Pre-construction and construction
- Operation and management
- Inspection
- Abandoned sites identification, clasification and management
- Emergency planning

Pre-construction and construction

- Licencing
- Environmental impact assessment and land-use planning
- Hazard identification and risk assessment
- Dam safety

Operation and management

- Based on operation manual and waste management plan
- Education and training of personnel along the “planning-design-construction-operation-decommisioning-rehabilitation” chain.
  - Adequate skills identification
- Education and training for inspectors

EMERGENCY PLANNING

- For each TMF for phases of construction, operation and closure
- Tests and revisions of emergency plans
- To evaluate
  - downstream inundation hazards resulting from floods or dam failure
  - upstream conditions that might result from major land displacements or increased flood flows
  - Potential „domino“ effects

EMERGENCY PLANNING (2)

- Internal emergency planning
- External emergency planning (UNEP APELL procedure applicable)
- Emergency planning for abandoned sites

Conclusions

Safety guidelines (as not legally binding document) intends to help to operators and competent authorities to increase TMF safety and therefore should be implemented by UNECE member countries, competent authorities and operators to reach a harmonized safety level for TMFs

Thank you for your attention