



**The Inception Workshop**  
of the Project to Strengthen the Safety  
of Mining Operations, in particular  
tailings management facilities (TMFs),  
in Kazakhstan and beyond in Central Asia

**Astana (Kazakhstan)**  
**November 7-8, 2018**



UNECE Convention on the  
Transboundary Effects of  
Industrial Accidents

**Assistance  
Programme**



**Introduction into the methodology  
and its application. Tailings hazard  
index. The Checklist and the Action  
list. Results for Ukraine and Armenia.**



Schweizerische Eidgenossenschaft  
Confédération suisse  
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# Substantiation of the need to develop a Checklist

1

- The need to develop a unified approach to TMFs at different stages of their life cycle.

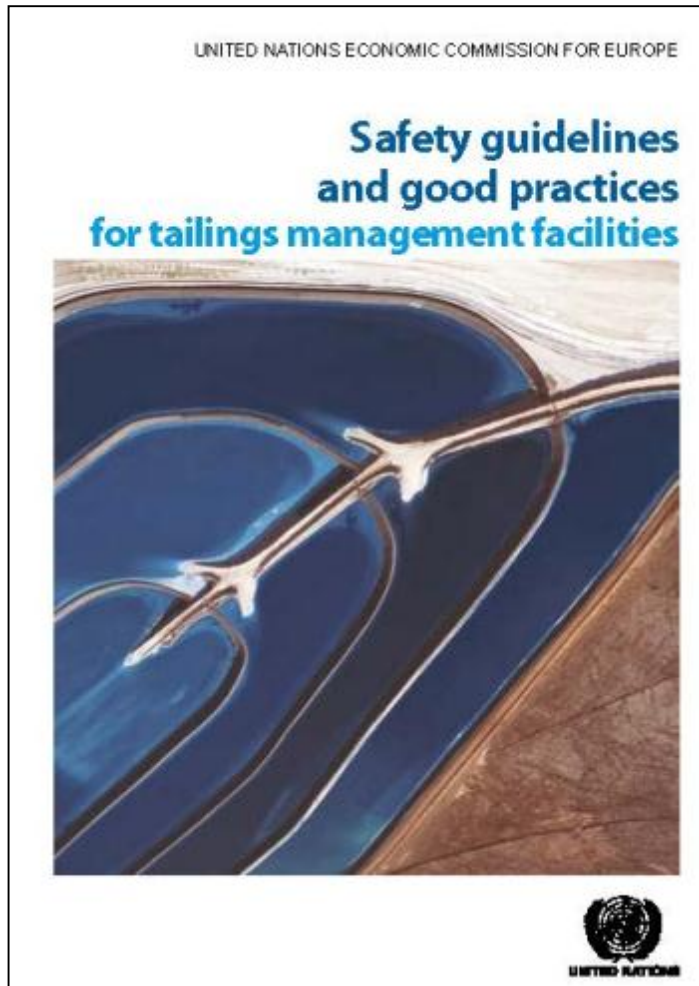
2

- The need to synchronise checks, safety assessments and prescribing actions to improve TMFs safety

3

- The need to apply limited resources efficiently for TMFs safety checks and enhancement of their safety levels.

# UNECE Safety guidelines and good practices for tailings management facilities as the base for the Checklist



- The Safety guidelines were developed by the Joint Expert Group on Water and Industrial Accidents with support of the UNECE Secretariat.
- The Safety guidelines were endorsed by COP5 of the Convention on Industrial Accidents (Geneva 2008) and by MOP5 of the UNECE Water Convention (Geneva 2009).
- In 2014, the document was updated.

# Development of the methodology for improvement of TMFs safety



Umwelt  
Bundesamt



The methodology, including

**1) Tailing hazard index and 2) the Checklist,**

has been developed by the Ukrainian project team in the framework of the German Federal Environment Agency project - **Improving Safety of Industrial Tailings Management Facilities Based on the Example of Ukrainian Facilities (2013-2015)** with participation of international experts

as a tool for practical implementation of UNECE Safety Guidelines and Good Practices for Tailings Management Facilities

# The methodology for improvement of TMFs safety

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graph TD; A[The methodology for improvement of TMFs safety] --> B[The tailing hazard index]; A --> C[The Checklist]; B --> D[Designed for swift preliminary assessment of TMFs hazards (ranking) at the national/regional levels]; C --> E[Designed for detailed assessment of individual TMFs];
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## The tailing hazard index

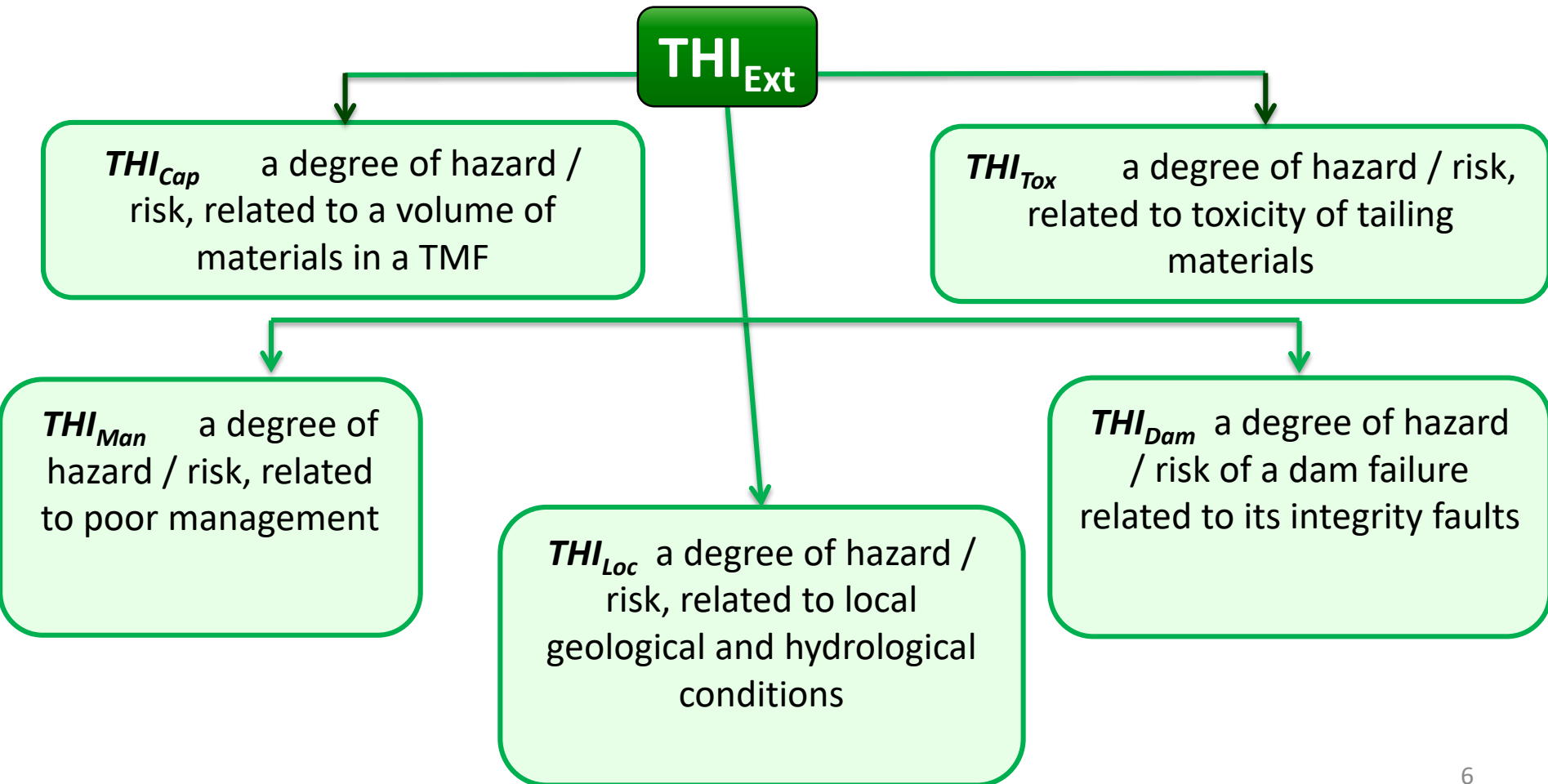
Designed for swift preliminary assessment of TMFs hazards (ranking) at the national/regional levels

## The Checklist

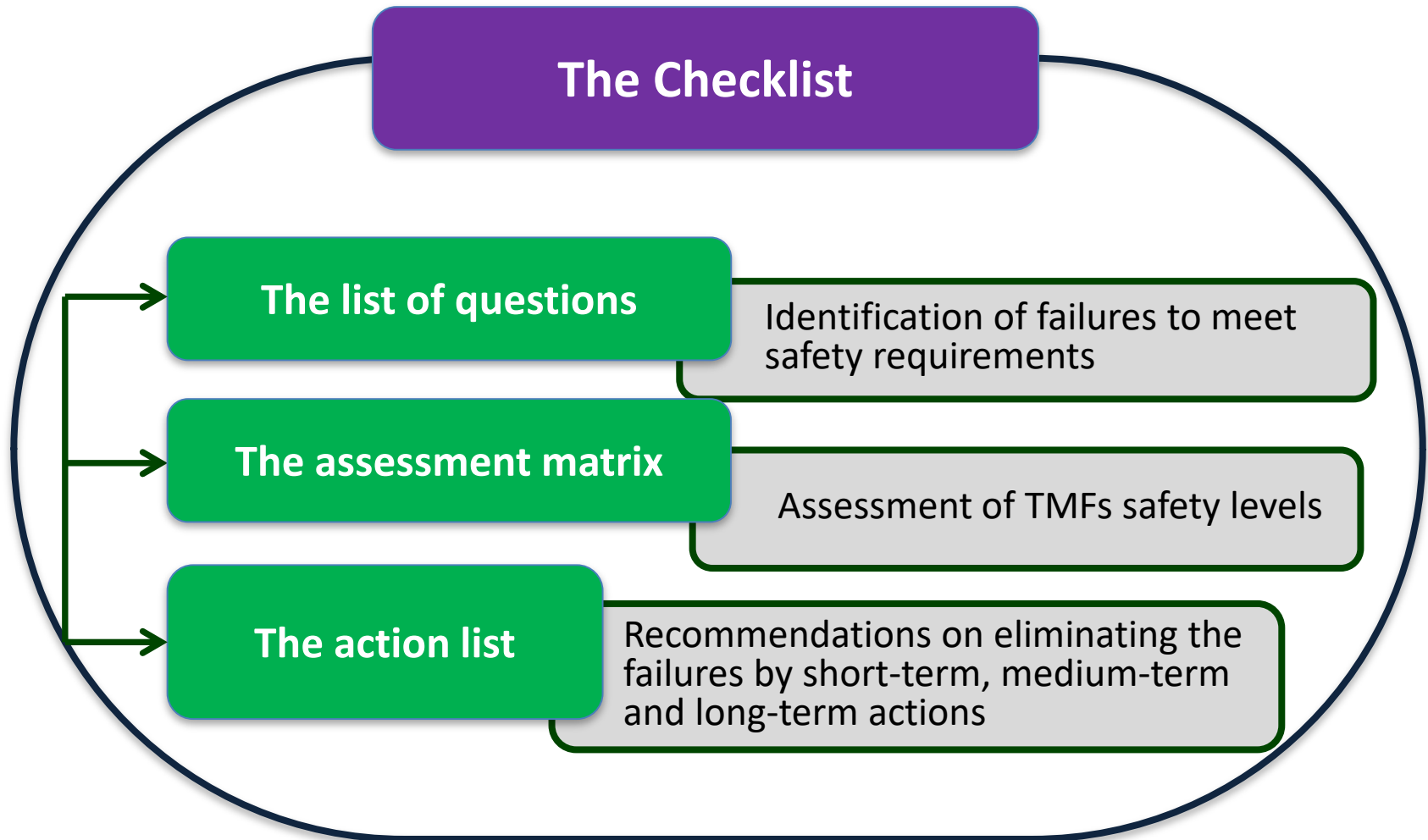
Designed for detailed assessment of individual TMFs

# Tailings hazard index (THI)

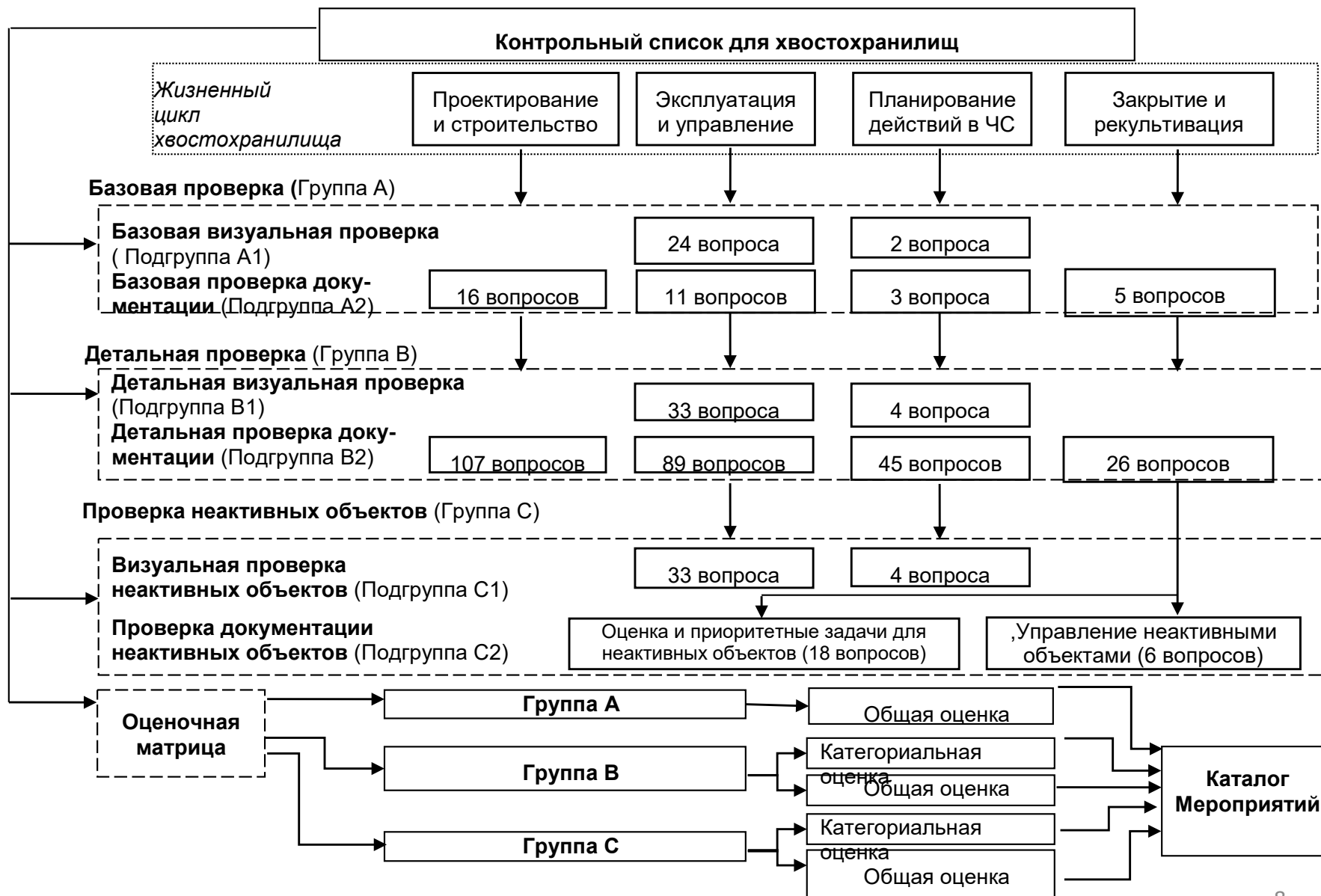
$$THI_{Ext} = THI_{Cap} + TXI_{Tox} + THI_{Man} + THI_{Loc} + THI_{Dam}$$



# The Checklist structure



# The Checklist structure in detail





# Group A

Group of questions	Purpose	Data sources	Users
<b>Group A “Basic assessment”</b>	Preliminary and operational assessment of a TMF safety level to determine priorities for further detailed assessment.	Available documentation of a TMF operator, interviewing the TMF personnel	Competent authorities

# Group B

Group of questions	Purpose	Data sources	Users
<b>Group B</b> <b>"Detailed assessment"</b>	Comprehensive and detailed assessment of a TMF safety level to determine the need to take actions	Available documentation of the TMF operator, additional studies and tests to clarify all parameters of the TMF, including the ones with involvement of external experts; visual checks; interviewing the TMF personnel	State inspectors and TMFs operators

# Group C

Group of questions	Purposes	Data sources	Users
<b>Group C</b> <b>“Assessment of inactive sites”</b>	Assessment of an inactive TMF safety level to determine the need to take actions	Available documentation of the TMF operator, additional studies and tests to clarify all parameters of the TMF, with involvement of external experts; visual checks; interviewing the TMF personnel	State inspectors and TMFs operators

# The Checklist questionnaire layout

#	Question	Recommendations (factors and parameters to be accounted for in answering the question)	Answer					Data source (reference to documents or photos as evidence)
			not applicable*	yes	rather yes	rather no	no	
Data recheck								
1	Does the design documentation correspond to the actual layout of the TMF elements?	Correspondence of charts and maps to actual layout of the TMF						

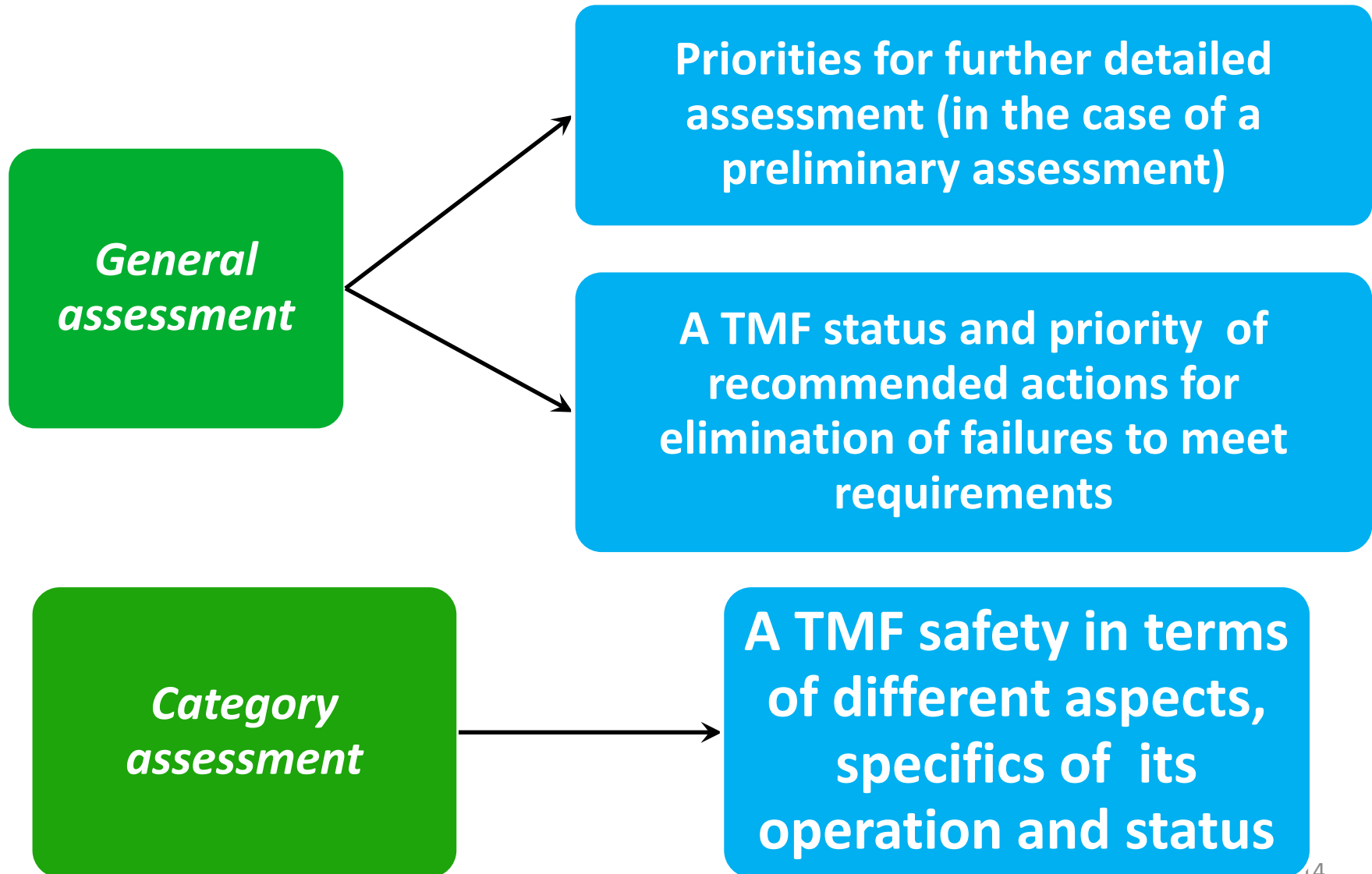
# The assessment matrix

## Quantitative evaluation of answers

- Positive response - **“Yes”** - is interpreted as the maximal TMF safety level in terms of the factor assessed.
- Negative response - **“No”** - is interpreted as the minimal TMF safety level in terms of the factor assessed.
- Uncertain responses - **“Rather yes”** and **“Rather no”** - allow a user to answer, accounting for availability and credibility of data sources.

Answer	Not applicable	Yes	Rather yes	Rather no	No
Value	-	3	2	1	0

# Types of assessment of TMFs safety levels



# Indicators of general TMFs safety levels

- **“Safety conformance” (“SC”)** indicator in the Checklist is defined as an index for quantitative description of a degree of compliance of a TMF parameters and characteristics with environmental and industrial safety requirements.
- **“Credibility”** indicator in the Checklist is defined as an index for quantitative description of sufficiency and consistence of the data used for "SC" indicator calculation.

# A sample TMF general safety assessment

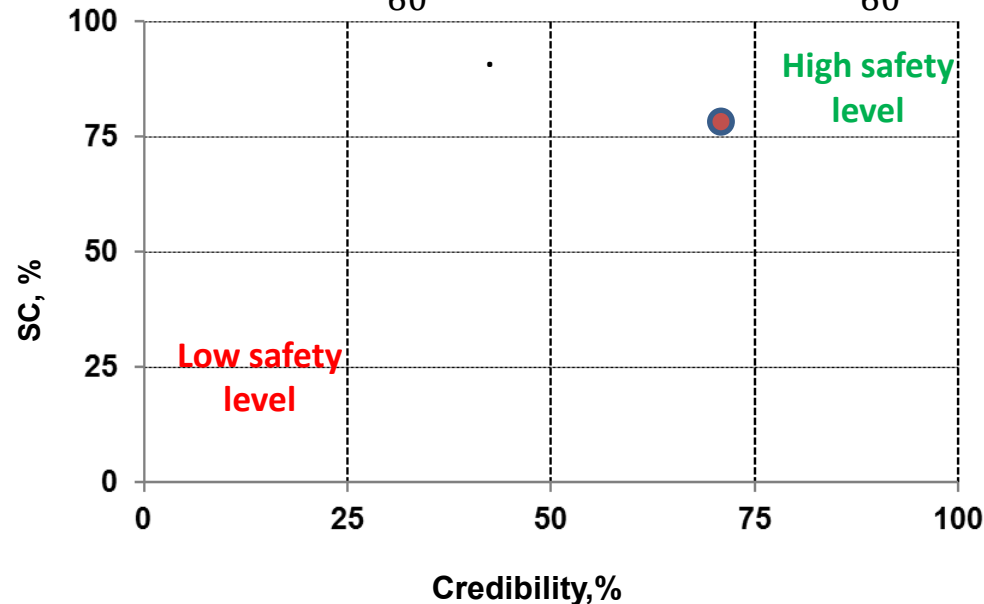
Results of assessment based on Group A questions of the Checklist.

The number of questions applied	Yes	Rather yes	Rather no	No
60	38	10	8	6

Values of SC and Credibility indicators

$$SC = 100\% \cdot \frac{1}{3 \cdot 60} (36 \cdot 3 + 10 \cdot 2 + 8 \cdot 1 + 6 \cdot 0) = 100\% \cdot \frac{136}{180} \approx 76\%$$

$$Credibility = 100\% \cdot \frac{1}{60} (60 - 18) = 100\% \cdot \frac{42}{60} \approx 70\%.$$





# Classification of TMFs based on assessment results

A TMF safety level	Criteria
<b>Acceptable</b>	100% of minimal safety requirements are met (SC = 100%)
<b>Unacceptable</b>	Less than 100% of minimal safety requirements are met (SC < 100%)
<b>Accidental condition</b>	Negative responses were provided to at least 5 critical questions*, associated with visual checks, or the TMF operator deliberately prevents inspection of the site or some parts of it

\* Critical questions include questions of B2 sub-group - "Detailed visual inspection" that directly associated with operational TMF safety (drainage facilities, dam safety, neutralisation of hazardous substances, monitoring).

# Category assessment.

## Significance of categories

- **Critical (extremely important) safety categories** mean TMFs safety categories that are mainly related with technical TMFs operation aspects and are vitally needed for safe maintenance of the site.
- **Non-critical (important) safety categories** deal with issues mainly associated with documentation, personnel and reporting.

# Priority of categories

#	Category	Priority for TMF safety
<b>I</b>	Geological, climate and local risks	Non-critical
<b>II</b>	TMF location plan	Non-critical
<b>III</b>	Substances (TMF capacity, toxicity)	Critical
<b>IV</b>	Dam and screens	Critical
<b>V</b>	Transport and infrastructure	Critical
<b>VI</b>	Water flows management	Critical
<b>VII</b>	Environmental impact assessment	Critical
<b>VIII</b>	Emergency action plan	Critical
<b>IX</b>	Monitoring	Critical
<b>X</b>	Training and personnel	Critical
<b>XI</b>	Inspection and reporting	Non-critical
<b>XII</b>	Closure and recultivation strategy	Non-critical

# Sample category assessment.

## Radar chart



# The action list

- A problem identified - a failure to meet safety requirements,
- Recommended actions,
- Priority.

#	The problem to be addressed	Actions prescribed	Priority
<b>DESIGN AND CONSTRUCTION</b>			
<b>1</b>	Incomplete design documentation	1A. To update the design documentation with support of a licensed company	Short term
		1B. To update the design documentation with involvement of experienced personnel with relevant licenses	Short term
		1C. To implement expert assessment of the design documentation for competent authorities	Short term
		1D. To develop or extend the design documentation according to regulatory requirements	Short term
		1E. To develop a detailed map of the TMF site and the surroundings	Short term
<b>2</b>	The TMF design was not discussed with local authorities and the general public	2A. To discuss the TMF design with local authorities and the general public	Short term
		2B. To inform local residents and NGOs on substance of TMFs designs and to get their opinions	Short term

Actions priority	Targets and standards applied	Resources
<b>Short term</b>	Urgent elimination of non-compliance with safety requirements, according to national standards	Resources of the TMF operator
<b>Medium term</b>	Elimination of failures to meet safety requirements, demanding several months for completion due to geotechnological reasons, according to national or international standards	Resources of the TMF operator and external sources. Cost/benefit optimisation
<b>Long term</b>	Technical transformation of the TMF to make it compliant with modern industrial and environmental safety standards	Resources of the TMF operator and external sources. Cost/benefit optimisation

# Application of the Checklist in Ukraine.

## 1. TMF in Kalush

Umwelt  
Bundesamt

Assessment in the framework of  
the first UBA project in Ukraine,  
2014

**Location.** Ivano-Frankovsk oblast, at the distance of  
0.85 km from Kalush

**Name.** TMF # 2 of Oriana JSC "Potassium Plant"

**Constructed** in 1984

**Materials.** Potassium production waste



### Waste volume.

Solids -  $9 \times 10^6 \text{ m}^3$ ;

Liquids -  $1.7 \times 10^6 \text{ m}^3$

### Environmental hazards

- Groundwater
- Rivers in the Dniester basin



# Application of the Checklist in Ukraine.

## 1. TMF in Kalush



**TMF #2 in 2010**



**TMF # 2 in 2014**

**Saltwater infiltration through the dam**





# Application of the Checklist in Ukraine.

## 1. TMF in Kalush

General  
assessment

**Credibility - 58.2%**  
**Safety conformance - 51.7%**

Category  
assessment

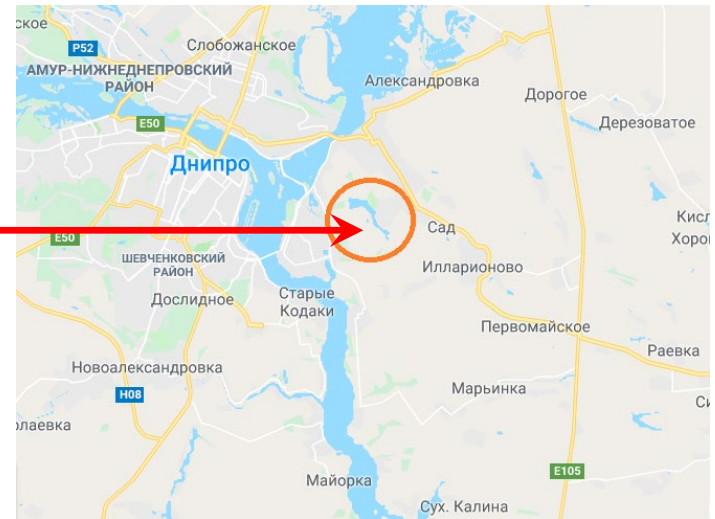
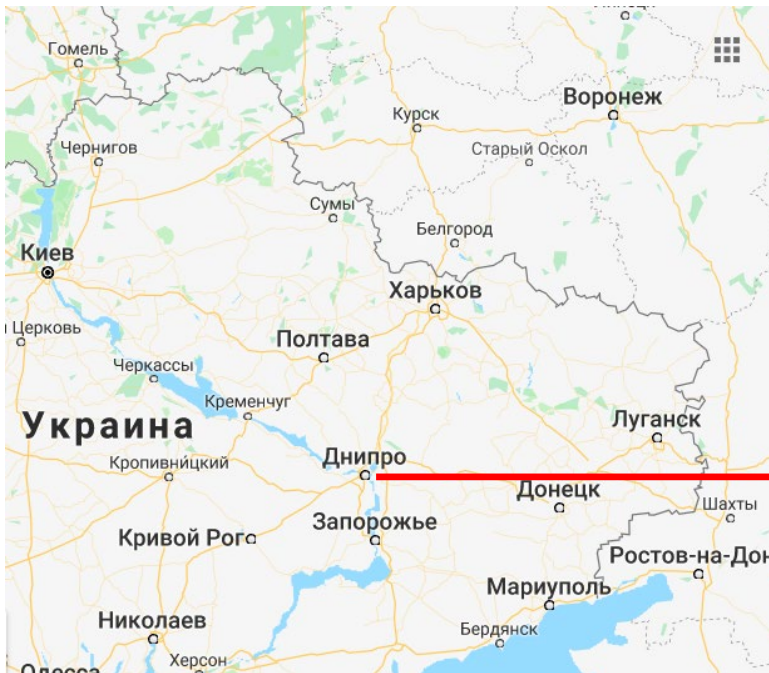


# Application of the Checklist in Ukraine.

## 2. TMF in Dnepr



Assessment in the framework of a UBA project - Raising Knowledge of Students and Lecturers on TMFs Safety and its Legislative Survey in Ukraine (2016-2017)



**Name.** Ash and sludge tailings pit of Pridneprosky TPP ("DTEK Dneproenergo" PJSC)

**Waste volume** - 15.75million tons

**Composition:** sludge, coal burning waste

**Constructed in** 1970

# Application of the Checklist in Ukraine.

## 2. TMF in Dnepr

The assessment participants: 4 groups of students (ecologists) under guidance of lecturers of 4 universities and the Checklist developers.

The assessment was conducted in the course of two trainings (October and November 2016) with participation of international and national experts.



# Application of the Checklist in Ukraine.

## 2. TMF in Dnepr

General  
assessment

Credibility 85.5%  
Safety conformance 74.1%

Category  
assessment



# Typical failures to meet safety requirements at TMFs

- Incomplete design documentation.
- Incomplete EIA.
- Constructions and transport infrastructure do not meet design requirements.
- Lacking/incomplete protection systems, drainage, monitoring, emergency alert systems.
- Lacking/incomplete ERPs and relevant procedures.
- Lacking/incomplete closure and recultivation plans.

# Main actions recommended

- Reinforcement of dams and other critical elements
- Development and introduction of protection methods, including neutralisation of toxic substances, modernisation of drainage, monitoring and ER procedures.
- Updating design documentation.
- Expert assessments, including the ones in the framework of EIA.
- Enhancement of personnel skills, improvement of reporting.
- Development of plans for closure and recultivation, utilisation of technogenic resources.

## The methodology improvement needs

- To raise significance of visual inspection.
- To identify critical issues of the highest importance to TMFs safety.
- To apply remote sensing means, including UAVs.
- To organise close interaction with TMFs operators and personnel.

**The methodology is an updatable document to be adapted to every country of its application**

**Thank you for your attention!**