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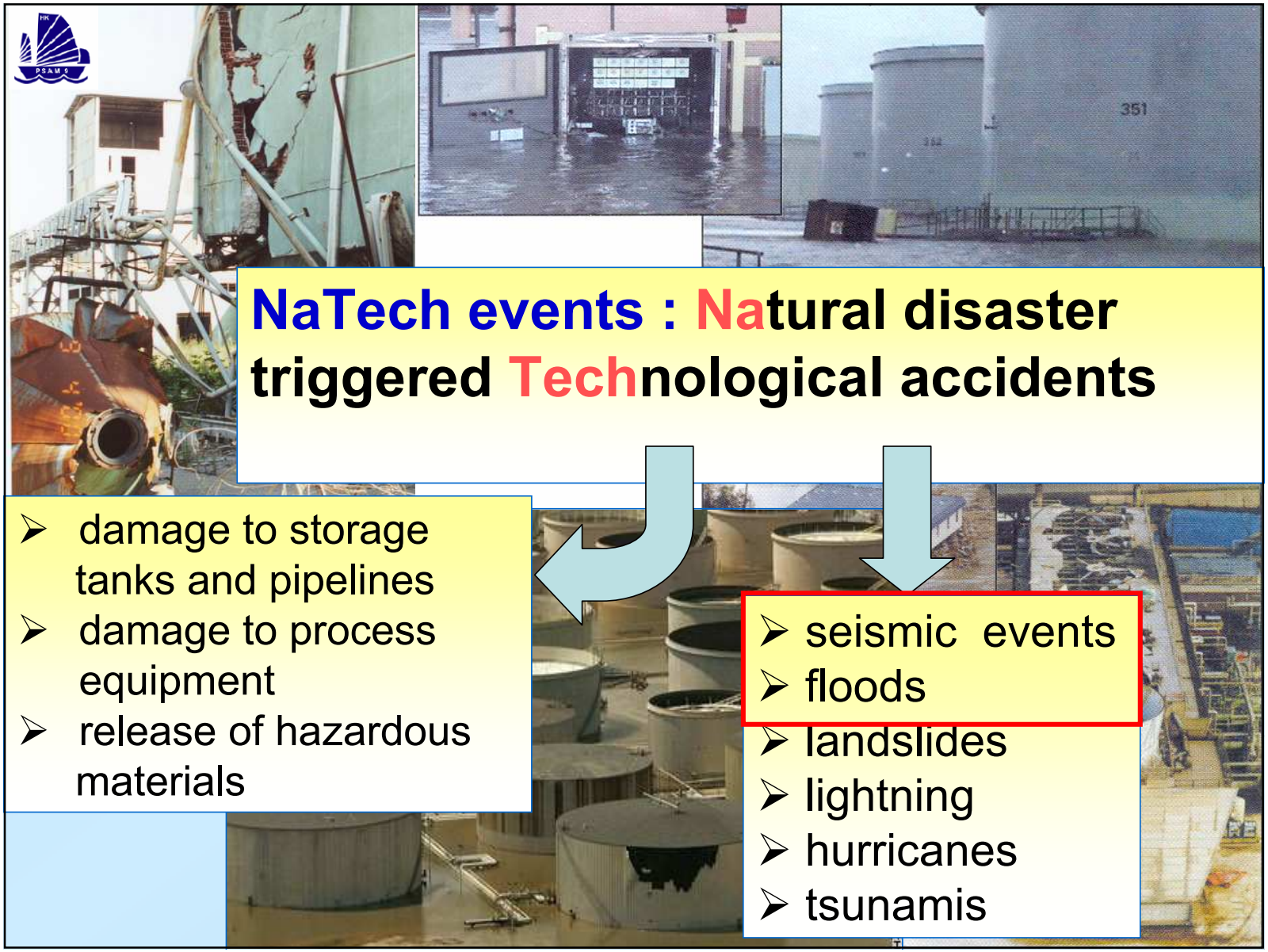
Analysis of NaTech Accidents recorded in Major Accident Databases

Michela Campedel[1], Valerio Cozzani[1],
Elisabeth Krausmann[2], Ana Maria Cruz[2]

(1) Alma Mater Studiorum – Università di Bologna
Dipartimento di Ingegneria Chimica, Mineraria
e delle Tecnologie Ambientali, Bologna, Italy

(2) European Commission, Joint Research Centre
MAHB, Institute for the Protection and
Security of the Citizen, Ispra (VA), Italy



NaTech events : Natural disaster triggered Technological accidents

- damage to storage tanks and pipelines
- damage to process equipment
- release of hazardous materials

- seismic events
- floods
- landslides
- lightning
- hurricanes
- tsunamis

Aims

- Retrieval and analysis of NaTech accidents recorded in Major Accident Databases
- Identification and analysis of damage modes of equipment items due to natural events
- Identification and analysis of consequences of releases of hazardous substances in NaTech events
- Identification of specific event trees for post-release scenarios during NaTech events

Historical Analysis of accident records

CRITERIA OF SELECTION:

- Industrial activities
- Hazardous materials

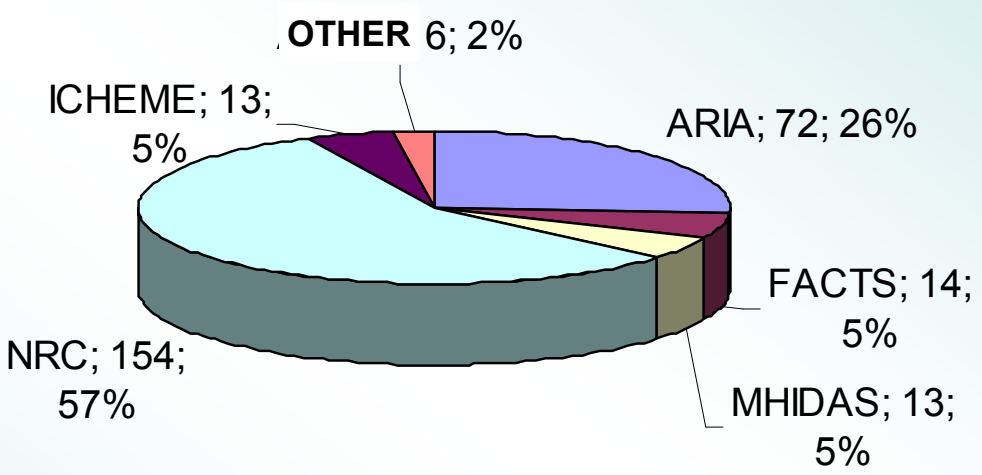
→ **Major accident**

- Specific equipment categories

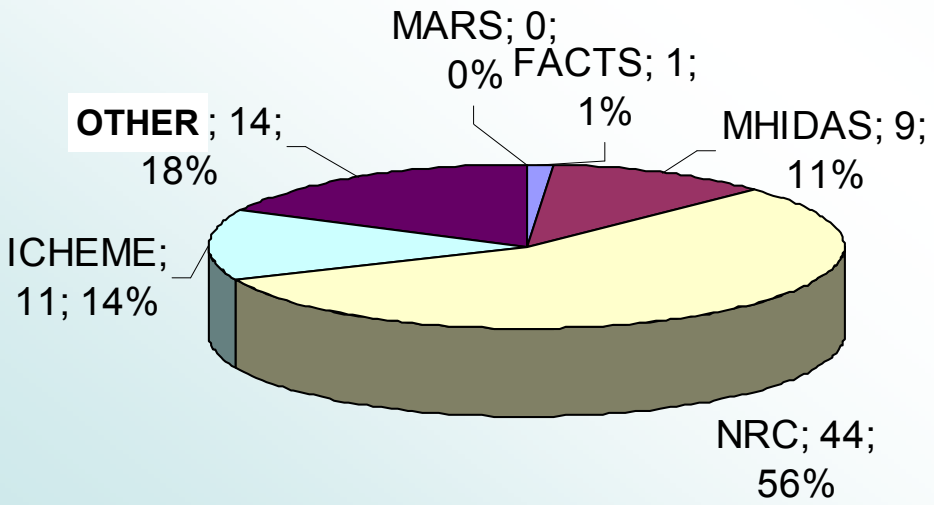
- **Loading/unloading and transport**
  pipeworks, pumps, compressors
- **Storage**
  atmospheric/pressurized storage tanks, warehouse
- **Process**
  process vessels, reactors, heat exchangers, pipeworks, pumps, compressors

Major Accident Databases:

	% Na-Tech accidents	Total records
ARIA (BARPI)	2÷3	30859
FACTS (TNO)	2÷3	22214
ICHEME	u.a.	u.a.
MARS (MAHB)	4÷5	602
MHIDAS (HSE)	2	7000
NRC	u.a.	u.a.



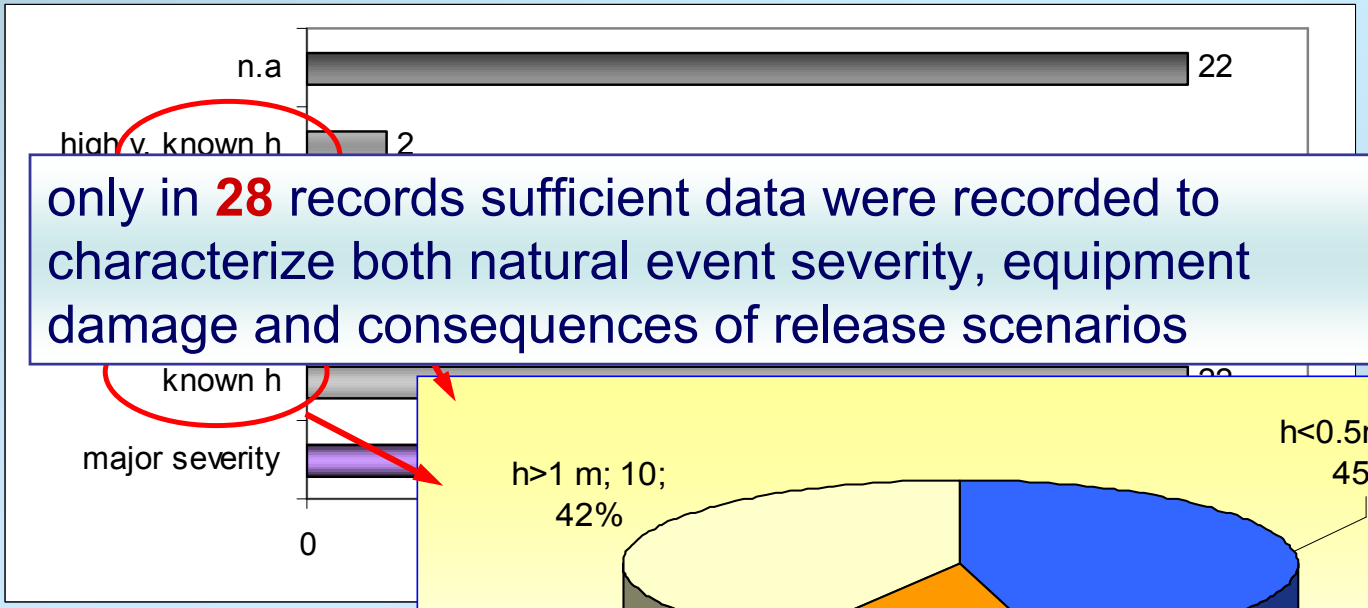
Accidents triggered by **floods:** **272** records (1960-2007)



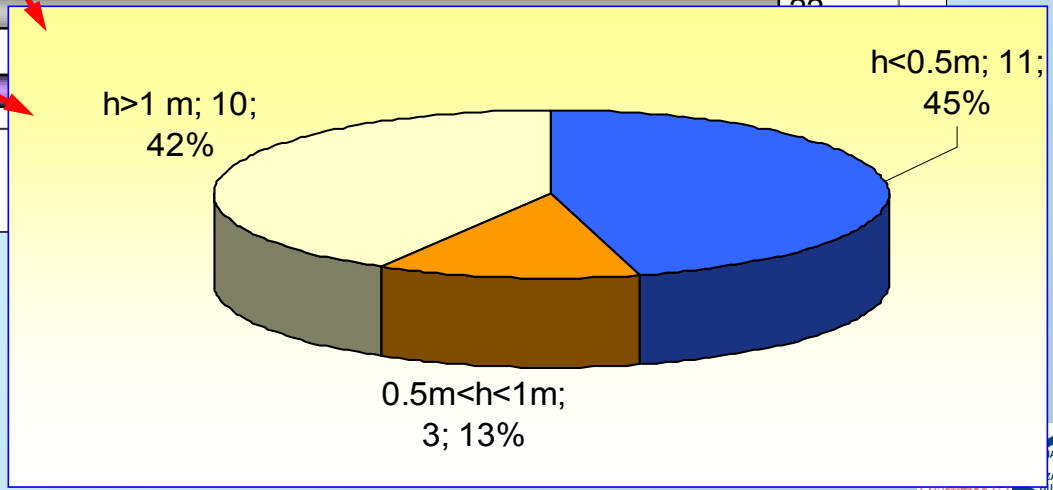
Accidents triggered by **earthquakes:** **78** records (1930-2007)

Example I: Floods

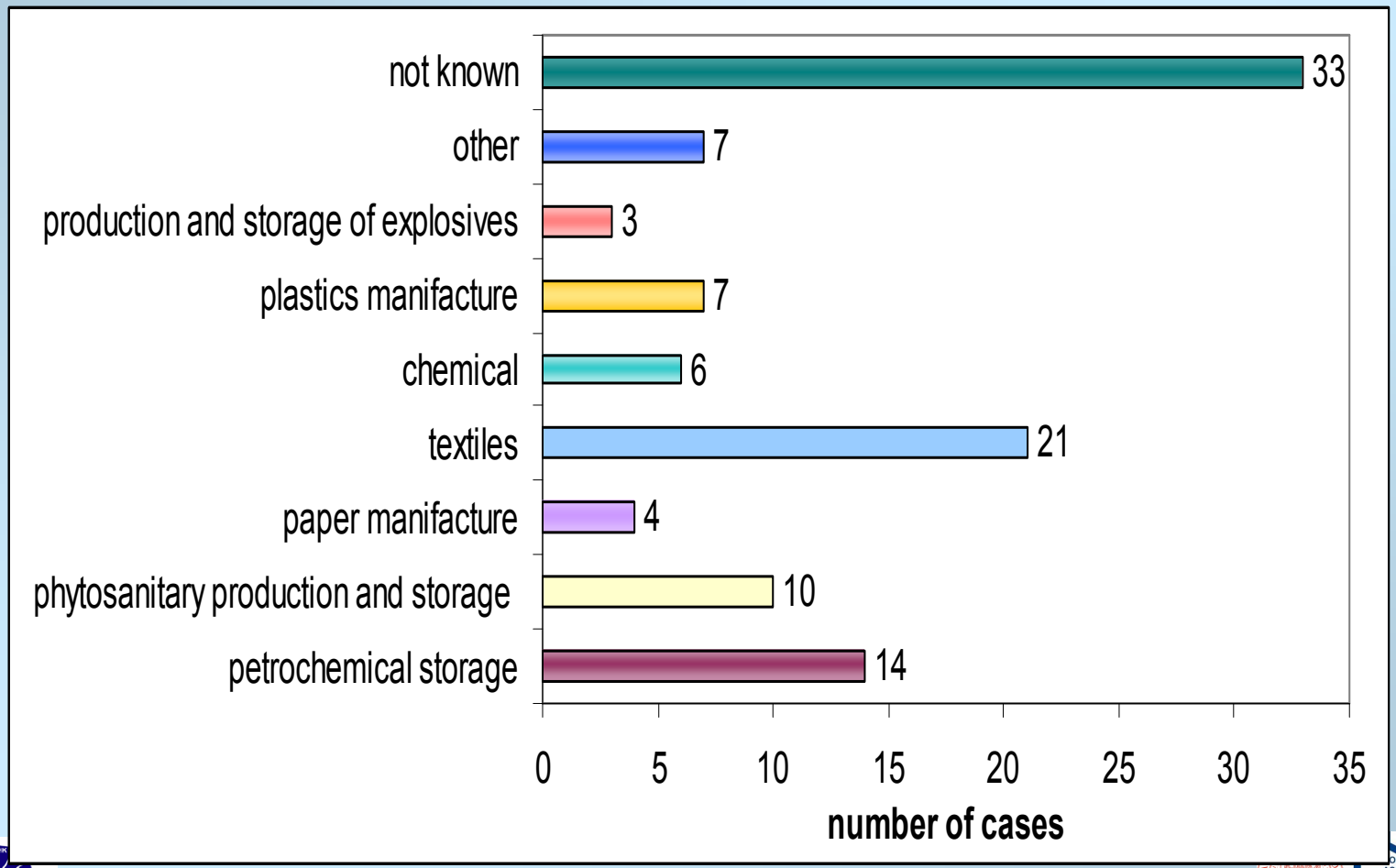
272 number total of records
70 records report details on the flood (water height, etc.)



only in **28** records sufficient data were recorded to characterize both natural event severity, equipment damage and consequences of release scenarios

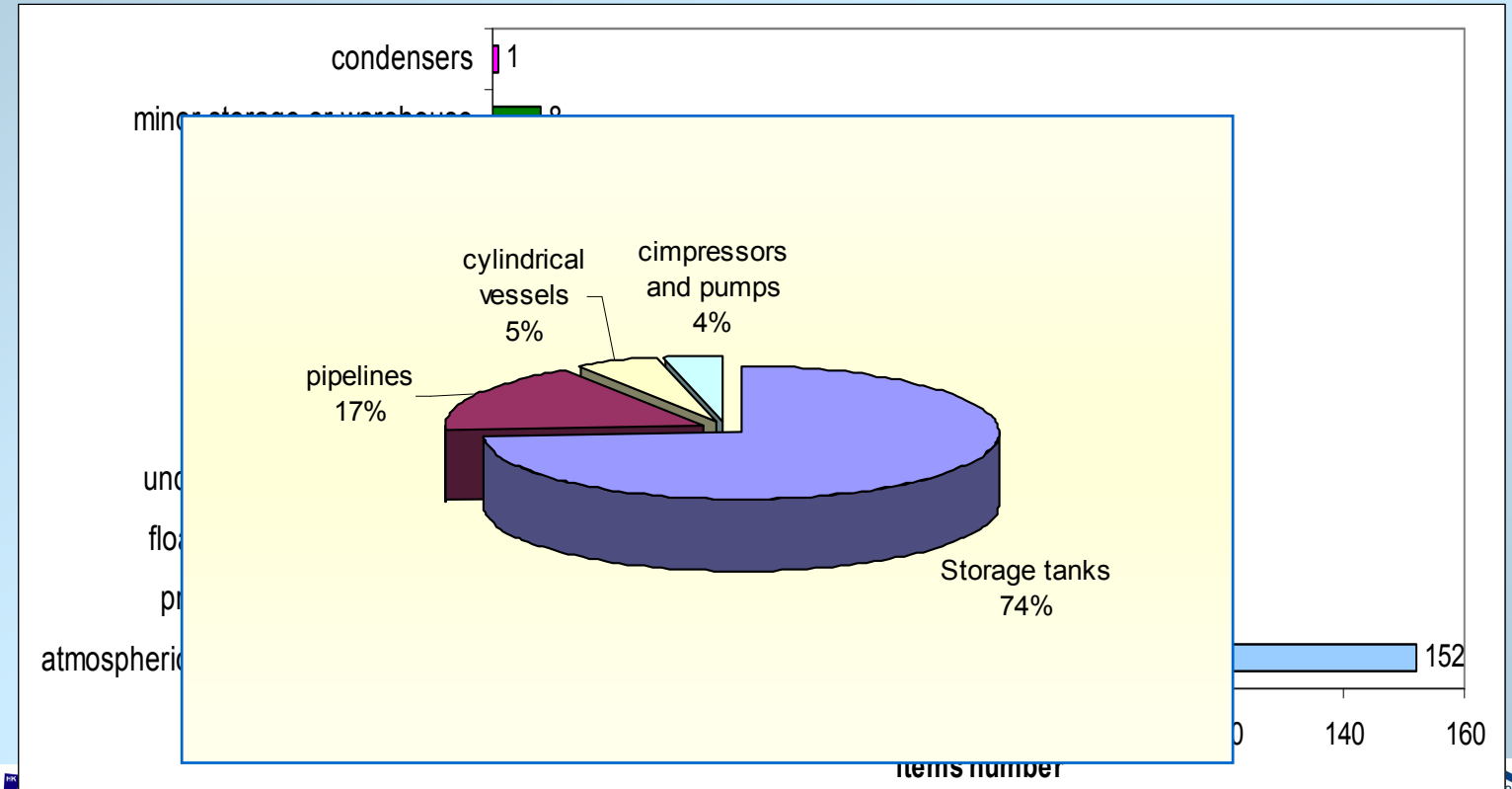


Floods: Industrial Activities involved



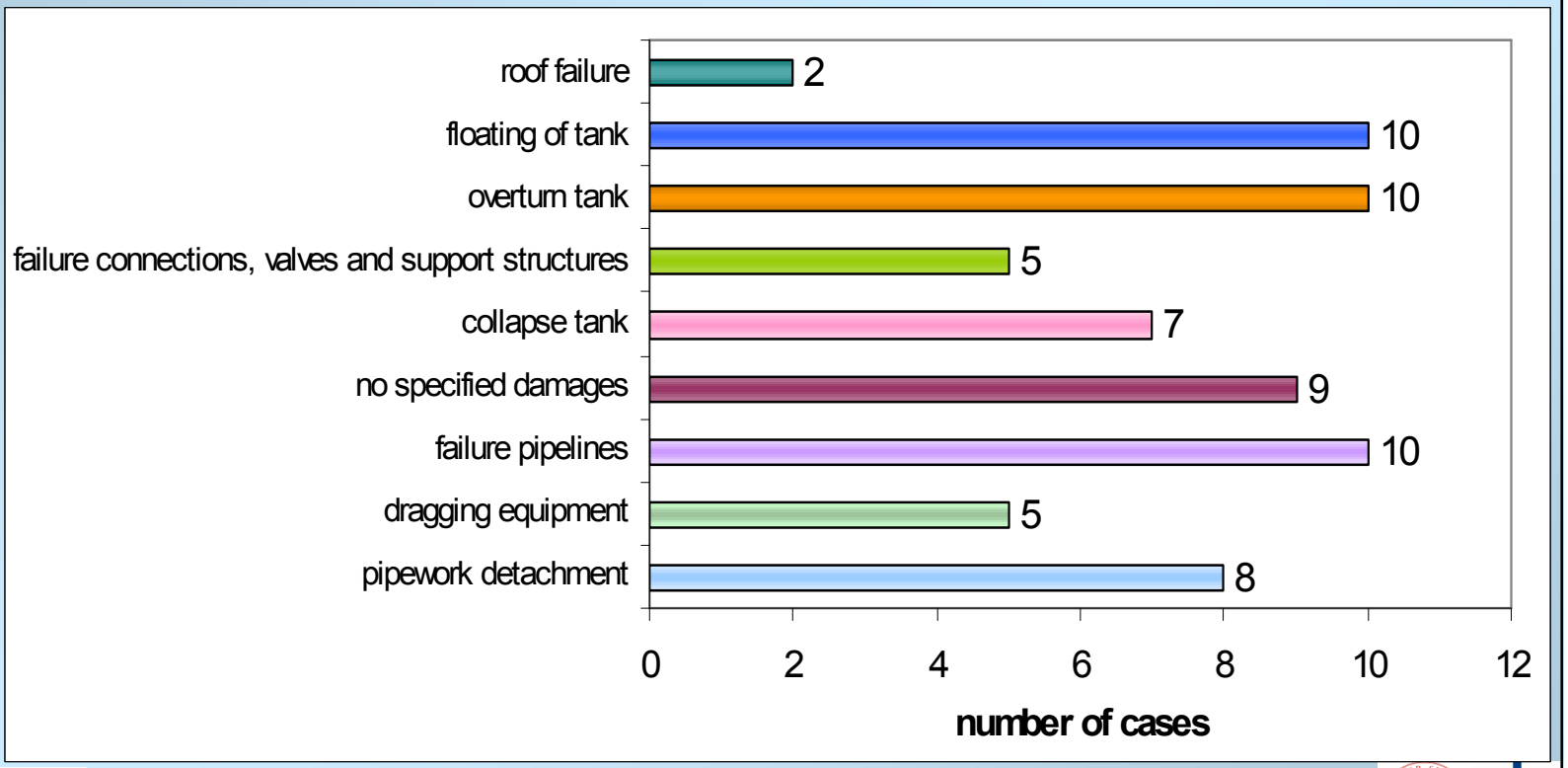
Floods: Damage to Equipment

Categories of process equipment damaged in **272 NaTech events** triggered by floods



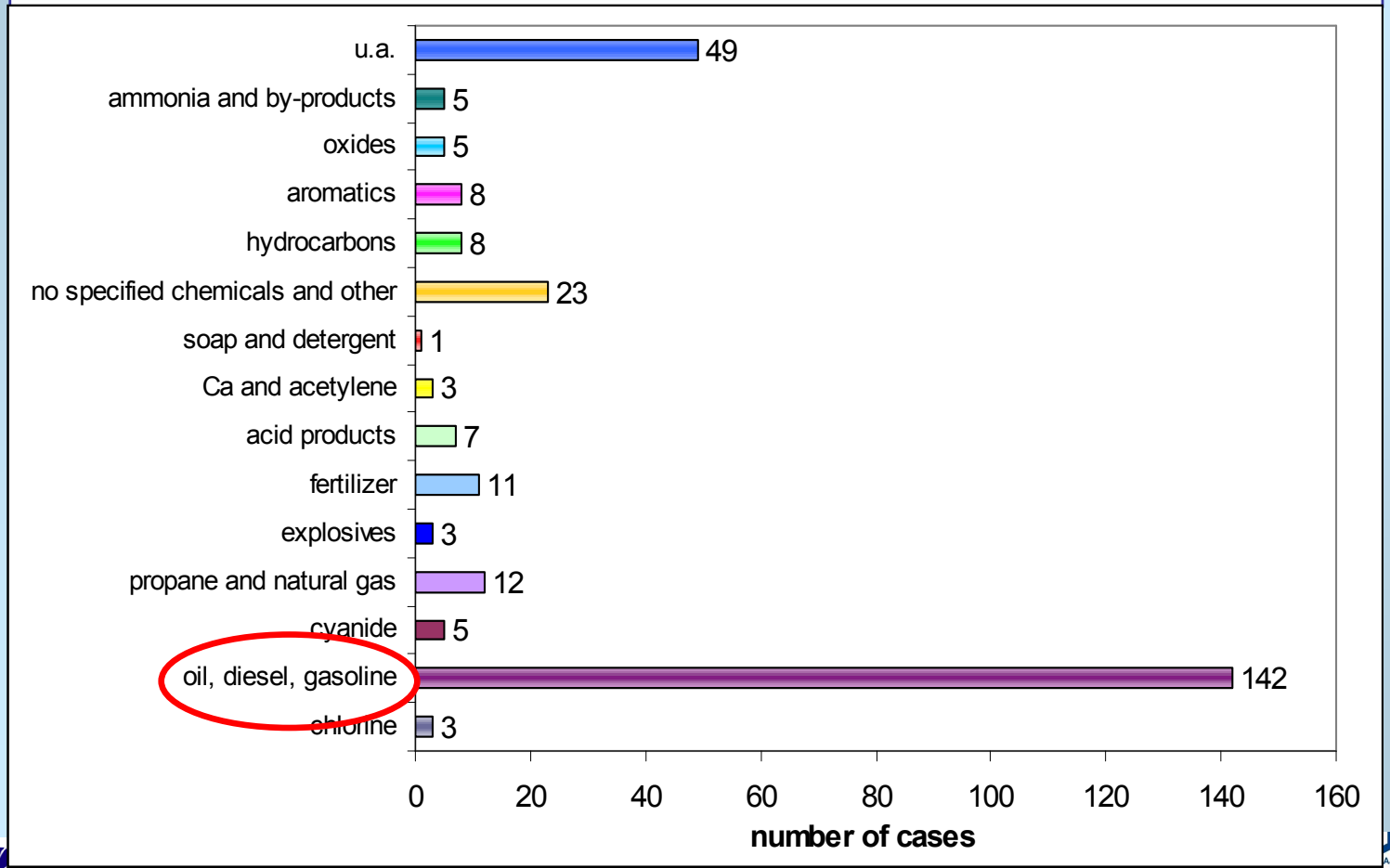
Floods: Damage to Equipment II

Type of damage to equipment (from **66** records where sufficient data was reported)



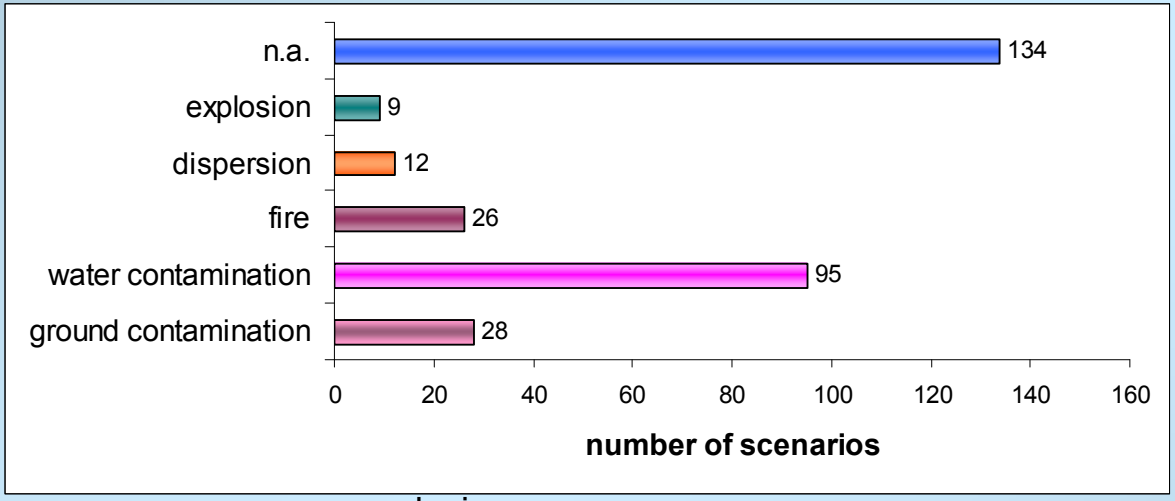
Floods: Substances Released

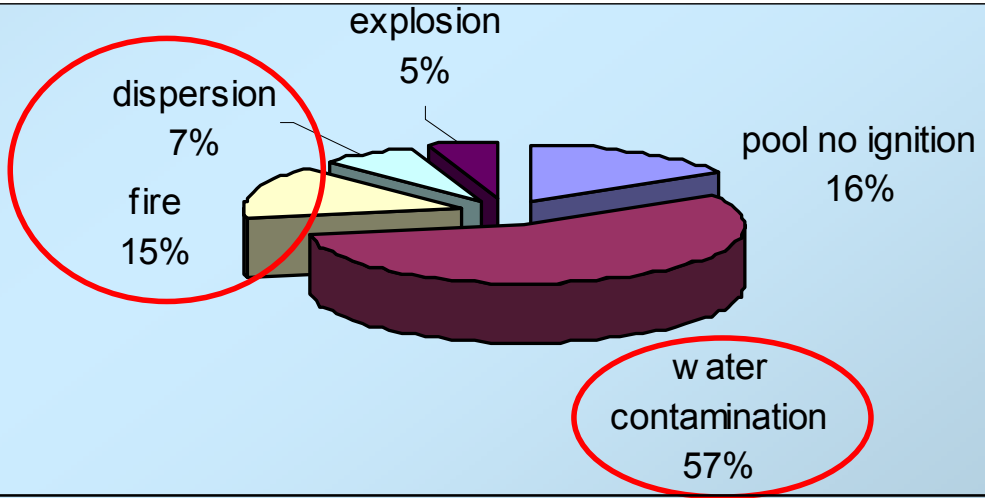
Substances released in NaTech accidents triggered by floods

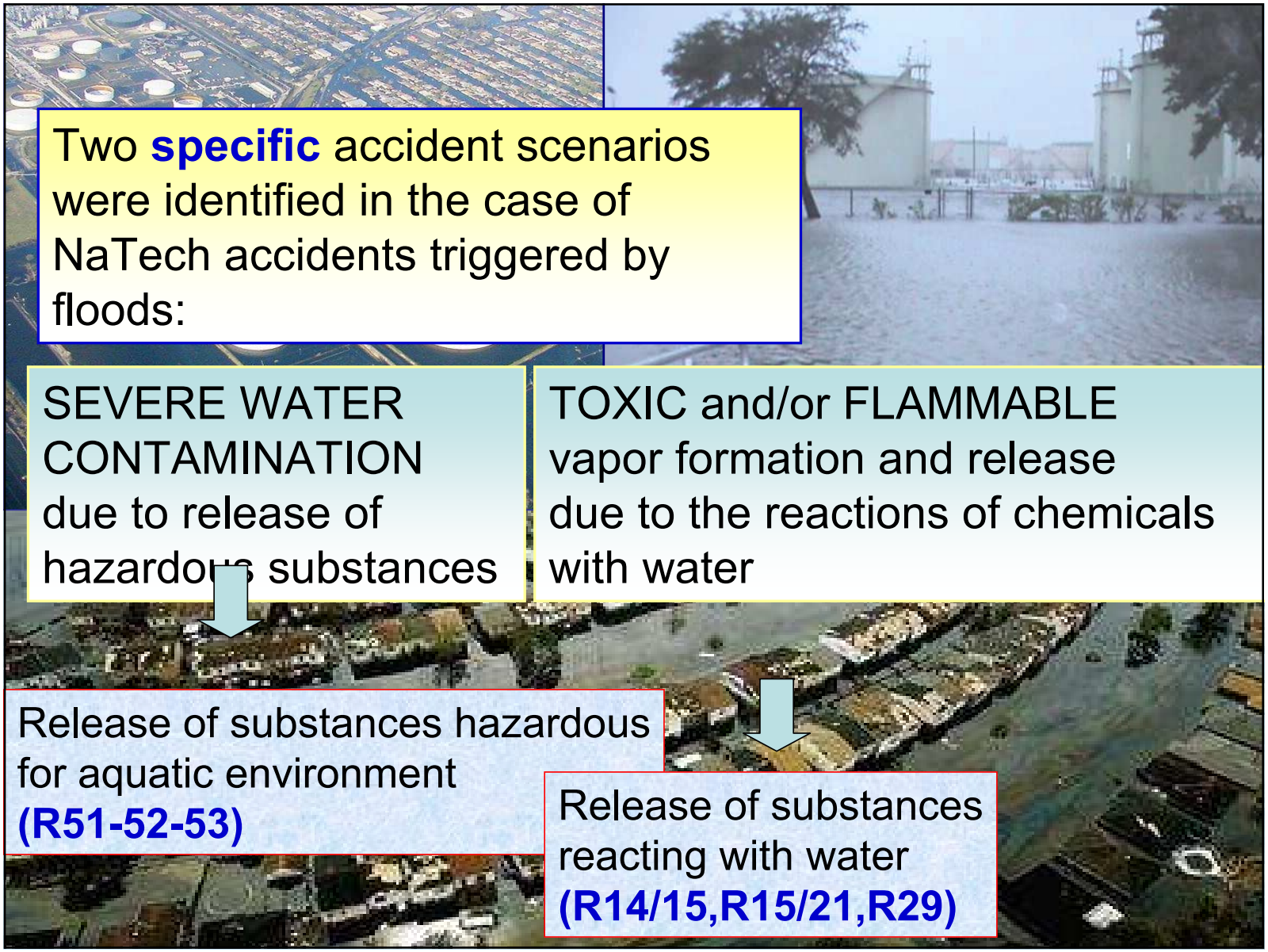


Floods: Final Scenarios

Final scenarios in NaTech events triggered by floods

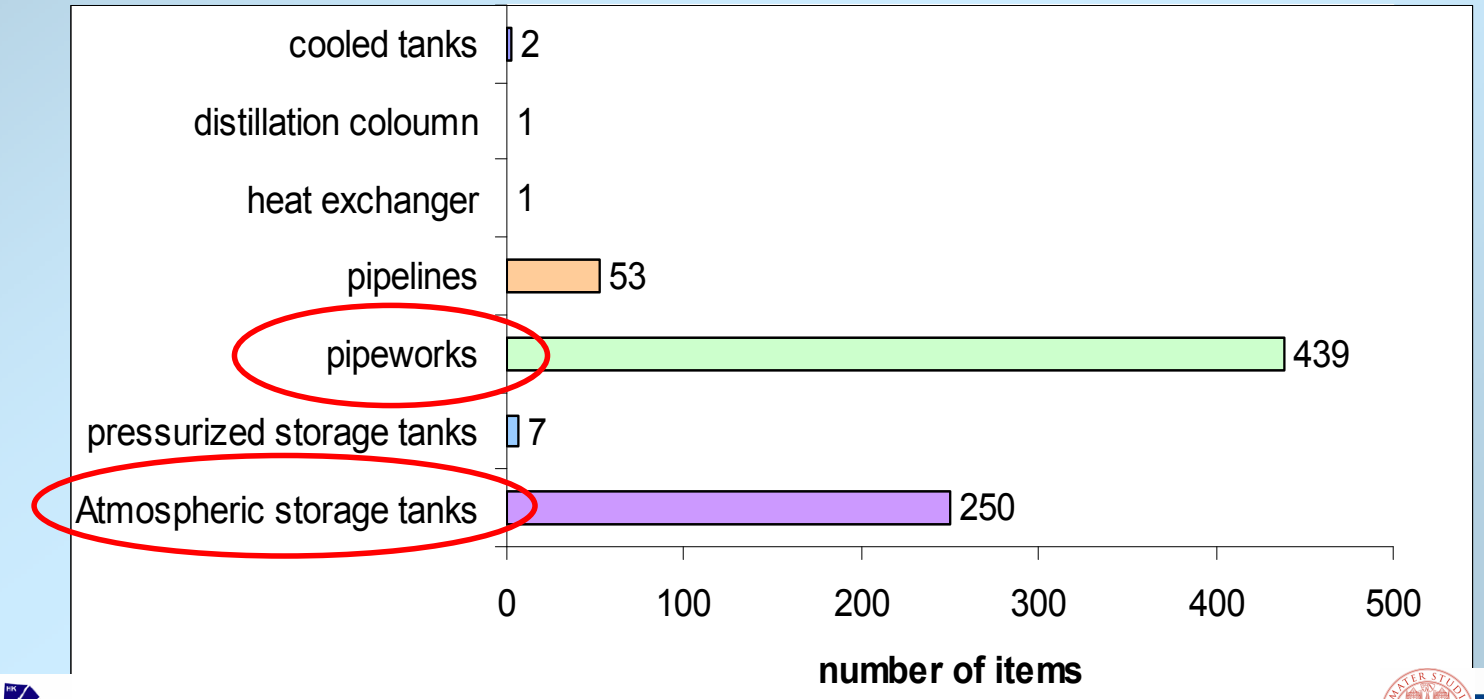





Two **specific** accident scenarios were identified in the case of NaTech accidents triggered by floods:
SEVERE WATER CONTAMINATION due to release of hazardous substances
TOXIC and/or FLAMMABLE vapor formation and release due to the reactions of chemicals with water
Release of substances hazardous for aquatic environment **(R51-52-53)**
Release of substances reacting with water **(R14/15,R15/21,R29)**

Example II: Earthquakes Damage to Equipment

Damage to process equipment experienced during earthquakes – data from **78** events reported in accident databases



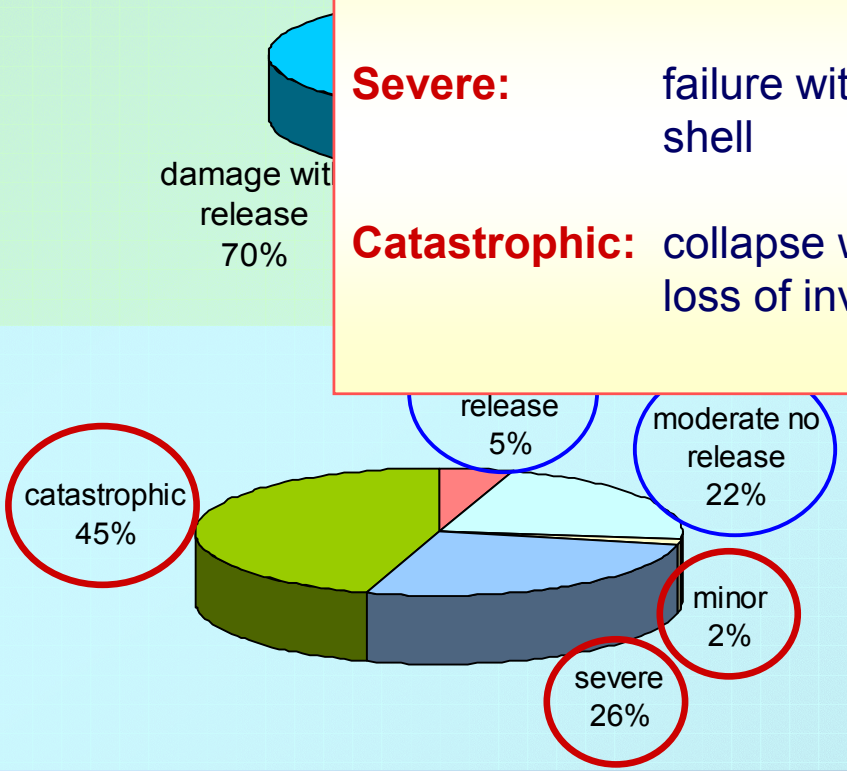
Earthquake: Damage to Equipment

Analysis of damage experienced by **257** process and storage vessels in **33** different earthquake events

Minor: leak from flanges or connections

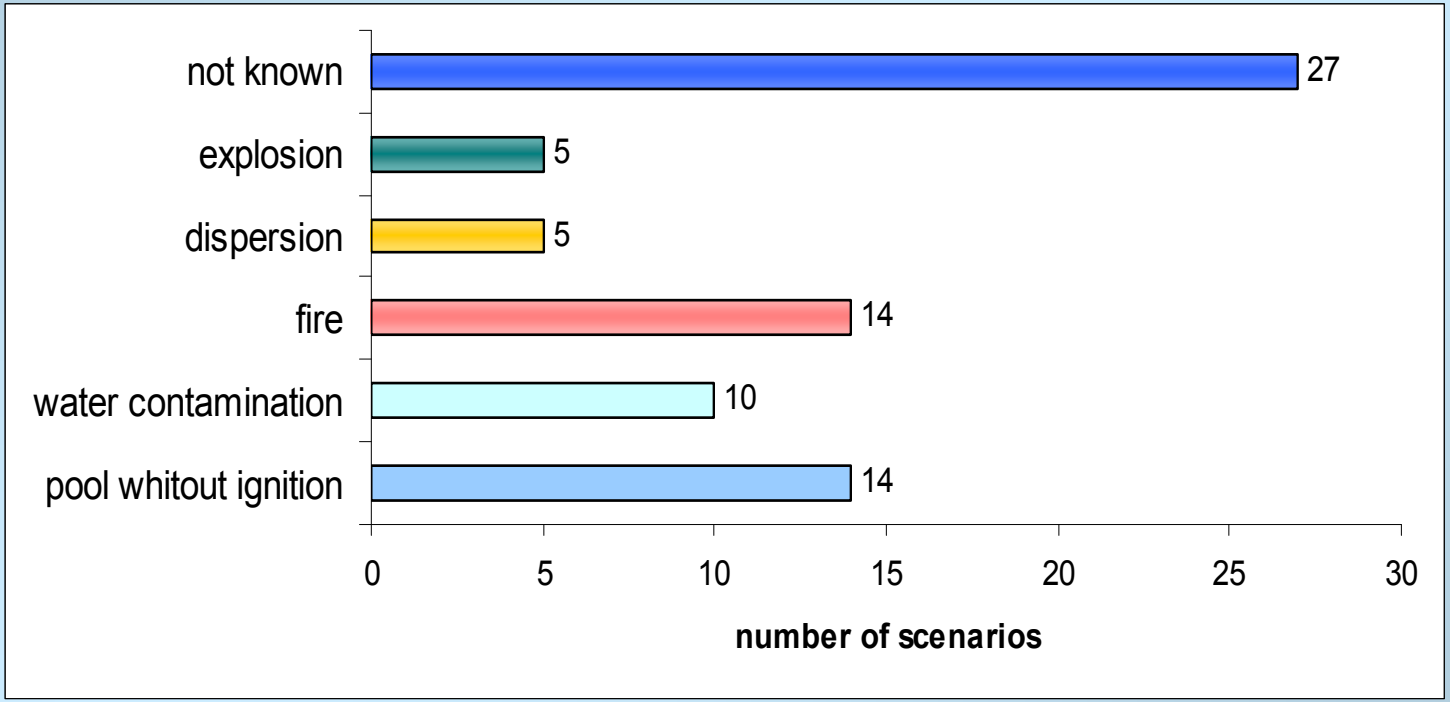
Severe: failure with loss from shell

Catastrophic: collapse with complete loss of inventory



Earthquake: Final Scenarios

Final scenarios in **78** release events triggered by earthquakes in process plants



Earthquake: Statistical data

Data from the analysis of **33** events with detailed data related to storage tanks and process vessels where the release of of **flammable** substances took place

Number of seismic events	29
Number of damaged equipment	≥254
Max number of damaged equipments in one event	97
Medium number of damaged equipments in one event	9
Number of damaged equipments with release	≥180
Number of cases of release with ignition	≥137
Ignition probability	0.761

Conclusions

- ☑ Main expected damage modes were identified for the impact of floods and earthquakes in process plants and storage farms.
- ☑ Data collected on final scenarios allow the identification of specific event tree for post-release scenarios in NaTech events.
- ☑ Retrieved data may be one of the elements for the development of simplified equipment damage models in NaTech events.
- ☑ Quality of available data on NaTech events is scarce: the development of a specific database may be an important element for the analysis, prevention and mitigation of these events.