iNTeg-Risk: Early Recognition, Monitoring and Integrated Management of Emerging, New Technology Related Risks

PUBLIC AWARENESS PROMOTING NEW OR EMERGING RISKS: THE CASE OF INDUSTRIAL ACCIDENTS TRIGGERED BY NATURAL HAZARDS

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Integ-Risk and Na-Tech

T1.5.3 ERRA D3: Emerging risks related to interaction between natural hazards and technologies at community level

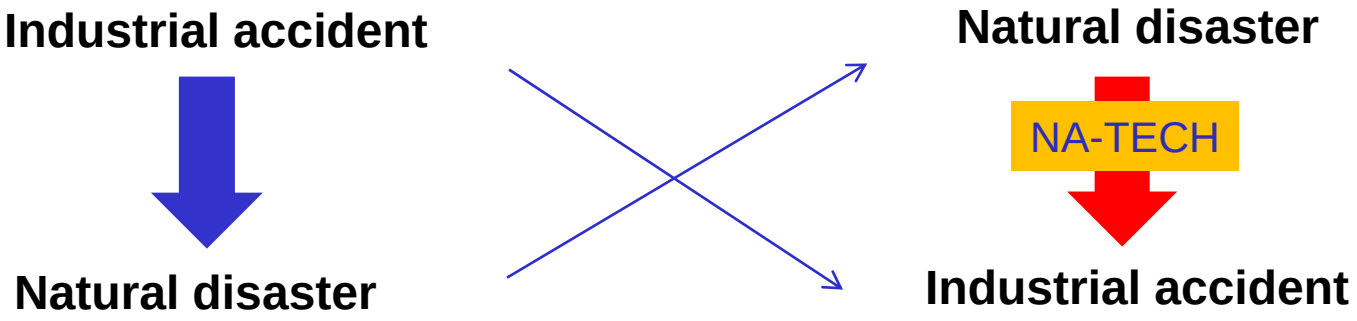
Objectives: improving the resilience of industrial facilities to technological accidents caused or aggravated by natural hazards

Description of work: Production of "Handbook of Good Practices for NATECH Mitigation“

Contribution to other SP:

- ✓ SP2: by structuring NATECH risks as a public policy and risk management issues
- ✓ SP3: by applying a methodology (vulnerability index and risk analysis) to two case studies
- ✓ SP4: by providing a handbook that will contribute to dissemination, training material etc.

Introduction: NA-TECH



- ✓ Spain (1998): 5 million m^3 toxic waste-water from Aznalcóllar Mine flowed into Guadiana river, directly polluting 4500 h of land and wiping out almost all life in the river.
- ✓ Seveso Accident (1976): large contaminated area by dioxin after run-away explosion
- ✓ …

- ✓ Katrina hurricane (2005) produced large environmental pollution after damaging
- ✓ Kobe earthquake (1995) resulted in overloading of emergency system, economical losses
- ✓ …

Chinese earthquakes (2008) … hundreds of people were trapped under two collapsed chemical plants in a town called Shifang, where 80 tons of leaked liquid ammonia caused the evacuation of 6000 people…

Introduction: NA-TECH

Engineering Design (e.g. API 650)

Only worst case or „reference“ natural event (snow, wind, earthquake),
Main attention to structural considerations (no interest to hazmat losses)

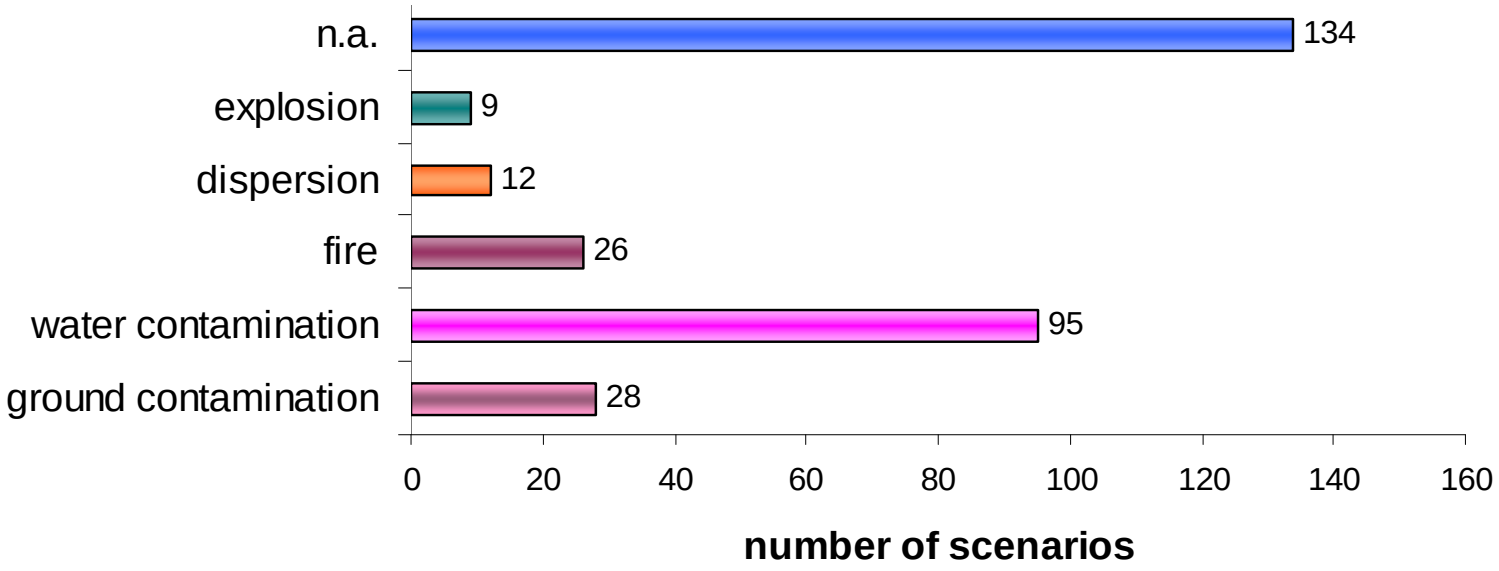
Multi-hazard Loss Estimation Methodology (HAZUS-MH)

Main attention to economical losses following structural damages
Oversimplified analysis for Na-Tech

Nuclear Industry (Nuclear-NaTech)

- ✓ **Even very small losses of contaminated materials have to be avoided**
- ✓ **Population, workers, management well informed**
- ✓ **Typically low likelihood of intense natural event (due to chosen location)**
- ✓ **No overloading of emergency system (only specialist for Nuclear-NaTech)**
- ✓ **Programmed shutoff (e.g. world larger nuclear plant shutoff in Japan after earthquake)**

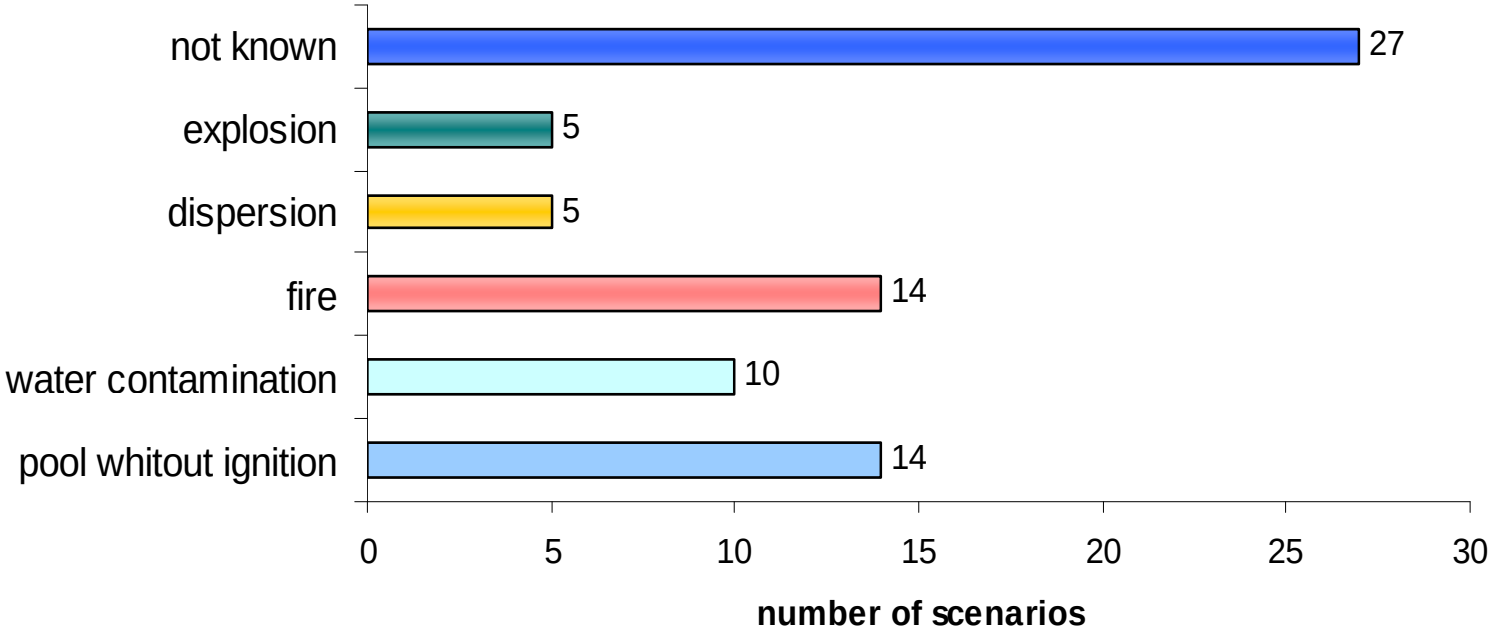
Introduction: NA-TECH



Accident scenarios initiated by flood events (Campedel et al., 2008)

Survey: 272 records (1960-2007), Database: IChemE, ARIA, Facts, Mhidas,NRC

Introduction: NA-TECH



Accident scenarios initiated by earthquakes (Campedel et al, 2008)

Survey: 78 records (1946 - 2007), Database: IChemE, ARIA, Facts, Mhidas,NRC

Public awareness: NA-TECH

Tupra refinery (Turkey) - Koaceli earthquake (1999)

Main issues: Overloading of emergency system
Strategic goods (oil) losses

Public awareness: NA-TECH

Katrina and Rita Hurricanes (2005)

Main issues: Environmental pollution
Economical losses
Long Early Warning

Public awareness: NA-TECH

Inclusion of new industrialised countries where natural events are frequent (risk perception) and public awareness is (was) scarce:

- ✓ **East Europe and Russia (after Chernobil)**
- ✓ **China (see Shifang) and Far East (Taiwan, Philippines, Indonesia)**
- ✓ **Indian Ocean countries (see Tsunami follow-up worries)**

Potential tsunami impact on a refinery in North-Eastern Sicily
[Cruz et a., Geoph. Res.Abs., 11, 2009]

Public awareness: NA-TECH

Showalter P.S., Myers M.F. (1992), *Natural disasters as the cause of technological emergencies: a review of the decade 1980-1989*, Working Paper n°78, Natural Hazards Research and Applications Information Center – University of Colorado.

Clerc A., Le Claire G. (1994), *The environmental impacts of natural and technological (na-tech) disasters,* Background discussion paper for The World Conference On Natural Disaster Reduction, Yokohama, Japan

Lindell M. K., Perry R.W. (1996), *Identifying and managing conjoint threats: Earthquake induced hazardous materials releases in the US*, Journal of Hazardous Materials 50.

More recent review

Cruz, A. M., Steinberg, L. J., Vetere-Arellano, A. L., Nordvik, J. P., and Pisano, F. (2004), *State of the Art in Natech (Natural Hazard Triggering Technological Disasters) Risk Assessment in Europe,* Report EUR 21292 EN, DG Joint Research Centre.

Young S., Balluz L., Malilay J. (2004), *Natural and technologic hazardous material releases during and after natural disasters: a review,* Science of the Total Environment 322.

NA-TECH as NEW RISK

NA-TECH RISKS ARE NEW RISKS WHICH HAVE TO BE:

1) DEFINED

i. **Environmental damage**
ii. **Human damage**
iii. **Economical Losses**
iv. **Risk Acceptability Parameters**

NA-TECH as NEW RISK

NA-TECH RISKS ARE NEW RISKS WHICH HAVE TO BE:

2) ASSESSED: NEW METHODOLOGIES

- ✓ **Large-scale (often on the natural side)**
- ✓ **Intrinsically multi-disciplinary (Prediction)**
- ✓ **Mitigation system often un-practicable (Mitigation)**
- ✓ **Overloading of emergency systems (Response)**

NA-TECH as NEW RISK

PREVENTION

i. Structural measures

ii. Organisational measures

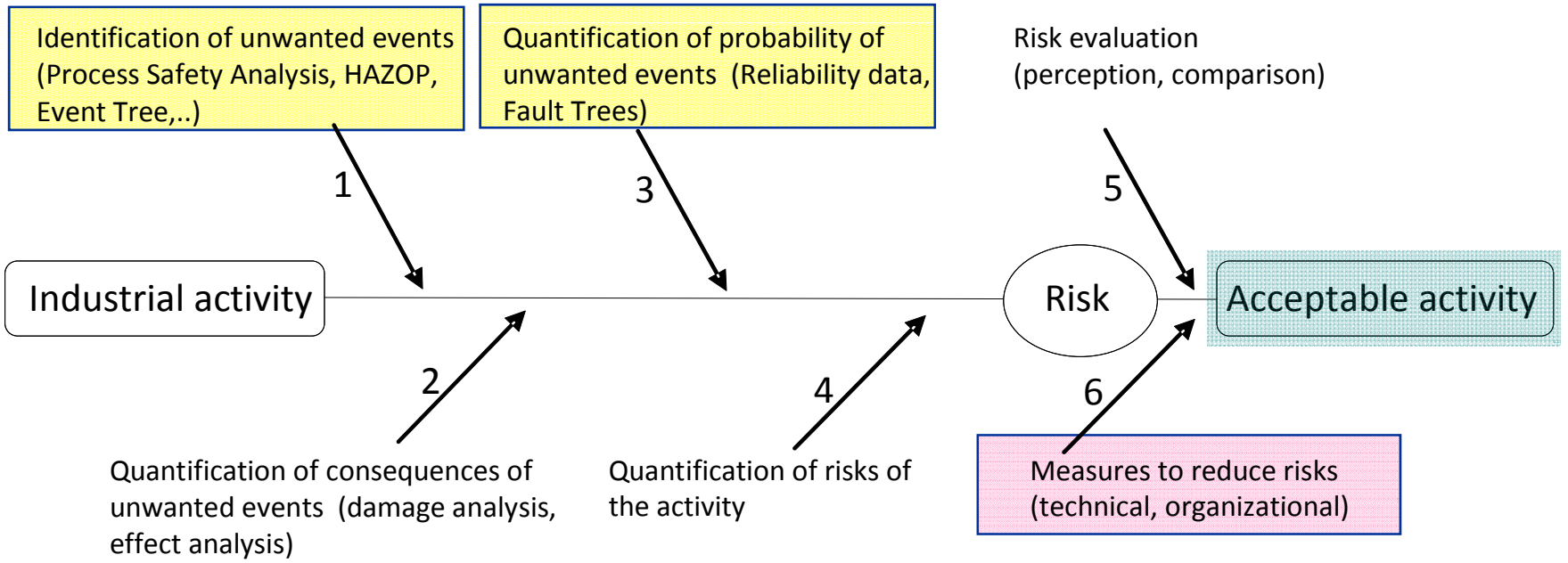
iii. Na-Tech **Early Warning Systems** are now possible

(even for “fast” events (earthquake) :

- ✓ sensor systems (network)
- ✓ rapid elaboration of signals (e.g. for seismic wave)
- ✓ automatic ***safety interlock system***
- ✓ fast shut-off
- ✓ ***hazmat*** transportation blockage

NA-TECH: What to do!

Na-Tech risk assessment: developing new methodology



1) Hazard of Natural Event
2) Equipment Vulnerability to Natural Event
3) Mitigations system evaluation (Na-Tech damage)
4) Na-Tech Acceptability criteria: new definition!!

NA-TECH: What to do!

SIMPLIFICATION IS NEEDED

- **Single or double degree-of-freedom definition of natural hazard**
- **Threshold values for *Na-Tech Hazard***
- **Threshold values for *Equipment Vulnerability* in terms of structural damage (damage state)**
- **Threshold values for *Equipment Vulnerability* in terms of loss of containment (risk state)**
- **Simple *Acceptability Parameters* for industrial installation or areas**

Conclusions

- Future conference (accepted papers/abstract) where Integ-risk is explicitly cited (Conprici):

  World Congress of Chemical Engineering (Montreal, 2009)

  Loss Prevention in the Process Industries (Brugge, 2010)

- Thanks you for your attention

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