unione petrolifera

Attuazione D.lgs 105/15 (Seveso) «Tematiche rischi di incidenti rilevanti Na-Tech: potenziali impatti meteo, idrogeoligici e cambio climatico»

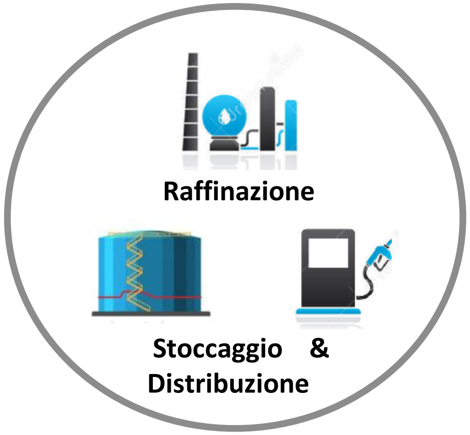
Fausto Sini
Unione Petrolifera
Sicurezza, Salute e Ambiente

5° SEMINARIO DI AGGIORNAMENTO
PER ISPETTORI AMBIENTALI ISPRA
Roma 14 OTTOBRE 2019

L’Unione Petrolifera oggi

L’Unione Petrolifera riunisce le principali aziende petrolifere che operano in Italia nell’ambito della raffinazione del petrolio, della logistica, della distribuzione dei prodotti petroliferi e dei biocarburanti necessari a garantire la mobilità di merci e persone (il cosiddetto downstream petrolifero)
Con 41 aziende associate, nazionali e internazionali, e 21 soci aggregati rappresenta il settore nelle sedi istituzionali e costituisce il fulcro delle iniziative di analisi e studio del comparto sui temi tecnici, economici e ambientali

La tutela dell’ambiente, l’attenzione per la sicurezza, l’impegno nella ricerca e nell’innovazione sono i valori fondamentali e irrinunciabili di Unione Petrolifera, al servizio di un comparto industriale moderno e vitale



Il downstream petrolifero

LE INFRASTRUTTURE

- ***13 raffinerie*** *distribuite sull’intero territorio nazionale,* ***di cui 2 bioraffinerie***
- *Una* ***logistica con oltre 100 depositi di capacità superiore a 3.000 mc*** *e* ***2.700 km di oleodotti***
- *Una* ***distribuzione*** *capillarmente diffuse sul territorio, con circa* ***21.000 punti vendita****.*

GLI OCCUPATI

- ***21.000 occupati diretti*** *con elevata scolarizzazione (il 20% è laureato) oltre ad un* ***indotto di altri 130.000****, con l’ausilio di mano d’opera altamente specializzata*
- ***Un indice di frequenza e gravità degli infortuni molto più basso di qualsiasi altro settore manifatturiero***
- *Un altissimo contributo tecnologico, con* ***oltre 1.000 brevetti registrati***

GLI INVESTIMENTI

Nel periodo dal 2014 al 2019 il settore petrolifero ha sostenuto uno sforzo notevole, economico e tecnologico (oltre 6 Miliardi €) soprattutto focalizzati a continui miglioramenti in campo ambientale e sicurezza (circa 50%)
Nel triennio 2020-2022 sono previsti ulteriori investimenti per oltre 3 miliardi di cui per ambiente e sicurezza circa 45%

IL CONTRIBUTO ALL’ECONOMIA

- *Produce* ***100 miliardi di euro di fatturato annuo***
- *Incassa per conto dello Stato* ***39 miliardi di euro tra accise e IVA***
- *Contribuisce alla* ***bilancia commerciale con 13 miliardi di euro di prodotti raffinati***

ANDAMENTO PERFORMANCE SICUREZZA SUL LAVORO

L'industria petrolifera prosegue nel miglioramento continuo delle prestazioni sicurezza e prevenzione rischi, intensificando le iniziative per il miglioramento del fattore umano tramite programmi di formazione e partecipazione del personale, intesi a determinare una sempre più diffusa cultura della sicurezza.
L'impegno costante si è concretizzato in risultati oggettivi, come evidenziano gli indici di frequenza e quelli di gravità degli infortuni sul lavoro nel settore petrolifero, che si confermano da lungo tempo essere fra i più virtuosi nelle classifiche stilate da INAIL.

	Frequenza infortuni denunciati (*) per 1000 addetti (**)			**Frequenza Mortalità accertate (*) per milione di addetti (**)**		
Comparto	Frequenza media 2014-2018	Frequenza 2014	Frequenza 2018	Frequenza media 2014-2018	Frequenza 2014	Frequenza 2018
Totale Manifatturiero	20,13	20,15	21,04	21,4	22,9	17,6
Totale Downstream petrolifero **(***)**	2,64	2,94	1,95	0	0	0

(*) Riferimento dati INAIL, appendice statistica relazione annuale 2019.
(**) Calcolo su numero lavoratori anno 2017
(***) Riferimento dati Unione Petrolifera

Andamento riduzioni emissioni in atmosfera nel Settore Petrolifero

Nel campo ambientale, nel periodo dal 1990-2017, il settore petrolifero ha ridotto drasticamente le emissioni in atmosfera.

I dati actual 2017, prodotti da ISPRA, **evidenziano rispetto al 1990 riduzioni:** SOx **90%**; NO**x** 62%; **PM10 e PM2,5 oltre il 90% e NMCOV oltre il 75% (ove PM10, PM2,5 e NMCOV in ogni caso del tutto marginali rispetto al totale nazionale e a singoli altri settori).**

- **Ciò pone il settore petrolifero in una posizione decisamente confortevole rispetto agli impegni totali nazionali della direttiva *NEC* , di riduzione delle emissioni nazionali, rispetto all'anno 2005, previsti dal 2020-2029 e anche 2030.**

2017 vs 1990

	Emissioni nel 1990	Riduzioni raggiunte nel 2017	
	KTONS	KTONS	%
SOx	271,9	241,0	88,6
NOx	42,5	26,6	62,7
PM10	6,4	6,0	93,7
PM2,5	4,3	4,0	94,3
NMVOC	27,8	21,0	75,6

2017 vs 2005

	Emissioni nel 1990	Riduzioni raggiunte nel 2017	
	KTONS	KTONS	%
SOx	105,5	74,5	71,8
NOx	31,1	15,2	49,1
PM10	2,1	1,7	80,7
PM2,5	1,3	1,1	81,5
NMVOC	27,5	20,7	75,3

Riferimento: ISPRA codici SNAP- Totale Raffinerie + Industria petrolifera + Torce

Na-Tech « Natural Events Triggering Technological Disasters»

Back-Ground

Na-Tech are **natural events of ecceptional severity** that «shock» one or more zones of a large area, **triggering multiple and simultaneous cacasde accidents in industrial establishments there located (*)**, which:

- amplify the damages caused in the territory by natural events
- cause major consequences to human health, environment, residential public areas, production and commercial activities

Na-Tech have a double risk composition

- **are originated by specific types of Natural hazards:**
- **Geofisico:** earthquakes, Tsunami, volcanoes eruptions;
- **Idro-geologico:** floods, landslide;
- **Meteo:** storms, tornado, lightening.
- **that interact with the activities of the establisment, triggering Tecnological disasters** such as fires, explosions, toxic releases in air, soil, superficial/undergound waters.

D.Lgs105/15 esplicita e richiede maggior attenzione ai rischi Na-Tech (Allegato 2-RDS, punto 4 «identificazione e analisi rischi incidenti», lettera a).

Na-Tech events significantly increased. In Europe is about duplicated in the period 1980-2009. **Italy most exposed country in the Mediterranean sea**.

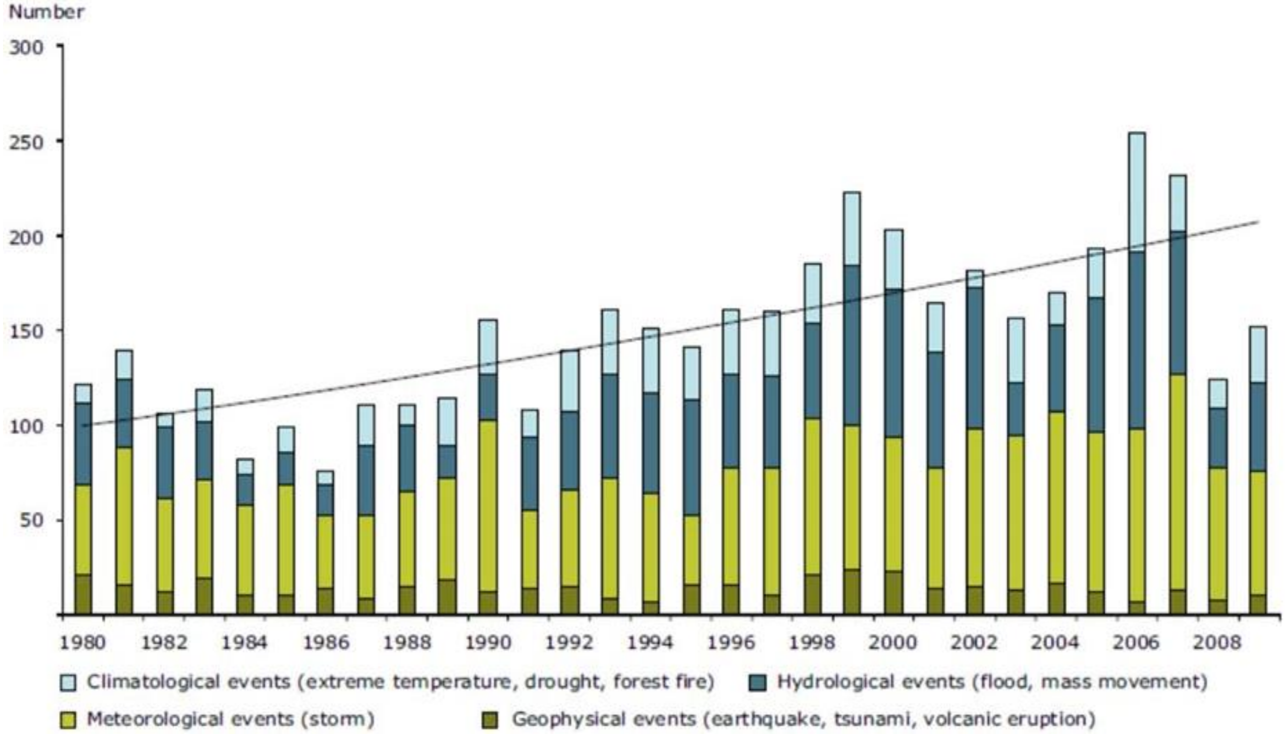
- **experience shows storage tanks and connecting piping are the most vulnerable equipment**.
- **need raising knowledge and international and national legislation to improve the risk assessment** and to prevent and mitigate the effects on civil buildings, infrastructures and industrial facilities.

(*) il problema si è accentuato anche a seguito della estensiva e progressiva urbanizzazione, soprattutto negli ultimi anni, nelle zone ove sono ubicati gli impianti industriali

Rapporto EEA, Technical report n. 13, 2010

Na-Tech events in Europe (period 1980-2009)

Trend of estreme natural events occurred in Europe, period 1980-2009 (**Mapping of natural disasters EEA, Technical report n. 13, 2010**).



Na-Tech-Tematica valutazione Rischi (1/2)
I tipici metodi convenzionali

- **In via generale i rischi derivanti da «*pericoli o cause operative interne allo stabilimento*»** è valutato dal prodotto della probabilità di occorrenza dell'evento incidentale rilevante **(P)** per la magnitudo **(M)** relativa alla gravità delle conseguenze attese.

Rischio operativo= (P x·M)

- **I rischi derivanti/causati da «*pericoli o disastri naturali*»** come terremoti o perturbazioni geofisiche (quali alluvioni, tempeste, frane, forti venti, temperature estreme, ecc.) ed incendi boschivi, che potrebbero indurre incidenti rilevanti**,** tiene conto di **tre principali fattori**: **(1)** probabilità **(P)** associata al verificarsi di un evento naturale di determinata intensità, **(2)** propensione delle apparecchiature/tubazioni a subire danneggiamenti **(Vulnerabilità V), (3)**estensione dei danni, con particolare riferimento al numero di persone, beni, infrastrutture, servizi potenzialmente coinvolti dagli effetti degli eventi incidentali rilevanti **(Esposizione E)**.

Rischio Na-Tech=f (PxExV)

Il rischio Natech può essere rappresentato, in termini analitici, dalla formula

Rischio = Pericolosità x Valore bene esposto x Vulnerabilità

- la **pericolosità** esprime l'entità del fenomeno e la probabilità che si manifesti in un arco temporale più o meno ampio;
- L'**esposizione** esprime la gravità dei danni alle persone, beni, infrastrutture, servizi potenzialmente coinvolti dagli effetti degli eventi incidentali
- la **vulnerabilità** può esprimersi come il danno atteso, ovvero la percentuale di riduzione del valore che il fenomeno calamitoso produce sul bene; si definisce atteso perché riferito ad un fenomeno la cui intensità e la cui frequenza non è certa, ma legata ad una curva di probabilità.

Per ridurre il rischio il gestore può quindi agire sui tre fattori (pericolosità, valore e vulnerabilità), ricercando, ove possibile, la miglior combinazione in termini di costi/ benefici.
Un elenco, del tutto indicativo, delle tipologie di effetti causati dall' evento naturale catastrofico:

☐☐vittime
☐☐edifici distrutti, danneggiati, minacciati
☐☐tronco stradale e/o ferroviario distrutto, danneggiato, minacciato
☐☐opere idrauliche distrutte, danneggiate, minacciate
☐☐opere di attraversamento distrutte, danneggiate, minacciate
☐☐coltivi distrutti, danneggiati, minacciati

Na-Tech-Tematica valutazione Rischi (2/2)
Alcuni metodi Innovativi

Abstract-JRC Technical Report EUR 29507 2018

The study presents lessons learned from the forensic analysis of past events and puts forward recommendations for future risk reduction for all storm effects. **The most important lesson is that storm predictions based on past events are not sufficient to be well prepared for future events, in particular in the face of climate change.**

Introduction-Bozza ISO/DIS 14091:2019(E) *Adaptation to Climate Change--Guidelines on vulnerability, impacts and risk assessment*

Risk assessments improve planning of adaptation to climate change and inform the implementation and monitoring of climate change adaptation activities. Adaptation is usually more effective when initiated at an early stage of project development, and when undertaken as a planned process, rather than in response to experiencing impacts.
Better knowledge of climate change risks will make it easier and cheaper to respond.

Climate change risks differ from other risks. Often little can be said about their short- or long-term probability so a conventional risk assessment which uses statistical probabilities can be ineffective. **For this reason, various approaches have been developed for assessing climate change risks and this document is a guide to the use of screening level assessments and impact chains.**

The screening level approach can serve as a stand-alone, simplified risk assessment for a straight forward system at risk or those with a limited budget, or serve as a pre-assessment prior to the use of impact chains. Based on a participatory and inclusive process, impact chains approaches provide an opportunity to address all relevant factors.
Both screening level assessments and impact chain assessments allow qualitative and quantitative analysis.

Vi sono vari esempi pratici e utili di applicazione metodi "*screening Level approach*" e "*Impact Chain*"

- impact chains for agriculture (less rain precipitation)
- Impact chain for temperature changes (heat, frost, snow)
- ecc

Rapporti ISPRA E MATTM importanti/utili per comprensione e valutazione rischi Na-Tech **Idrogeologico e Storms**

Ministero dell'Ambiente
e della Tutela del Territorio e del Mare

Direzione Generale per la Difesa del Suolo

IL RISCHIO IDROGEOLOGICO

IN ITALIA

Pubblicato nel ottobre 2008 sul sito internet del Ministero dell'Ambiente e della Tutela del Territorio e del Mare
www . minambiente . it. - sez. Biblioteca/Pubblicazioni/Difesa del Suolo

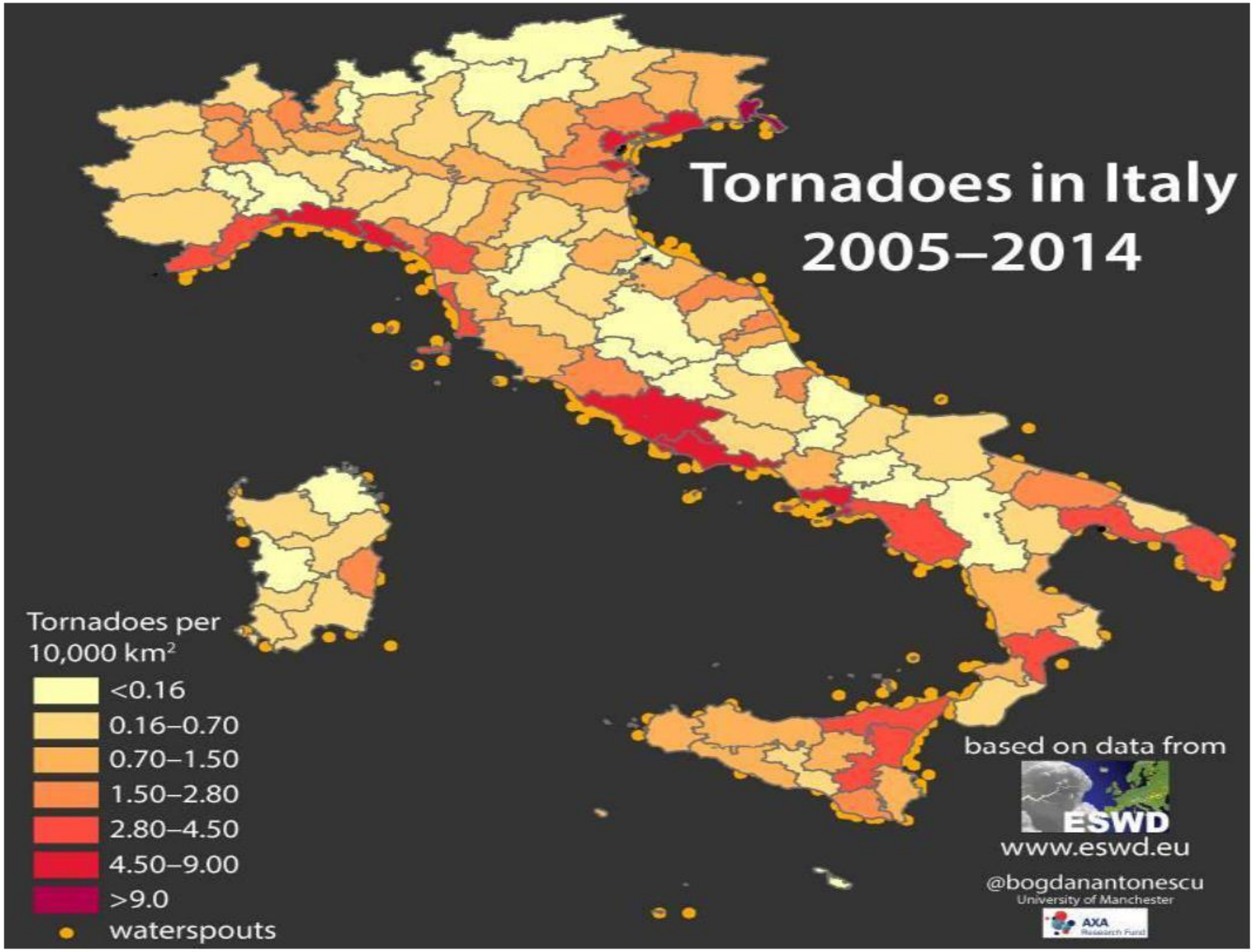


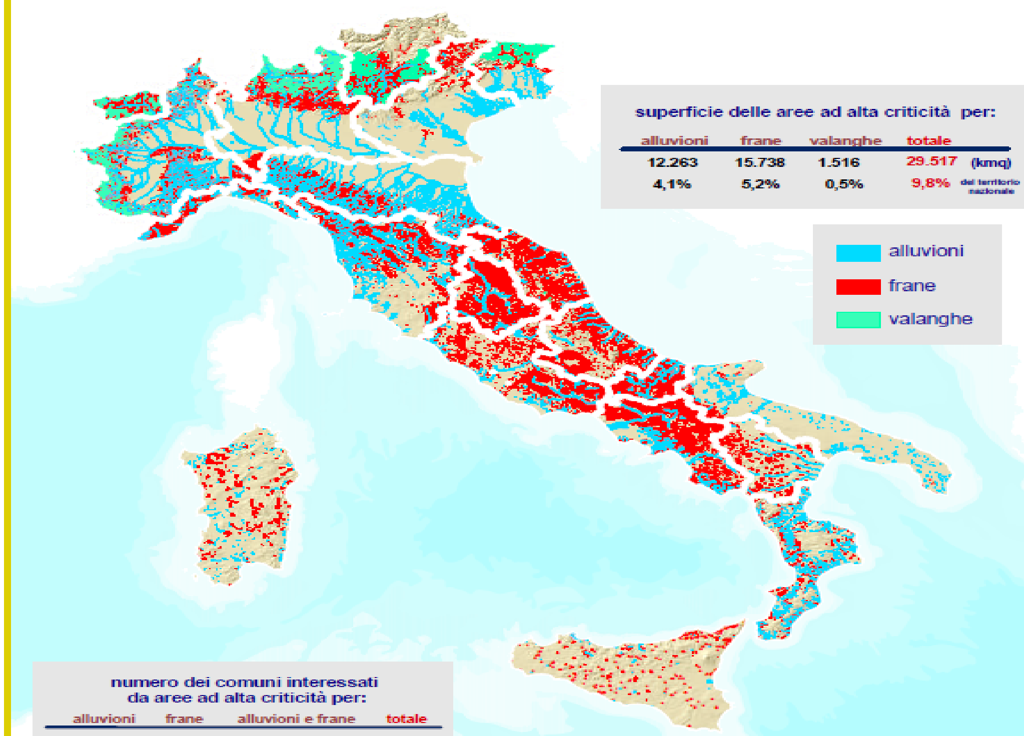
Fig. 6: Tornado e maremoti in Italia nel periodo 2005-2014, un colore più scuro indica una più alta frequenza (fonte: European Severe Weather Database)[6]

Back-UP

Ministero dell'Ambiente e della Tutela del Territorio

Direzione Generale per la Difesa del Suolo

Carta delle aree ad alta criticità idrogeologica *



superficie delle aree ad alta criticità per:

alluvioni	frane	valanghe	totale	
12.263	15.738	1.516	29.517	(kmq)
4,1%	5,2%	0,5%	9,8%	del territorio nazionale

numero dei comuni interessati da aree ad alta criticità per:

alluvioni	frane	alluvioni e frane	totale
1.492	2.023	3.118	6.633
18,6%	24,9%	38,4%	81,9%

* aree caratterizzate da livelli più elevati di pericolosità e di rischio idrogeologici, perimetrate dalle Autorità di bacino, Regioni e Province Autonome nei Piani Straordinari o nei Piani stralcio per l'Assetto Idrogeologico approvati, adottati o predisposti.

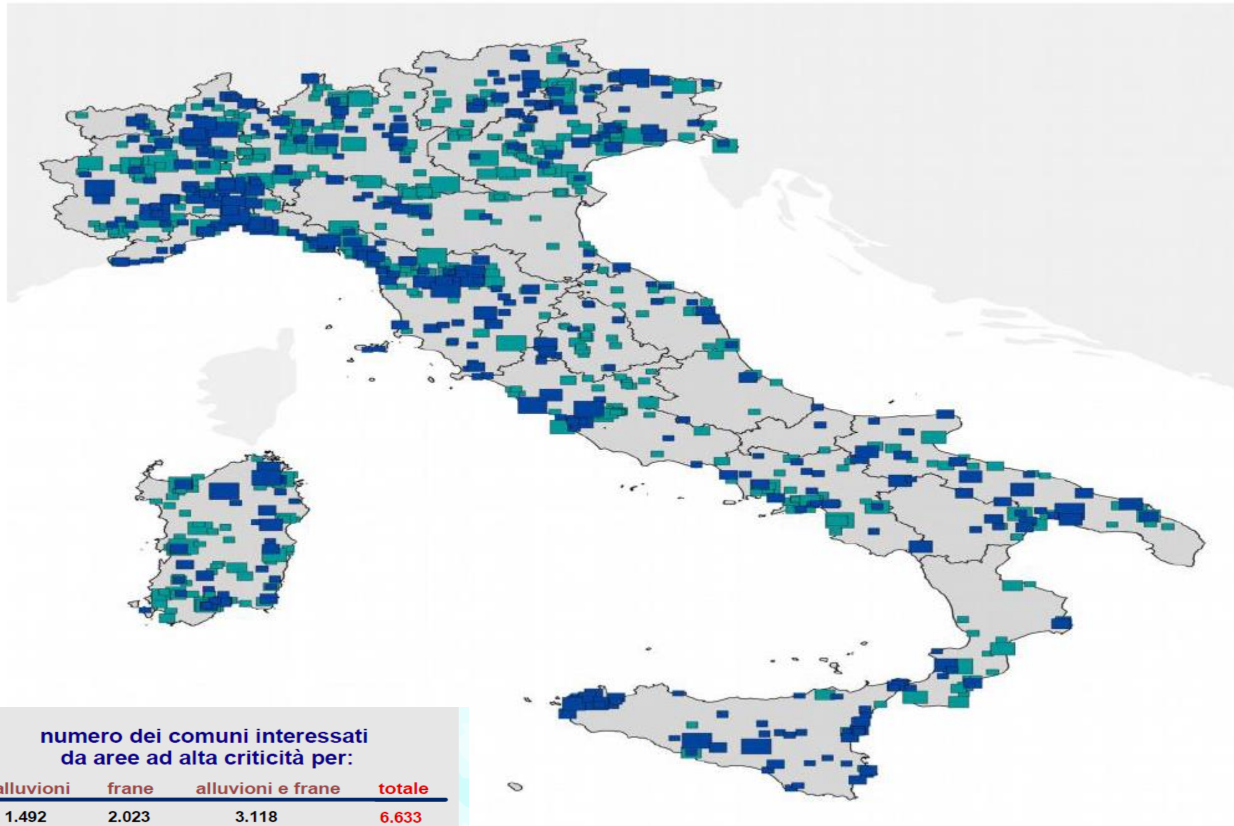
Segreteria Tecnica per la Tutela del Territorio

unione petrolifera

Back-UP

Ministero dell'Ambiente e della Tutela del Territorio

Direzione Generale per la Difesa del Suolo



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Segreteria Tecnica per la Tutela del Territorio

Fig. 7: Distribuzione geografica eventi di inondazione nel periodo 1964-2013, gli eventi che hanno causato vittime sono indicati in blu, mentre quelli che hanno causato evacuazione in azzurro (fonte: CNR-IRPI) [7]

Back-UP

ISPRA 2017- Aree di pericolosità Idraulica P3 (mappa 1 di 3)

[5] Un'area a pericolosità idraulica può essere inondata secondo uno o più dei tre differenti scenari di probabilità. Lo scenario P1, che rappresenta lo scenario massimo atteso ovvero la massima estensione delle aree inondabili in Italia, contiene gli scenari P3 e P2, al netto di alcune eccezioni. I dati relativi ai tre scenari non vanno quindi sommati.

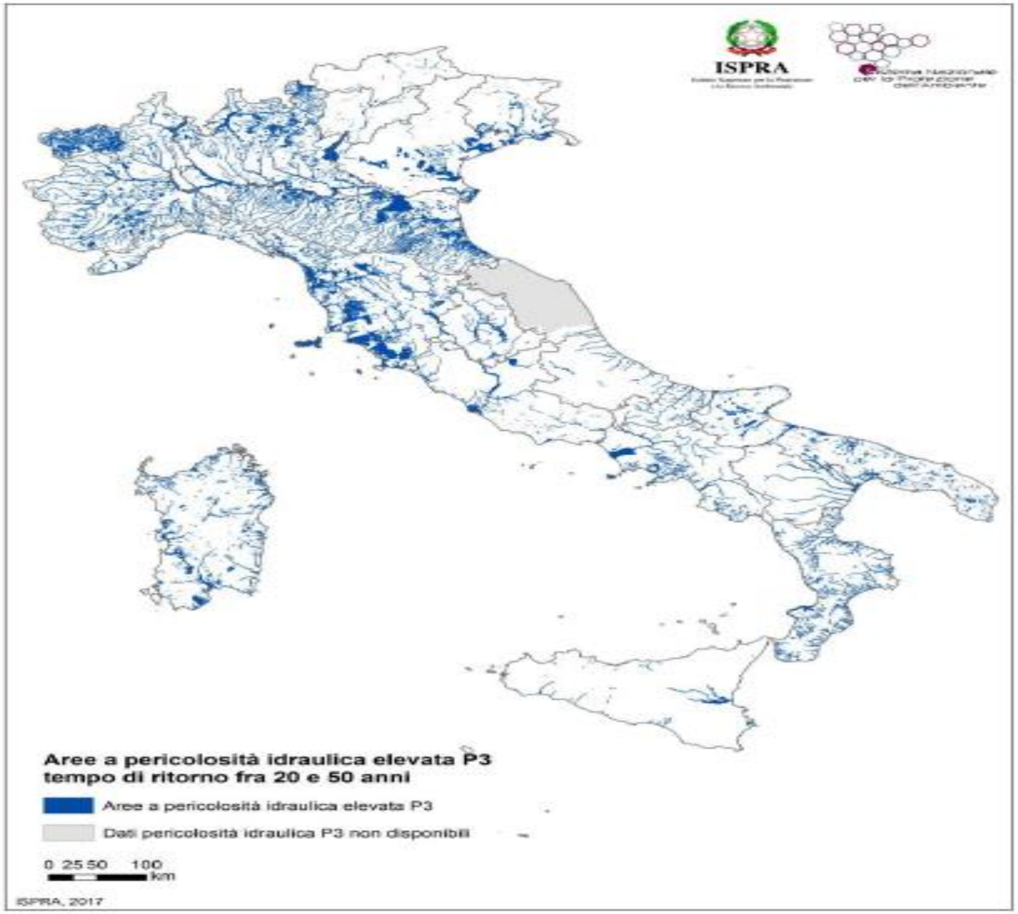


Figura 2.1- *Aree a pericolosità idraulica elevata P3 - Mosaicatura 2017*

Back-UP

ISPRA 2017-Aree di pericolosità Idraulica P2 (mappa 2 di 3)

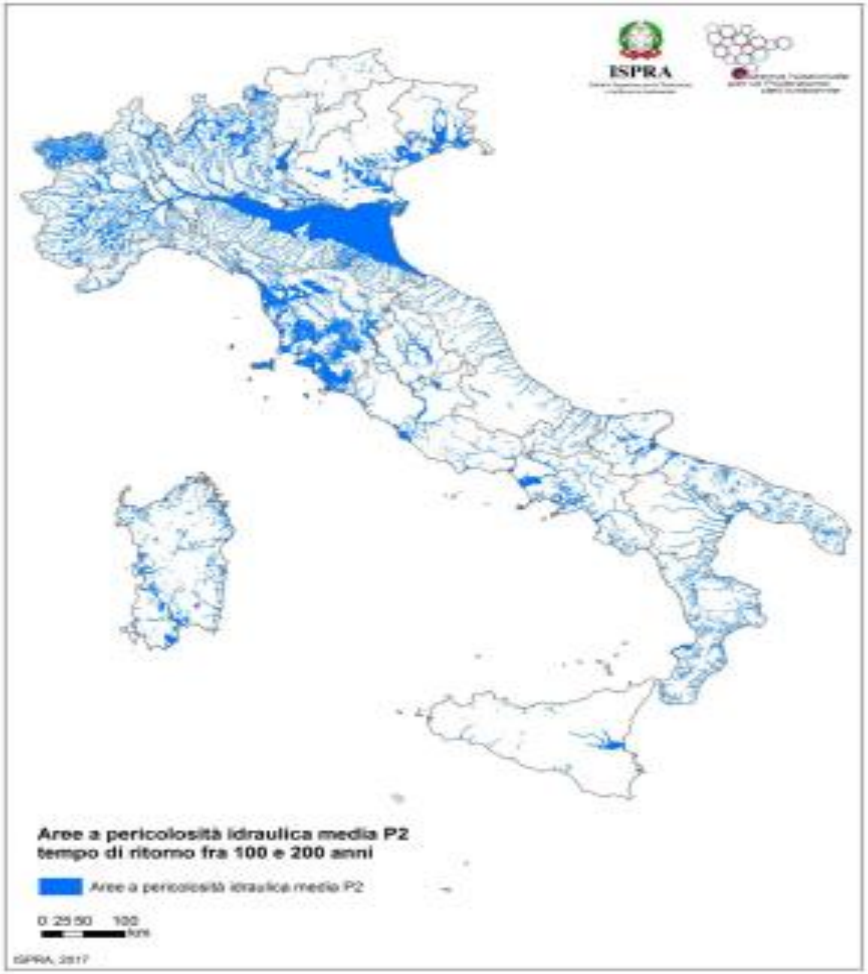


Figura 2.2 - *Aree a pericolosità idraulica media P2 - Mosaicatura 2017*

Back-UP

ISPRA 2017- Aree di pericolosità Idraulica P1 (mappa 3 di 3)

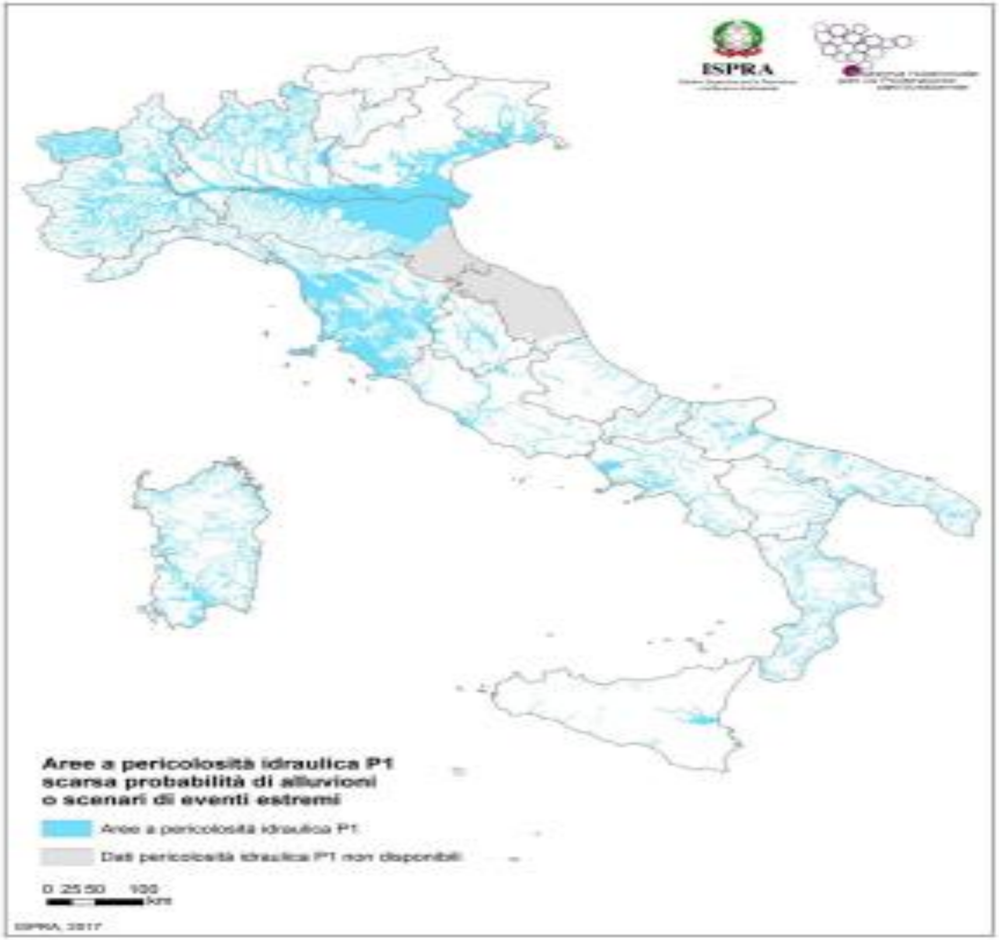
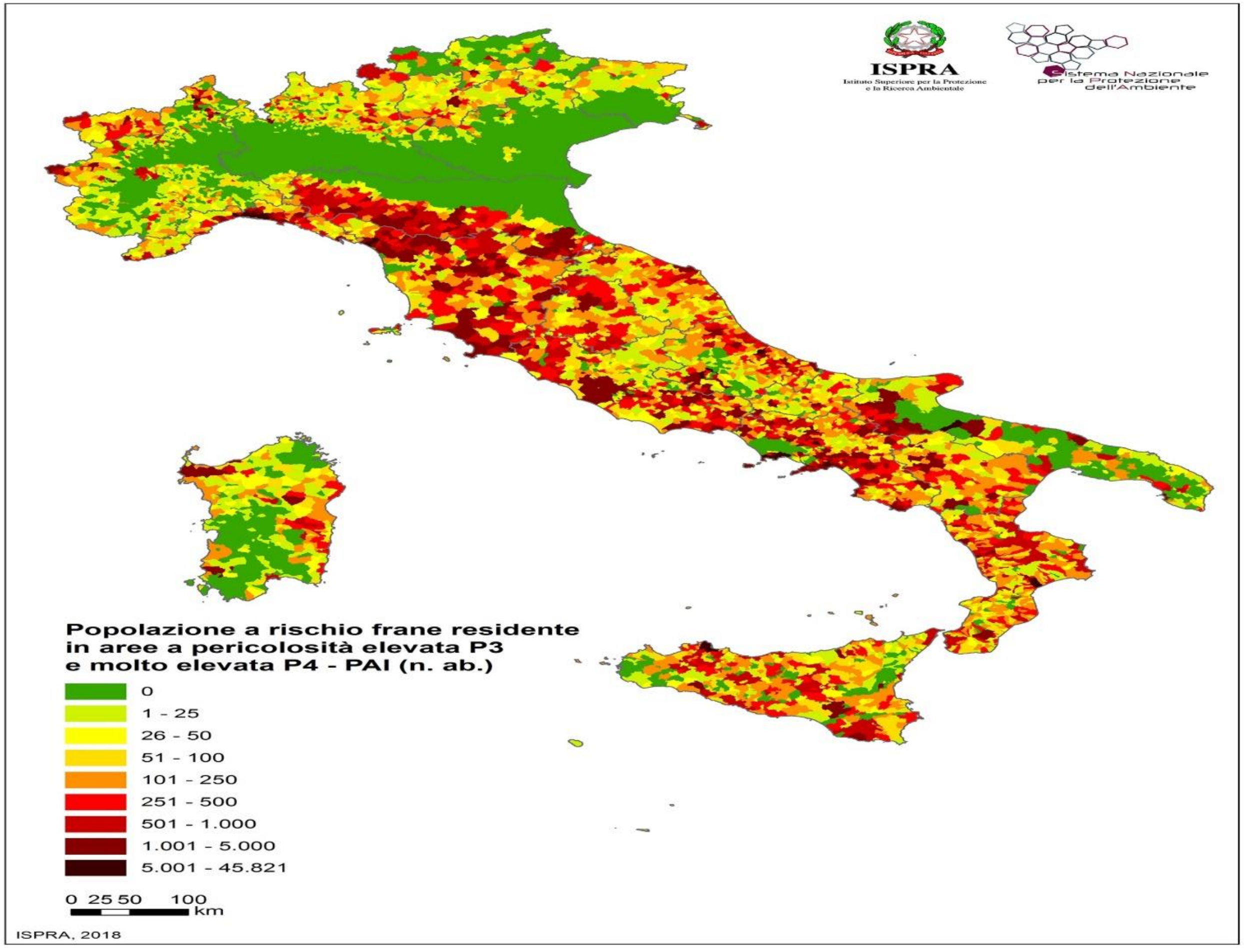


Figura 2.3 - *Aree a pericolosità idraulica bassa P1 - Mosaicatura 2017*

Back-UP

ISPRA 2018- Popolazione a rischio Frane a pericolosità in aree elevata



Rapporto EU JRC 2018 EUR29507 EN per comprensione e valutazione rischi Na-Tech

Storms

Condizioni utilizzo del JRC Technical Report EUR 29507

"Understanding Natech Risk Due to Storms "Lessons learned and recommendations, EUR 29507 EN, European Union, 2018"

How to cite this report*:* ***Necci****, A., Girgin, S., Krausmann, E., Understanding Natech Risk Due to Storms – Lessons learned and recommendations, EUR 29507 EN, European Union, 2018, ISBN 978-92-79-98274-3, doi:10.2760/21366 (where available), JRC114176.*

UP- Sintesi contenuto JRC-Technical Report EUR 29507-2018

STORM TRIGGERED EVENTS

Capitolo 2. Storm categories and effects

- **Types of storms**
- **Climate change**
- **Effect of storms: Wind action, Heavy precipitation, Storm surge, Lightening**

Capitolo 3. Natech statistics: **Data source, Method used**

Capitolo 4. Results

- **Analysis of Natech events**
- **Analysis of Storm- Triggered Natech events in TSD and MHIDAS data bases**
- **Results summary**

Capitolo 5. Analysis of accidents case studies

Capitolo 6. Damage mode analysis

- **Roof damage, Falling objects, Vessel buckling, Displacement, Damage to electrical equipment, Flotation, Impact with floating objects, Impact with airborne objects, Sinking of floating roof, Power loss, Breach/overfill, Ignition of flammables, Thermal puncturing of metal enclosures**

Capitolo 7. Lessons learned and recommandationsDamage mode analysis

Capitolo 8. Conclusions

Considerazioni UP

In questo intervento UP è stato sintetizzato l'esaustivo contenuto del rapporto JRC, focalizzando l'attenzione su numerosi capitoli.

Si raccomanda, in ogni caso, agli utilizzatori del rapporto di esaminarlo nel suo intero complesso.

STORM TRIGGERED EVENTS - JRC-Technical Report EUR 29507-2018

Capitolo 8. Conclusions

This study analysed past technological incidents involving hazardous materials caused by the impact of storms.
The study concluded that incidents caused by storms were frequent and resulted often but not always in consequences to people, the environment and the economy.

The different types of storm events were analysed with respect to their ability to leave a "damage footprint" on the ground. *A number of effects are responsible for damage to the natural and built environment.*
The study concluded that the main effects responsible for damage are: strong winds, heavy precipitation, lightning and storm surge*.*

A large number of technological incidents were collected and analysed to get a statistical description of storm-triggered events. Several accident databases were consulted and analysed to identify Natech events and in particular storm-triggered accidents.
The main finding of this study is that the relative occurrence of storm triggered Natech events appears to have increased when compared to the occurrence of technological incidents from other causes.
Another important conclusion of this analysis is the high vulnerability of storage tanks to all the effects of storms. In addition, while lightning is the most frequent trigger of incidents, rain and flood is responsible for the largest losses.

The number of storm-triggered incidents recorded over the last years could have been lower if natural hazards were not underestimated during both facility design and operation.
The lessons and recommendations identified in the frame of this study should help to prevent such events in the future and to better mitigate their consequences.

In addition, although a proactive attitude of the industry is required to prevent incidents, other actors, such as engineering companies, manufacturers, workers' unions, authorities and policy makers need to work together to build a safer future for industries handling hazardous materials in natural hazard prone areas.

Sintesi UP del contenuto del JRC Technical Report EUR 29507-2018

Capitolo 2 –Storm categories and effects (1/2)

2.1 Types of storm

Severe storms have historically affected Europe. For example, the Xynthia storm in 2010 was the largest European coastal disaster of the last 50 years, with 47 people killed in France alone (Chadenas et al., 2014). The 1953 storm surge in the southern North Sea, which resulted in over 2,000 deaths and extensive flooding across The Netherlands, England, Belgium and Scotland, led to strengthened flood defences and the development of modern flood warning systems (Wadey et al., 2015). The impact of each storm is evaluated in different ways in different countries, often using local socio-economic impact criteria (e.g. loss of lives and damage to property).

2.2 Tropical cyclones

Although tropical cyclone activity is low in the North Indian Ocean and the North Atlantic compared to the Pacific, the frequency of coastal flooding is much higher. Extreme flooding is prevalent mainly on low-gradient shores, including barrier and deltaic systems; these areas have often also attracted the development of dense population centres (Woodruff et al., 2013). In the regions they affect, tropical cyclones are often the most damaging storms and, therefore, of primary importance when assessing flood risk.

2.1.2 Windstorms

Most European windstorms originate from extra-tropical cyclones (synoptic-scale low pressure systems) with very strong winds or violent gusts that are capable of producing devastating socioeconomic impacts. The path that these storms follow (storm track) tends to curve toward northern European countries (e.g. the Faroe Islands, Ireland, the UK, and Scandinavia). However, occasionally the storms can travel further southwards, affecting countries such as France, Portugal, and Spain…. Windstorms are a major problem for Atlantic and Central Europe (XWS, 2016; Roberts et al., 2014).

2.1.3 Polar Lows

A polar low is a small-scale cyclones that is found over ocean areas poleward of the main polar front in both the Northern and Southern Hemispheres. **In Europe, they frequently occur in the northern Norwegian Sea and at the Barents Sea and only occasionally in the north of United Kingdom** (Mallet et al., 2013).Because of their hurricane-force winds and circular shapes with an eye in the centre, they are often referred to as Arctic hurricanes. These systems expire quickly and they usually exist for no more than a couple of days. They can produce high-speed surface winds, large-amplitude ocean waves and heavy snow precipitation (Mallet et al., 2013)

Sintesi UP del contenuto del JRC Technical Report EUR 29507-2018

Capitolo 2 – Storm categories and effects (2/2)

2.1.4 Medicanes

High winds in Europe can also be a result of convective storms (e.g. tornadoes which are the most severe) and cyclones formed in the Mediterranean basin (XWS, 2016). Similar to tropical cyclones, Mediterranean cyclones (sometimes called "medicanes") are rare meteorological phenomena observed in the Mediterranean Sea. Due to the dry nature of the Mediterranean region, formation of medicanes is infrequent, with only 100 recorded events between 1948 and 2014 (Reale and Atlas, 2001).

According to recent studies conducted on global warming effects on the Mediterranean region, tropical-like cyclones are likely to happen with lower frequency in the next 100 years, yet with stronger intensity (Reale and Atlas, 2001). Even though these events are less violent than most of the tropical cyclones, the wind speed reaches hurricane strength.

2.1.5 Thunderstorms

Downburst winds, large hailstones, and flash flooding caused by heavy precipitation can wreak havoc on human settlements, technological systems and agriculture. Stronger thunderstorm cells are capable of producing tornadoes and waterspouts. **High Thunderstorms can form at any geographic location but most frequently within the mid-latitude, where warm, moist air from tropical latitudes collides with cooler air from polar latitudes (NSSL, 2018).**

2.2 Climate change

Hewson and Neu (2015) give an overview of the most important assessments with climate models on the expected changes in European climate and their impacts on extreme weather events. **In the current climate, the main hazard for Europe are severe winter storms, which are typically local effects of extratropical cyclones, while tropical cyclones rarely reach Europe. However, this situation can quickly change. According to Haarsma et al. (2013), both the number and the severity of hurricanes reaching Europe are expected to increase due to climate change.**

Sea climate is also expected to change. According to Kushnir et al. (1997), **North Atlantic wave heights have increased in the past years**. The same conclusion was drawn by Gulev and Hasse (1999), who also relate the increase of wave height with the increase of wind speed in the northern Atlantic. This raises concern regarding the possibility of storm intensity increase in the northern Atlantic region, in the near future. Furthermore, based on global warming scenarios, rougher wave conditions and higher sea levels should be expected (Debernard et al, 2002).

Sintesi UP del contenuto del JRC Technical Report EUR 29507-2018

Capitolo 3 -Natech Statistics

3.1 Data sources

The data sources for the present analysis were the European industrial incident databases ARIA (BARPI, 2018a), **MHIDAS** (HSE, 2007), **TAD** (ICheme, 2004) **eMARS** (eMARS, 2018) and **FACTS** (FACTS, 2018). The ARIA database is publicly accessible, while access to FACTS requires a licence. The eMARS database contains confidential information on major accidents submitted to the European Commission by the Competent Authorities. The MHIDAS and TAD databases are no longer supported.

3.2 Method used

- **For the data extraction, selection criteria were defined in agreement with the following rules**:

➢ **The loss of containment of a hazardous substance occurred or could have occurred.**

➢ **An industrial activity processing or storing hazardous substances was involved**.

➢ **The event generated (or had the potential to generate) an accident scenario with off-site consequences (major accident).**

- **In the analysis of industrial sites, we included mainly activities falling under the provisions of the European Seveso III Directive and similar legislation outside Europe. However, the databases include also incidents in other industrial sites not covered by these types of legal frameworks, which were also considered in the present study for lessons learning purposes**.
- **During the data selection process only incidents with an obvious role of natural events as a main event trigger were included in the analysis as Natech incidents. In order to identify these events, the data set was filtered according to the following steps:**

➢ **Analysis** of incidents tags or keywords **based on cause. When the tag or keyword referred to natural causes or to one specific natural event** (e.g. lightning, flood, earthquake) **the incidents was added.**

➢ **Analysis of incidents description or summary. When the summary texts include references to natural causes or to one specific natural event** (e.g. lightning, flood, earthquake) **the incidents was added**.

➢ **Among these, Storm-triggered Natech incidents were filtered out and further analysed**. When possible, the categories available in the databases were used to filter the results. When such information was not available, a keyword-based selection with manual verification was performed.

Sintesi UP del contenuto del JRC Technical Report EUR 29507-2018

Capitolo 4.1 Analysis of Natech events Table 1 (1/3)

Nella sottostante Tabella 1 viene sintetizzato il numero degli incidendi recorded in ciascun data base. La Tabella contiene tre differenti categorie: "*Transport vehicles*" (i.e. train, truck or vessel), "*Pipelines*" and "*Fixed installations*". **Poichè i meccanismi che innescano gli accidenti Na-Tech possono essere completamente differenti per le istallazioni industriali o per il trasporto l'analisi degli incidenti Na-Tech riguarda solo le istallazioni fisse e nelle statistiche gli altri eventi sono stati esclusi**

Although of general interest, incidents at offshore oil and gas operations, transport by vessel, by train and by truck and pipelines are beyond the scope of this study and were therefore excluded from the analysis.

Table 1. Number of Natech events in each database

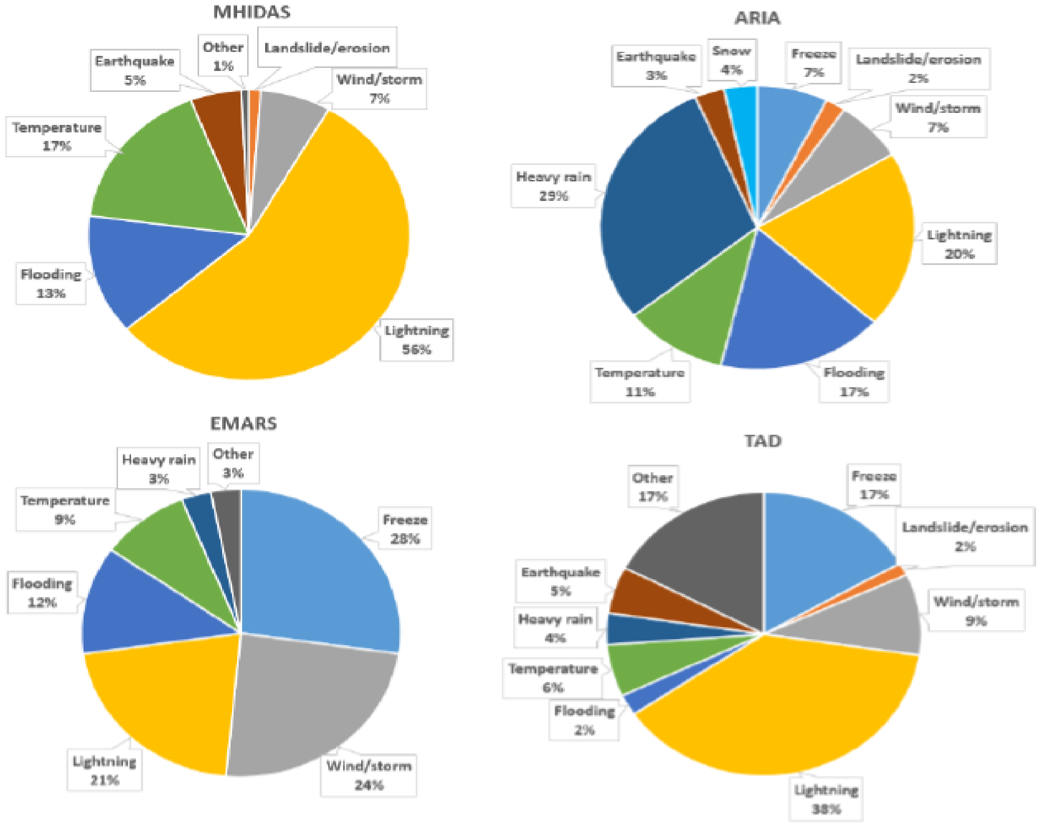
Database name	Total Natech	Transport vehicles	Pipelines	Fixed installations
MHIDAS	705	359	93	254
FACTS	962	137	136	689
eMARS	33	0	0	33
ARIA	920	N.A.[3]	N.A.	N.A.
TAD	560	185	39	336

Source: JRC

Pie charts describing the distribution of Natech incidents by triggering natural events
Data bases: MHIDAS, ARIA, TAD, eMARS

Capitolo 4.1 Analysis of Natech events-Figura 2 (2/3)

Figure 2. Pie charts describing the distribution of Natech incidents by triggering natural event for the databases: MHIDAS, ARIA, TAD and eMARS

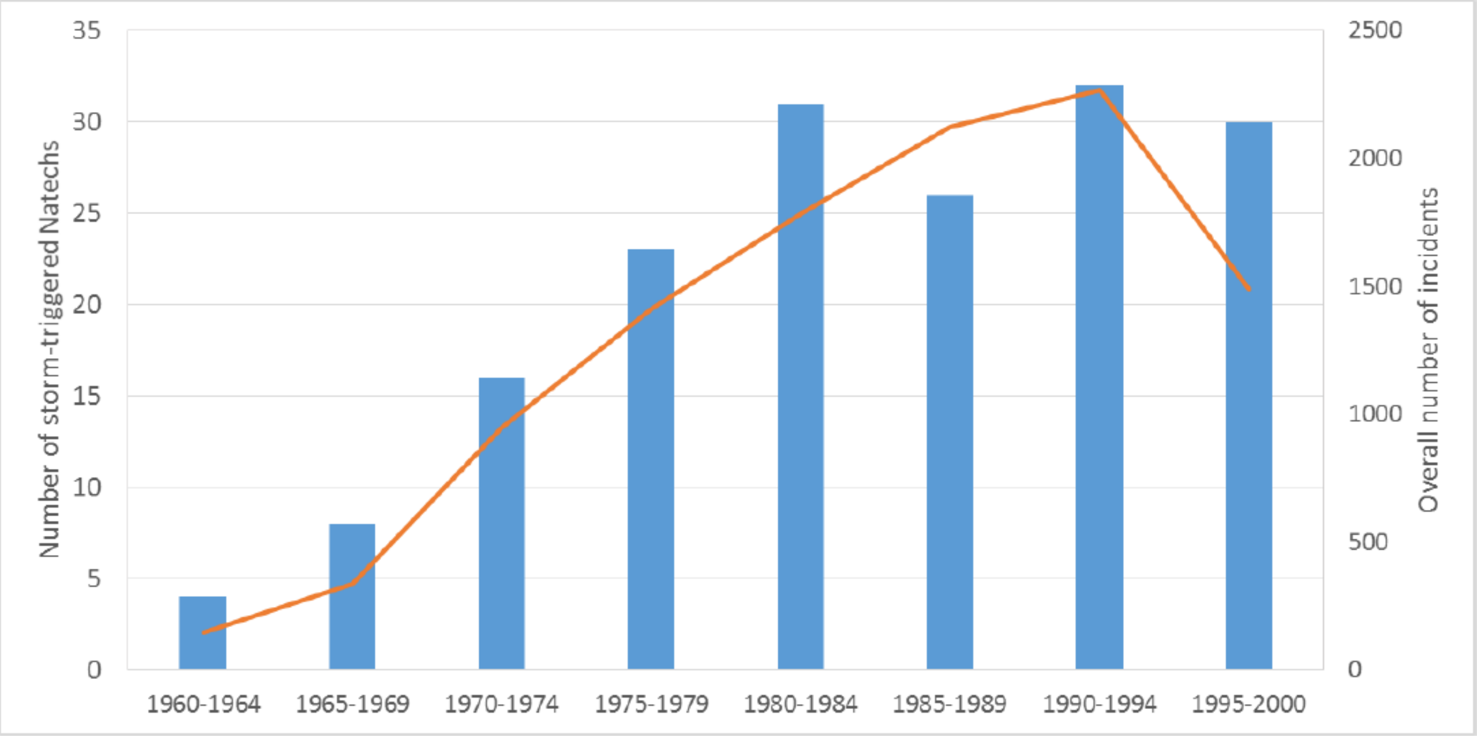


Source: JRC

Storm-triggered Natech events in TAD data base

Figura 3, Capitolo 4.2.1 - (1/6)

Figure 3. Number of storm-triggered Natech events (blue bars) and total number of technological incidents (orange line) collected since 1960 and grouped in 5 year periods for the TAD database



Source: JRC

Storm-triggered Natech events in TAD data base (2/6)

Capitolo 4.2.1 –Figura 4 (All storm effects) e Figura 5 (Lightning triggered incidents only)

Figure 4. Distribution of storm-triggered Natech events by the type of structure (all storm effects)

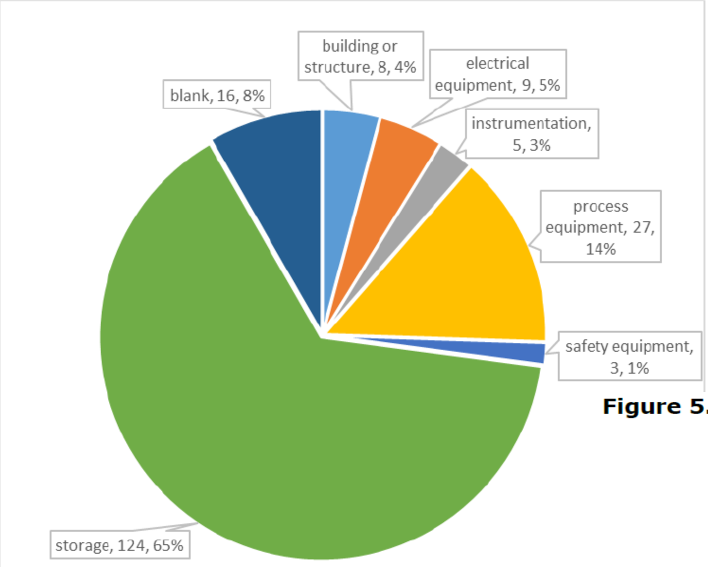
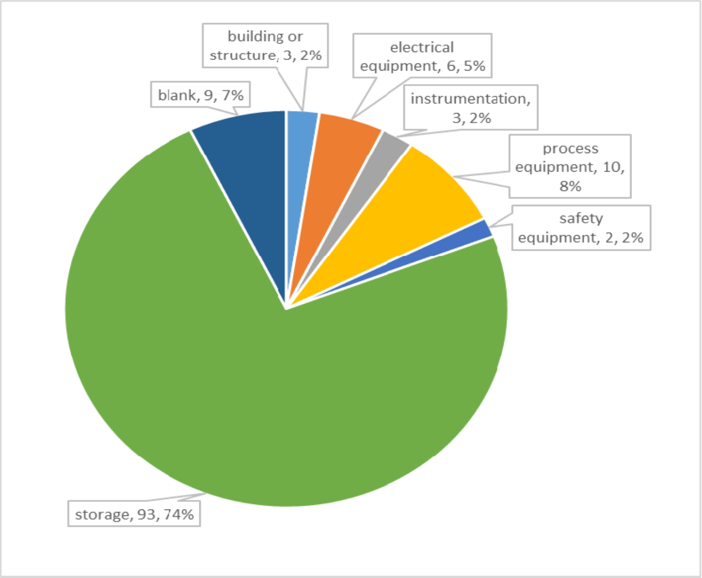


Figure 5. Distribution of storm-triggered Natech events by the type of structure (li triggered incidents only)

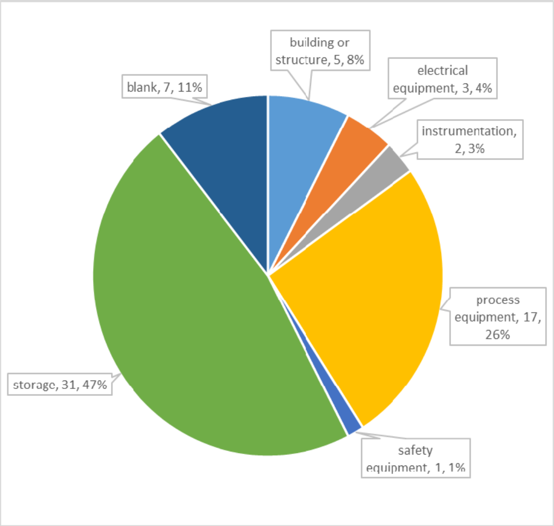


Source: JRC

Storm-triggered Natech events in TAD data base (3/6)

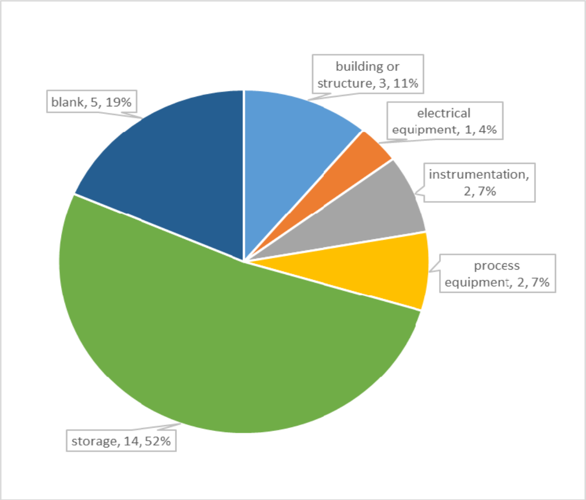
Capitolo 4.2.1 –Figura 6 (Lightning triggered incidents excluded) e Figura 7 (only incidents triggered by rain and flood)

Figure 6. Distribution of storm-triggered Natech events by the type of structure (lightning triggered incidents excluded)



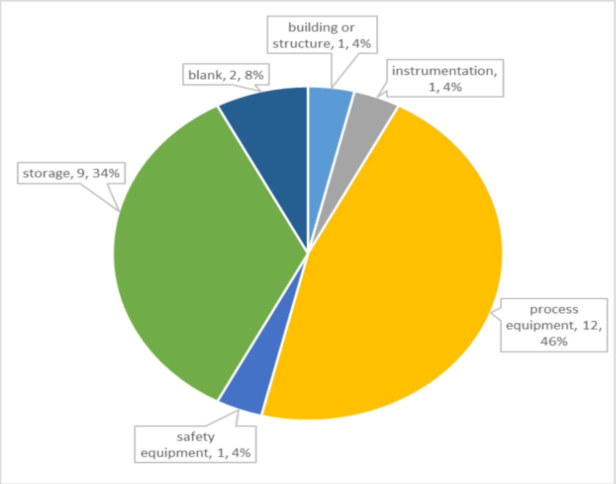
Source: JRC

Figure 7. Distribution of storm-triggered Natech events by the type of structure (only incidents triggered by rain and flood)



Source: JRC

Figure 8. Distribution of storm-triggered Natech events by the type of structure (only incidents triggered by wind)

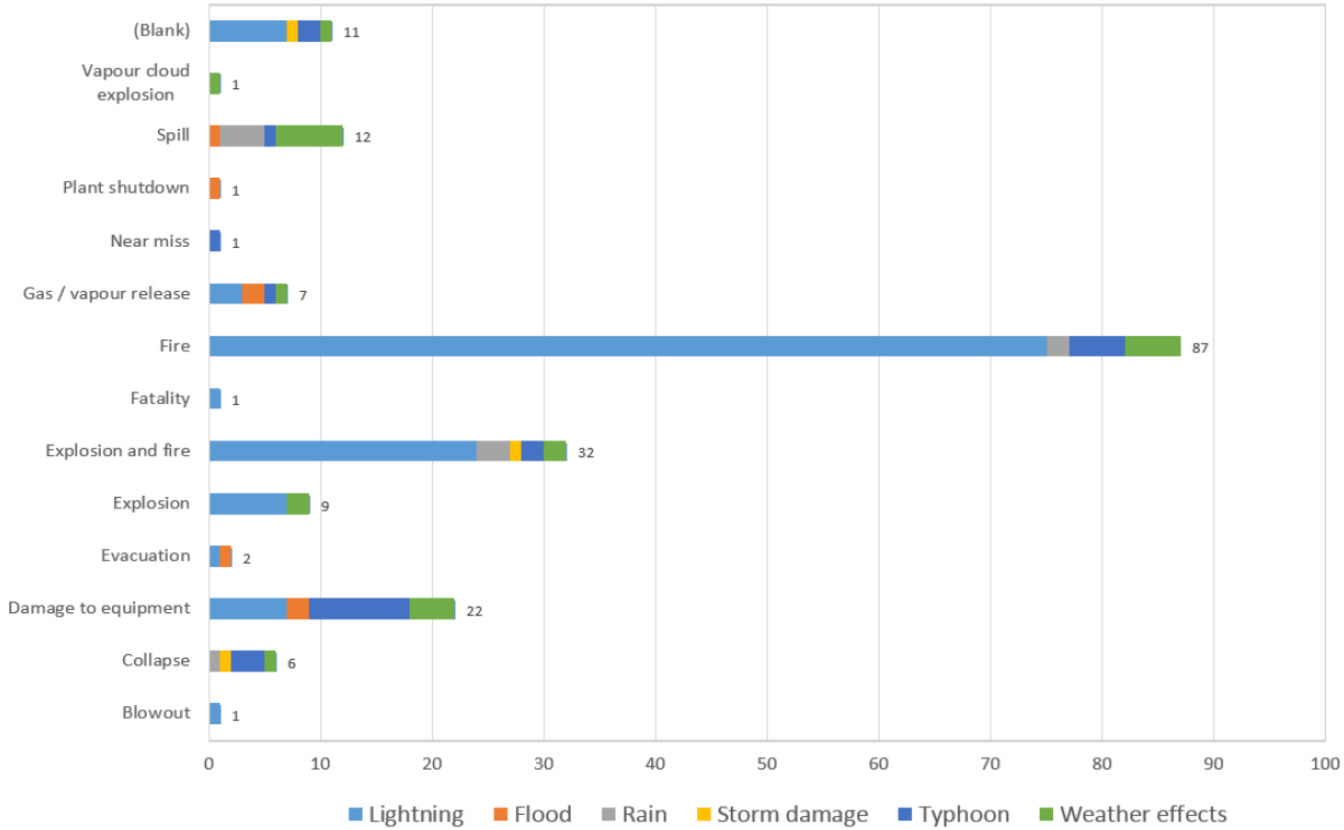


Source: JRC

Storm-triggered Natech events in TAD data base (4/6)

Capitolo 4.2.1 –Figura 9 (Storm triggered events by Consequence)

Figure 9. Distribution of storm-triggered Natech incidents by consequence. The specific storm effects that triggered the events are identified with different colours

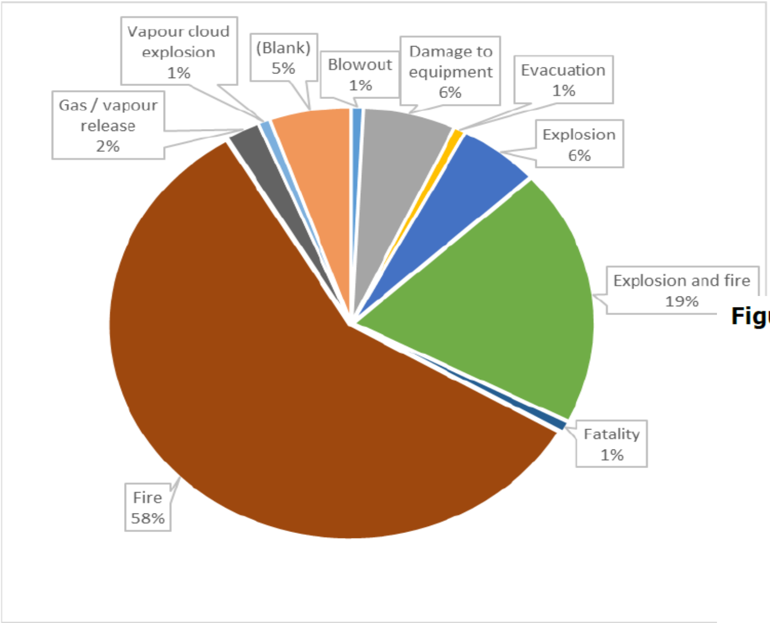


Source: JRC

Storm-triggered Natech events in TAD Data base (5/6)

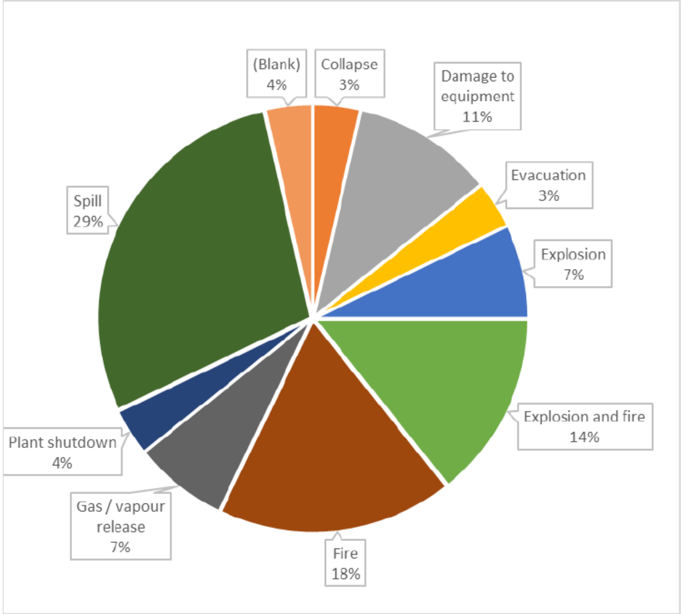
Capitolo 4.2.1 –Figura 10, Storm triggered events by Consequence (only incidents by lightening), Figura 11 (only by heavy rain and flooding)

Figure 10. Distribution of storm-triggered Natech incidents by consequence (only incidents triggered by lightning)



Source: JRC

Figure 11. Distribution of storm-triggered Natech incidents by consequence (only incidents triggered by heavy rain or flooding)

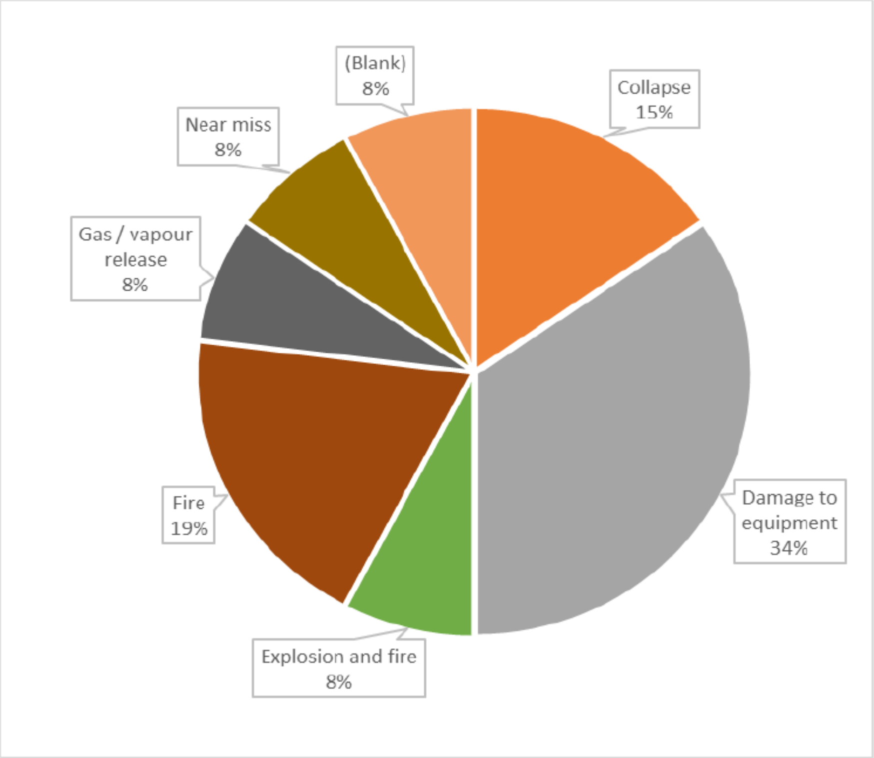


Source: JRC

Storm-triggered Natech events in TAD Data base (6/6)

Capitolo 4.2.1 –Figura 12, Storm triggered events by Consequence (only incidents by wind)

Figure 12. Distribution of storm-triggered Natech incidents by consequence (only incide triggered by wind)

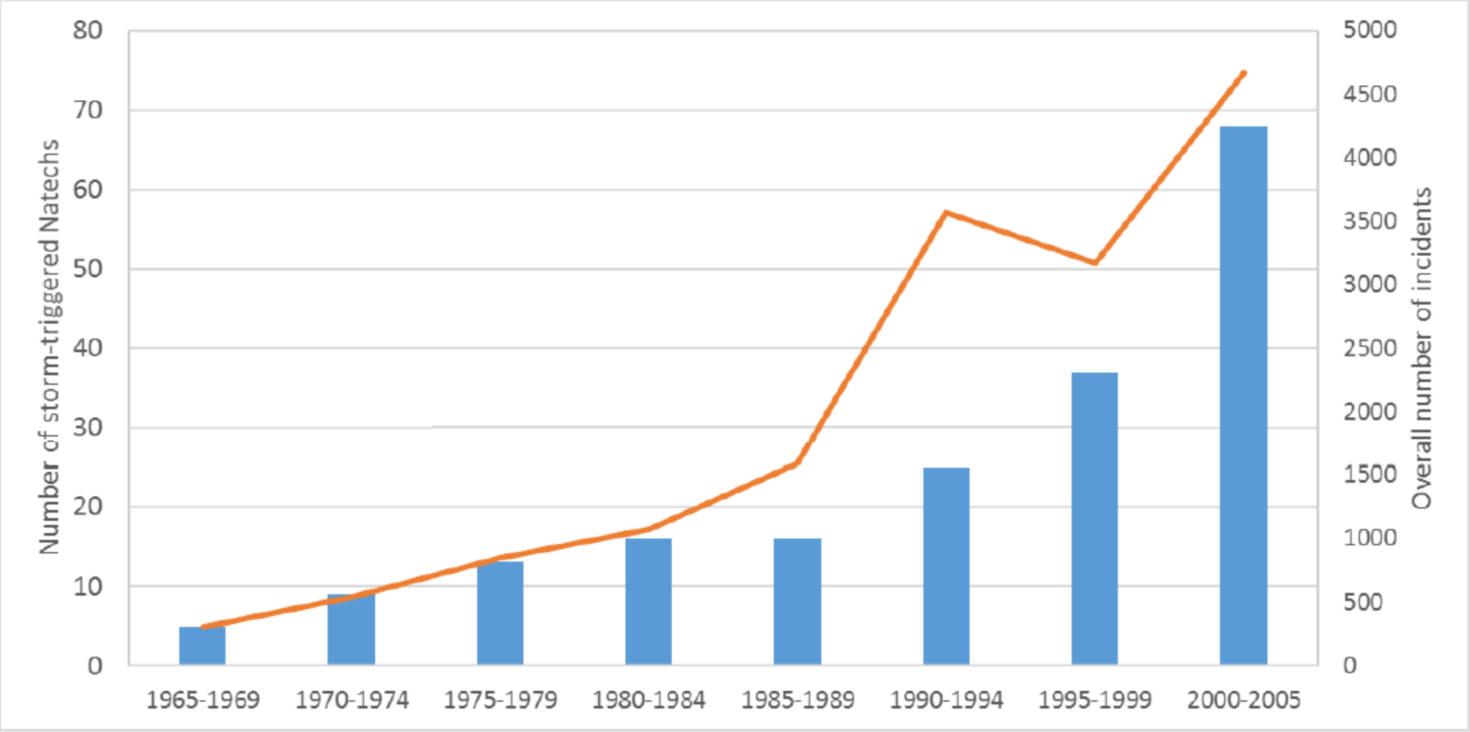


Source: JRC

Storm-triggered Natech events in MHIDAS data base (1/5)

Capitolo 4.2.2 -Figura 13

Figure 13. Number of storm-triggered Natech events (blue bars) and the overall number of records in the MHIDAS database (orange line), since 1960 and every in 5-years increments

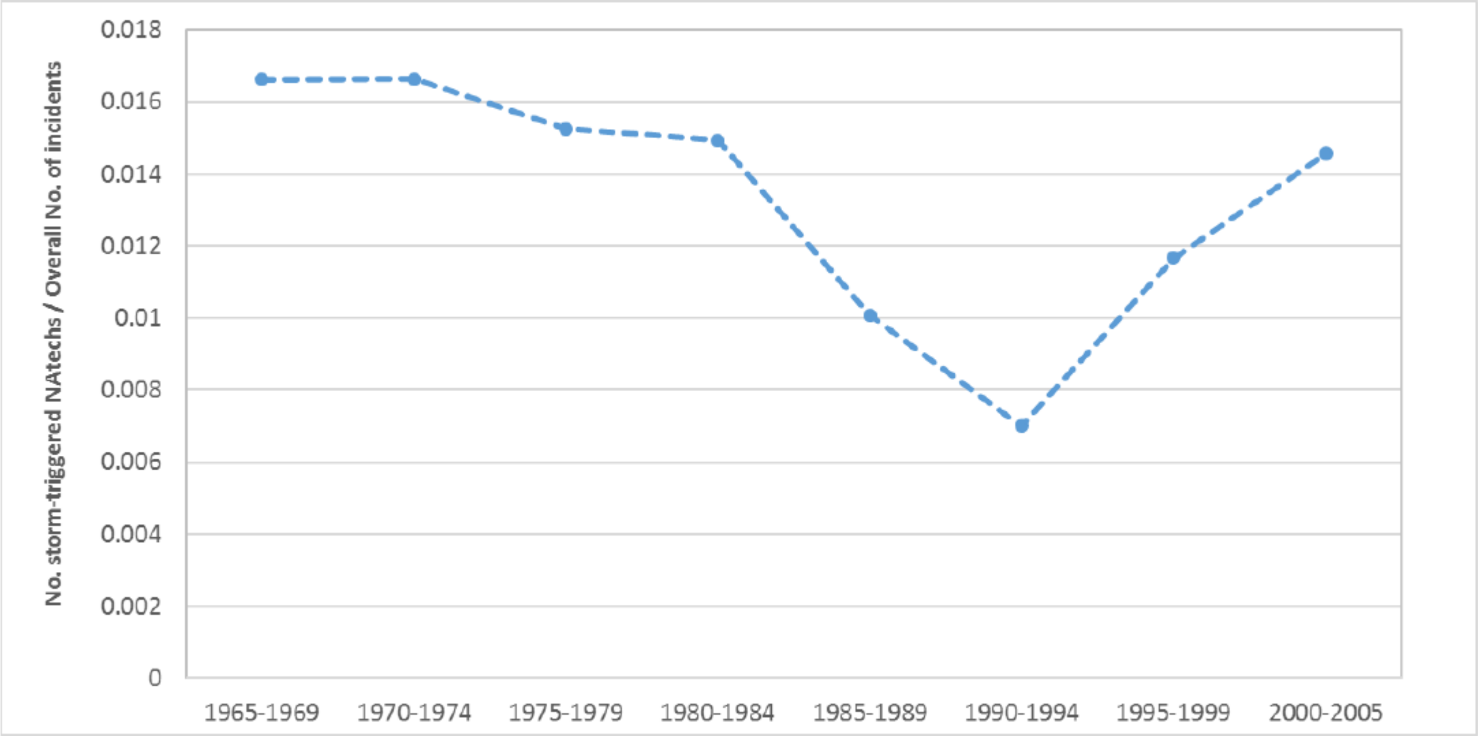


Source: JRC

Storm-triggered Natech events in MHIDAS data base (2/5)

Capitolo 4.2.2 -Figura 14

Figure 14. Ratio of the number of storm-triggered Natech events and the overall number of records in the MHIDAS database, since 1960 and every in 5-years increments



Source: JRC

Storm-triggered Natech events in MHIDAS data base (3/5)

Capitolo 4.2.2 -Figura 14

The graph **Figure 14** shows an initial reduction of the ratio of storm-triggered Natechs, but then a sudden increase, starting from the late 90s. **Similar to what was observed for TAD in Section 4.2.1, the relative increase of the number of storm-triggered Natech event compared to other incidents could indicate that new safety requirements effectively mitigated the risk due to conventional technological accidents, while failing to reduce the risk posed by storm-triggered Natech events**.

The focus of MHIDAS is on the actual technological accidents with hazardous-substance releases, thus damage to structures or to auxiliary equipment that did not result in an accident was not reported.

For this reason, in MHIDAS only three categories that describe the affected type of equipment or structure were identified: electrical equipment, process equipment and storage.

Figure 15 shows the distribution of storm-triggered accidents with respect to the type of equipment or structure that was involved or damaged. **Storage facilities** were the most frequently hit by storm events **(84%). Process equipment** follows with **only 15% relative occurrence. Electrical equipment has only one record.**

We decided to analyse Natech accidents separately, on the basis of the natural effect that triggered the event. **In all the cases analysed, the majority of equipment affected was storage, followed by process equipment**. Still, for specific natural hazards there are variations that require some considerations.

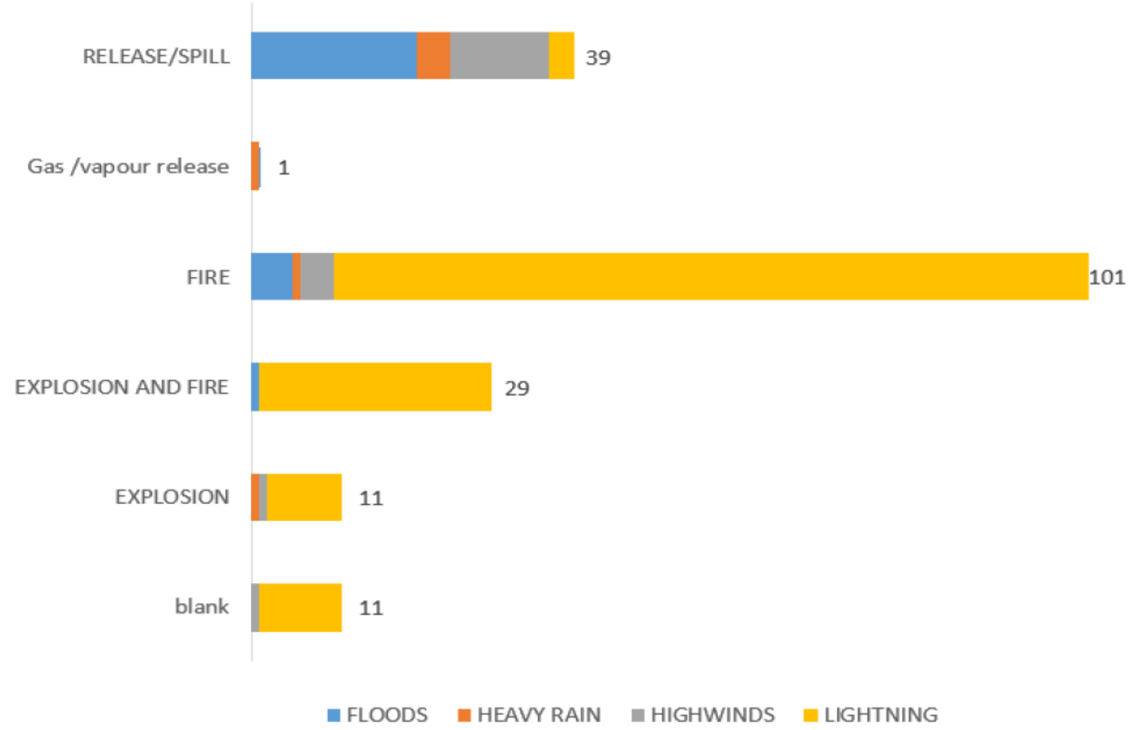
Figure 16 shows the distribution of storm-triggered Natech events that were triggered **by lightning strikes**. The results are similar to that of the whole dataset, except that **lightning strikes had a higher relative impact on storage equipment and a lower impact on process equipment, if compared to the distribution of the entire set** (Figure 15).

Figure 17 shows the distribution of storm-triggered Natech events that were triggered by all effects **except lightning**. **In this case, the category process equipment has a higher relative occurrence if compared to the distribution of the entire set** (Figure 15), **while storage has a lower occurrence.**

Storm-triggered Natech events in MHIDAS data base (4 /5)

Capitolo 4.2.2 -Figura 20

Figure 20. Distribution of storm-triggered Natech accidents by consequence. The specific storm effects that triggered the accidents are identified with different colours



Storm-triggered Natech in MHIDAS data base (5/5)

In questa presentazione UP, e solo per motivi di brevità, le figure qui di seguito elencate non vengono riportate. Dette figure sono simili a quelle dell'analisi JRC del TAD

Figure 15. Distribution of storm-triggered Natech **events by the type of equipment or structure**

Figure 16. Distribution of storm-triggered Natech **events by the type of equipment or structure** (lightning triggered accidents only)

Figure 17. Distribution of storm-triggered Natech **events by the type of structure** (lightning triggered accident excluded)

Figure 18. Distribution of storm-triggered Natech **events by the type of structure** (only accidents triggered by rain and flood)

Figure 19. Distribution of storm-triggered Natech **events by the type of structure** (only accidents triggered by wind)

Figure 21. Distribution of storm-triggered Natech **accidents by consequence** (only accidents triggered by lightning)

Figure 22. Distribution of storm-triggered Natech **accidents by consequence** (only accidents triggered by heavy rain or flood)

Figure 23. Distribution of storm-triggered Natech **accidents by consequence**(only accidents triggered by wind)

Storm-triggered Natech events- Analysis results summary

Capitolo 4.2.3 **(Vedi anche capitol 7)**

From the analysis of the incidents in TAD and MHIDAS it is possible to conclude that:

- **Storage equipment is the most vulnerable to storm damage** (see Figure 15);
- **Fires and explosions are the most common scenarios** (see Figure 20);
- **Lightning has the highest number of records and the highest relative number of major accidents recorded (over 80% of lightning-triggered accidents are fires or explosions)** (see Figure 21);
- **Rain and flood have also a very high relative occurrence of major accidents (75% are either fires or releases of hazardous substances) and if compared to other hazards they have the highest potential for environmental damage due to the high occurrence of spills** (see Figure 22);
- **The effect of wind is the least probable to trigger Natech accidents. Even when wind does cause damage to equipment, it is more likely to be process equipment (and in particular tall structures), which has a lower holding capacity compared to storage equipment and thus less potential for a major accident** (see Figure 19).

Storm-triggered Natech events- Damage Mode (1/2)

Capitolo 6

6.1 Roof damage

Roof damage can occur during the strongest windstorms and tropical storms. The strongest winds were not only able to damage the external insulation, removing entire sections from several equipment items during the most recent hurricanes, but they also ripped off thinner metal plates from their main roof structures. Damage to the roofs of atmospheric tanks was associated with wind suctions

6.2 Falling objects

When tall structures like chimneys, racks, towers and buildings **collapse, they can involve other structures and equipment**

6.3 Vessel buckling

The shell buckling of the highest section of equipment, and in particular of storage tanks, is frequently caused by high winds during storms and hurricanes, while buckling of the lower section is more likely due to floods (Godoy, 2007). Buckling can be accompanied by leakage of the content due to failure of the bottom/shell welding, manhole failure, pipe/fitting failure or failure of riveted seams (Cooper, 1997).

When a vessel is empty, the structure is at its lowest strength against buckling and it is vulnerable to either wind or water pressure. Ring stiffeners may reduce the risk of tank deflections. In past hurricane events, tanks with ring stiffeners did not exhibit buckling, even in areas where buckling damage was instead observed in unreinforced tanks (Godoy, 2007).

Godoy (2016) highlights the three main parameters that drive the buckling of atmospheric vertical storage tanks: the tank shape (height on diameter ratio), the distribution (spacing, relative position and pattern) of tank groups and topographic effects (e.g. hills, containment dikes).

6.4 Displacement

Displacement of equipment and pipes is one of the most common damage modes during natural disasters. In storms, strong winds with speeds of several hundred km/hour can drag lighter objects, while in the areas affected by flooding buoyant equipment can be dragged along by the water current or by winds (Godoy, 2007). Usually, when storage and process equipment is displaced, the piping system is dragged along, usually also sustaining damage. Pipes can be breached, bent or torn, while flanges and fittings can lose their seal (Cooper, 1997). Storms can also directly affect pipes and pipelines.

6.5 Damage to electrical equipment

Electrical equipment is responsible for the correct functioning of the processes of industrial activities. Water intrusion can cause short circuits that can destroy electrical equipment or disrupt their functions. Short-circuits can generate electric arcs and ignite flammable materials floating on the water or hovering in the air.

6.6 Flotation

Uplifting of vessels and tanks mainly due to buoyancy forces is the main flood-induced failure mode for empty or nearly empty storage tanks following flood, flash flood and storm surge events (Krausmann and Salzano, 2017).

Empty vessels are reported to be much more vulnerable to flotation. For this reason, it is recommended to fill empty vessels with water in preparation for a storm or a flood (Krausmann et al., 2011)

6.7 Impact with floating objects

Objects floating on floodwaters can contain high momentum due to the water current they are carried along with. In case of storm surge, strong wind and waves can grant additional motion to floating objects. **Impacting objects can buckle vessels, puncture through metal enclosures, bend steel structures and break pipe connections** (Krausmann and Salzano, 2017). The water can carry any floating item, tank, barrel, vehicle, tree or building away. Objects from both inside and outside an industrial establishment can damage industrial equipment and trigger Natechs.

6.8 Impact with airborne objects

The strong winds of a windstorm, hurricane or tornado can carry any sort of object when the air reaches a very high speed (NIST, 2006). These objects, even if usually not big in size, have a very high momentum because of their high velocity and can damage equipment upon impact.

6.9 Sinking of floating roof

When a floating roof of a tank sinks, the exposed liquid can evaporate, releasing large quantities of toxic, carcinogenic or pollutant substances into the air. Exposed flammable liquid can ignite, setting the entire tank on fire and projecting plumes of noxious smoke in the air (Krausmann and Salzano, 2017).

Storm-triggered Natech events

Capitolo 7- Lessons learned

In regions prone to storms with extreme intensity, controlling the risk of processing, storing or transporting hazardous substances can be very difficult. Based on the analysis in the previous sections, here we present a number of lessons and recommendations that can be used to more effectively manage the risk from storm-triggered technological accidents. The lessons generated from the analysis are as follows:

- **When violent storms hit**, **several facilities may be affected simultaneously** overwhelming the capacity of responders to cope with the disaster;
- **Storage equipment is the most vulnerable to storm damage**;
- **Fires and explosions are the most common consequence scenarios**;
- **Lightning is the most frequent cause of storm-triggered Natech accidents**;
- **Rain and flood can also trigger Natech accidents with a high frequency, and these events result in the highest costs and the highest damage to the environment**;
- **The effects of wind are the least probable to trigger Natech events, end even when they do they usually have a lower severity if compared with other effects**;
- **Not only is the loss of the power supply due to storms sufficient**, by itself, **to trigger Natech events**, **but emergency response and the initial recovery phase can also be seriously hampered by the lack of electricity supply**;
- **Planning for emergencies** requires consideration of the possible natural events, otherwise insufficient or inadequate emergency procedures can exacerbate the severity of an accident, instead of mitigating it;
- **Storm predictions based on past events are not sufficient to be well prepared for future storm–triggered Natechs**, in particular in the face of climate change.

Storm-triggered Natech events

Capitolo 7-Recommendations for better preparedness against storm-triggered Natechs

- **Industrial facilities should be better protected** from the effect of storms, and in particular storage tanks;
- An effective response to storms can be better achieved if emergency exercises include storm-triggered Natech scenarios;
- Emergency plans should **use early warnings** as trigger points **to initiate emergency procedures** and the triggering conditions should be clear;
- **Risk assessments and emergency plans should be reviewed on a regular basis to ensure they are up to date in particular in view of climate change**;
- **Operators should provide reliable backup electric power supply** and ensure that the backup power does not fail under the same condition as the primary power supply;
- **Worst case storm events should not be predicted as if they were a recurrence of events that already happened in the past**; **instead, industry should increase safety factors to account for changes** (**both actual and potential**) **in the environment and in the climate**;
- **Areas with a high density of refineries and chemical facilities should have local recovery plans with a schedule for restart operations** to avoid simultaneous emissions and preserve air quality;
- **Responders should prepare for scenarios in which they have insufficient resources** to cope with all the simultaneous events, and their management should **learn how to decide priority targets for intervention**.

Alcune considerazioni finali

In Italia abbiamo numerose mappe (elaborate e aggiornate da ISPRA; MATTM; INGV-Istituto Nazionale di Geofisica e Vulcanologia; Protezione Civile) sulle aree/zone a pericolosità di rischio sismico, idro-geologico, idraulico, frane, ecc.). **Tali mappe sono indiscutibilmente molto utili per una valutazione convenzionale di rischio semplificata/screening predittivo.**

I rischi NaTech, dovuti in particolare a eventi estremi per cambio climatico, sono tuttavia differenti da altri rischi in quanto, al momento, previsioni e uso di dati statistici basati su eventi passati non sono sufficienti a determinare le probabilità di accadimento nel medio/lungo termine.

Un approccio combinato di valutazione e analisi rischio basato su livello di screening come pre-assessment seguito da una valutazione con approccio impact chain rappresenta una opportunità di miglioramento per una più efficace ed efficiente protezione e ricorso ad eventuali misure di sistemi di adattamento.

In considerazione della complessità della materia, Unione Petrolifera ritiene di primaria importanza ed utilità continuare e intensificare lo scambio di informazione, confronto e cooperazione con Ispra, MATTM e Protezione Civile, al fine di delineare ed attivare le migliori soluzioni per affrontare la tematica.

Ringraziamo ISPRA per il cortese e gradito invito a partecipare al seminario.
Si ringrazia per l'attenzione e l'interesse dedicato da tutti i partecipanti
Auguriamo un fruttuoso risultato di questa impegnativa giornata di approfondimento e formazione reciproca su una tematica certamente molto interessante e complessa.

Fausto Sini
Maria Virginia Coccia
Unione Petrolifera
Sicurezza, Salute e Ambiente

Back-up, personale

Invecchiamento attrezzature-Rischio incidenti rilevanti

Invecchiamento fisico delle attrezzature/impianti

- ***L'invecchiamento non è connesso all'età dell'apparecchiatura, bensì alle modifiche che la stessa ha subito nel tempo, in termini di grado di deterioramento e/o di danno subito......*** **(da: All. B Dlgs. 105/2015 – HSE 2006)**

Invecchiamento organizzativo e professionale

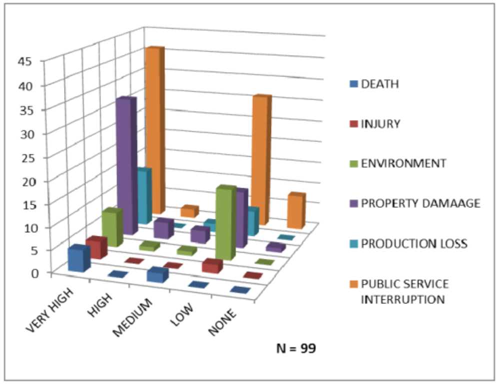
- ***obsolescenza delle tecnologie, delle procedure, del personale e delle competenze***

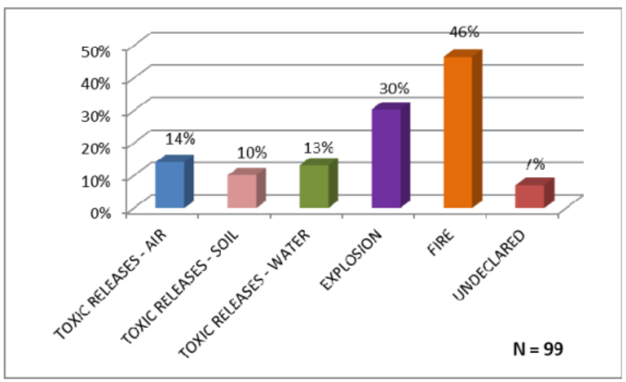
  (da: OCSE 2017)

- L'invecchiamento di un impianto può essere gestito

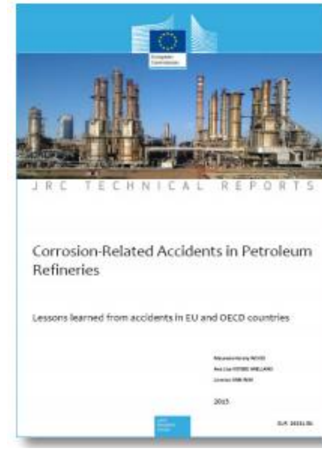
Back-up, personale

EUJRC 2013 report-Incidenti dovuti a corrosione nelle raffinerie





EU review sugli incidenti dovuti a corrosione nelle raffinerie



eMARS

99 incidenti rilevanti a livello mondiale in raffinerie sono stati causati da corrosione:

67 morti
219 feriti
700+ M€ danni diretti
700+ M€ bonifiche

Invecchiamento attrezzature-Rischio incidenti rilevanti

Regno Unito:

Dal 1996 al 2008 173 incidenti con perdite di contenimento dovute all'invecchiamento (fonte: HSE – banca dati RIDDOR)

Francia:

In 20 anni 300 incidenti dovuti alla corrosione

In ambito UE (da banca dati MARS):

- il **60%** degli incidenti potenzialmente rilevanti sono dovuti a perdita di integrità o a guasti della strumentazione di controllo e il **50%** di questi sono connessi con l'invecchiamento (fonte: Plant Ageing Study HSE 2010)

In ambito OCSE (OECD):

- Dal 2000 al 2014 rilevati 430 incidenti in 7 paesi OCSE dovuti all'invecchiamento con rilasci significativi di sostanze pericolose e conseguenze anche gravi (fonte: OCSE 2017)

Back-up, personale

Invecchiamento attrezzature-Rischio incidenti rilevanti

Nel periodo 2000-2014 rilevati 430 incidenti in 7 paesi OCSE (Australia, Francia, Germania, Italia, Svezia, Olanda e Regno Unito) dovuti a invecchiamento con rilasci significativi di sostanze pericolose e conseguenze anche gravi (fonte: OCSE 2017)

Analisi ha condotto ad alcune importanti conclusioni

- ✓ **Principale meccanismo invecchiamento** è la **corrosione (45%)**, seguita da fatica, usura o vibrazione o una combinazione delle tre (20%), obsolescenza (12%), erosione (10%), con un 13% di casi di natura indeterminata;
- ✓ **Nella metà dei casi** (215) l'incidente ha determinato **rilascio sostanze pericolose**, in 70 casi almeno una vittima, in 63 casi danni all'ambiente, 52 casi perdite economiche, in 30 casi gli effetti non indicati;
- ✓ **Impianti maggiormente colpiti** sono stati: **petrolchimici (33%) e chimici (26%)** seguiti da industrie alimentari (8%), cartiere (6%), impianti di depurazione (6%), produzione di fertilizzanti (5%), officine del gas (5%), industrie delle plastiche (4,5%), degli esplosivi (4%) e impianti di trattamento rifiuti (2%);
- ✓ **componenti di impianto interessati sono stati**, nei 217 casi ove il dato è disponibile: **tubazioni (98), serbatoi (71),** scambiatori di calore (18), reattori (13), pompe (12) e dischi di rottura (5).

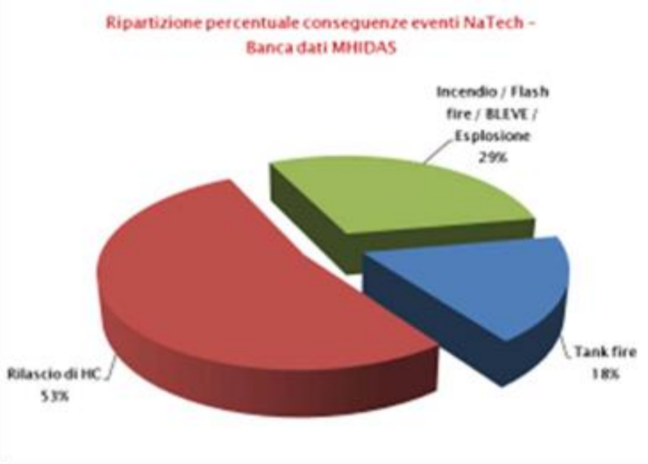
IN ITALIA

Dal **2001 al 2017** notificati alla EU COM (**fonte: Banca dati MARS**) **29 incidenti rilevanti di cui 28%. dovuti a guasti o perdite di contenimento potenzialmente riconducibili a invecchiamento**

BACK-UP personale

SEVESO III NA-Tech. ESPERIENZA CONSEGUENZE EVENTI IN Europa

- **On 7109 incidents in industrial sites, about 215 (3%) are triggered by NaTechevents (data from MHIDAS as elaborated by Italy Enea).**

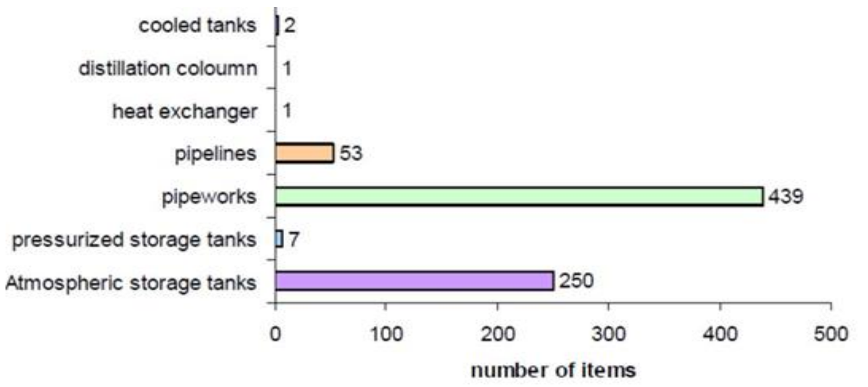


BACK-UP personale

ESPERIENZE SU EVENTI NATECH-SISMICI

(Informazione della Protezione Civile)

- **Hstorical data show that 78 NaTech accidents were caused by seismic events and that most vulnerable equipment are atmospheric tanks and connecting piping**.



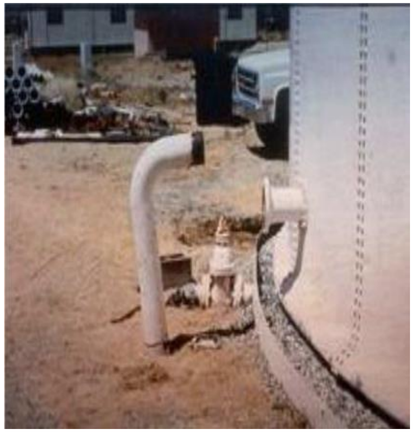
Tipologia Danni per eventi NATECH

➢ **Severity of Natech accidents is amplified by the simoultaneous shut-down of utilities and firefighting systems impeding the intervention and mitigagion activities.** Recent examples :

- Collapse of a chimney (115 meters), consequences on piping and Furnace of Topping unit, fire and shut-off valves out of service.
- Fire in gasoline tank. Propagation of fire in other tanks.
- Damages to the Pier structure and loss of hydorcarbon to sea.
- GPL loading arm broken.
- Loss of utilities, electric power, cooling water, damages to firefighting network.

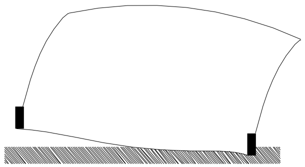
BACK-UP personale

Seismic damages to storage tanks and piping

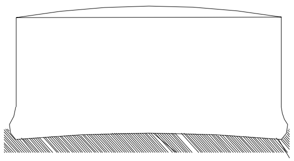


BACK-UP personale

Unanchored tank are subjected to "UPLIFTING" and "ELEPHANT FOOT BUCKLING".



UPLIFTING



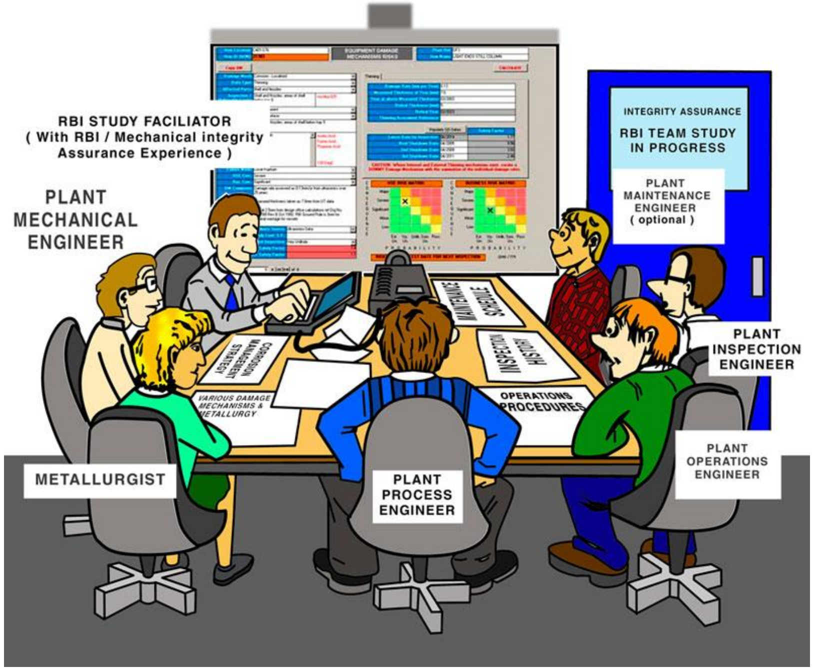
ELEPHANT FOOT BUCKLING

Main parameters ruling dynamic behaviour of tanks are height over radius ratio and filling level.

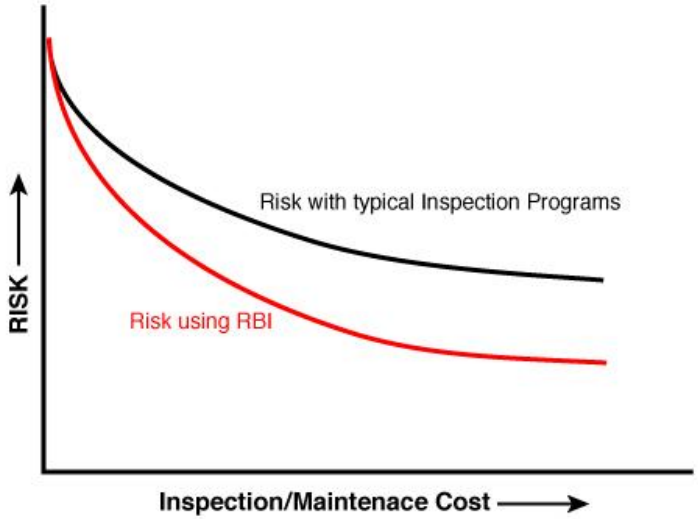
- Only full or nearly full tanks experienced failure.
- Low H/r ratios tank suffered cracks in conical roof connection or damage on floating panel sinking. Most common shell's damage is elephant foot buckling probability increase with H/r increasing.
- If base plate can uplift (unanchored tanks with H/r<0.8) elephant foot is not experienced but base plate/shell connection can fail causing spillage or content complete loss. For unanchored tank another limit state is the shell and plate connection failure due to their direct attachment and lack of flexibility.

It is worth noting that anchoring tanks seems to be a good seismic provisions for tank also avoid piping connections detaching and to eliminate uplifting risk, but unanchored tank increase their oscillating period reducing seismic action power, therefore trade off balance have to be found.

Metodi RISK BASED INSPECTIONS (RBI)



L'approccio RBI è il più diffuso nell'industria chimica e petrolifera per gestire l'integrità delle attrezzature.



BACK-UP Personale

ESPERIENCE: TYPE OF STRUCTURAL DAMAGES TO ATMOSPHERIC STORAGE TANKS

Type of Damages	Causes	Loss of Dangerouse substances
Elephant Foot Buckling	**Elevate tensioni di compressione generate dal momento ribaltante possono innescare fenomeni di instabilità delle pareti del serbatoio**	**Major, in the occurrence of Tank walls collapse**
UpLifting	**Il momento ribaltante può causare un parziale sollevamento delle piastre di base: lo spostamento verticale può determinare la rottura delle pareti del serbatoio e/o la rottura delle tubazioni di ingresso-uscita**	**Major, in the occurrence of Tank walls collapse and/or breaking of tank in/out piping**
Sloshing	**L'oscillazione del pelo libero del liquido all'interno del serbatoio può determinare danni al tetto e/o alla parte alta delle pareti del serbatoio**	**Minor**
Sliding	**Solo per serbatoi non ancorati: lo spostamento relativo tra il serbatoio e il piano di posa può determinare la rottura delle tubazioni di ingresso-uscita**	**Major, in the occurrence of breaking of tank in/out piping**
Liquefaction	**Rapido rilascio di sostanze dovuto al totale collasso della struttura determinato della liquefazione del terreno**	**Major**

Item FR 1.1.1.1 Large Vessels

ITEM FAILURE RATES

Type of Release	Failure Rate (per vessel yr)
Catastrophic	5 x 10-6
Major	1 x 10-4
Minor	2.5 x 10-3
Roof	2 x 10-3

12. The failure rates apply to fixed position, single walled vessels with a **capacity greater than 450m3**, which operate at ambient temperature and pressure.
13. Roof failures includes all failures of the roof and does not include liquid pooling on the ground. For vessels that are storing flammable liquids, this could lead to a flammable atmosphere being formed and possible ignition and escalation. For tanks that store toxic chemicals a toxic cloud could be formed. Most atmospheric storage tanks are specifically designed so that the roof wall seam will preferentially fail hopefully mitigating the effects of an incident.
14. The above rates are derived from historical data in work carried out by Glossop (RAS/01/06). They are applicable to large flat-bottomed metal storage vessels where flammable liquids are stored at atmospheric temperature and pressure. These values are not directly applicable to vessels storing non-flammable liquids because a different set of failure modes is relevant. However, they may be used as a basis for such vessels – seek advice from the Topic Specialist

RELEASE SIZES

Type of Release	Non flammable Contents (per vessel year)	Flammable Contents (per vessel year)
Catastrophic	8 x 10-6	1,6 x 10-5
Large	5 x 10-5	1 x 10-4
Small	5 x 10-4	1 x 10-3

17. Large releases are defined as a rapid loss of most or all contents e.g. large hole in a vessel leaking over several minutes.
18. Small releases are defined as smaller or much slower loss of contents e.g. through a small leak over 30 minutes.
19. FR117_2 defines hole sizes for tanks of unknown size (large holes are defined as 250 mm diameter and small holes as 75 mm diameter).
20. To calculate the hole sizes when the size of the tank is known, assume that a large hole would empty the tank in 5 minutes and a small hole would empty the tank in 30 minutes. What this equates to in terms of volumetric flow per second (tank volume/ time in seconds) can then be calculated and, from this, using the substance density, the mass flow in kg/s can be obtained. Using STREAM, it is then possible to determine what hole sizes would result in the calculated mass flow rates for small and large holes. The calculated hole sizes should be used unless they are larger than those specified in paragraph 19 (250/75mm), in which case the default 250mm and 75mm holes should be chosen

BAT 51 Decisione 2014/738/UE della EUCOM che stabilisce le migliori tecniche disponibili concernenti la raffinazione di petrolio e gas, ai sensi della Direttiva 2010/75/UE relativa alle emissioni industriali

BAT 51. Al fine di prevenire o ridurre le emissioni nel suolo o nelle falde freatiche provenienti dallo stoccaggio di composti di idrocarburi liquidi volatili, la BAT consiste nell'applicare una delle tecniche tra quelle riportate di seguito o una loro combinazione.

	Tecnica	Descrizione	Applicabilità
i.	Programma di manutenzione comprendente il monitoraggio, la prevenzione e il controllo della corrosione	Sistema di gestione comprendente il rilevamento delle perdite e controlli operativi per prevenire l'eccessivo riempimento, una procedura di controllo dell'inventario e procedure di ispezioni basate sul rischio applicate periodicamente ai serbatoi di stoccaggio per verificarne l'integrità, nonché una manutenzione volta a migliorare il contenimento del serbatoio stesso. Esso prevede anche un meccanismo di intervento in caso di fuoriuscite prima che gli sversamenti possano raggiungere le falde freatiche. Da rinforzare in particolare nei periodi di manutenzione	Generalmente applicabile
ii.	Serbatoi a doppio fondo	Un secondo fondo impermeabile che fornisce protezione contro le fuoriuscite provenienti dal primo fondo del serbatoio	Generalmente applicabile ai nuovi serbatoi e dopo la revisione dei serbatoi esistenti [1]
iii.	Membrane di rivestimento interno impermeabili	Una barriera continua a tenuta impermeabile sotto l'intera superficie inferiore del serbatoio	Generalmente applicabile ai nuovi serbatoi e dopo la messa fuori servizio e la manutenzione completa dei serbatoi esistenti [1]
iv.	Bacino di protezione che assicura un sufficiente contenimento dell'area di stoccaggio	L'area di contenimento è progettata per circoscrivere eventuali grandi sversamenti potenzialmente causati da una rottura del serbatoio o da un eccessivo riempimento (per motivi sia ambientali che di sicurezza). Le dimensioni e le relative norme edilizie sono generalmente definite da regolamenti locali	Generalmente applicabile.

[1] Le tecniche ii e iii possono non essere applicabili in maniera generale quando i serbatoi sono destinati a prodotti la cui movimentazione allo stato liquido richiede calore (ad esempio, bitume), e quando le perdite sono rese improbabili dalla solidificazione.

Attività aziende UP per il monitoraggio e controllo rischi invecchiamento

- **Le aziende hanno da lungo tempo pianificato i controlli e mantenuto efficienti le proprie apparecchiature tenendo conto dei degradi « *invecchiamento*».**

➢ sempre messo in atto le norme nazionali applicabili (ANCC, ISPESL, PED, ecc).

- **Oltre alle norme nazionali gli stabilimenti hanno pluriennale esperienza in materia di valutazione dei rischi e utilizzano norme di consolidata e lunga esperienza internazionale, settore specifiche, quali ad esempio**:
  - ➢ API 653 «*Tank Inspection, Repair, Alteration and Reconstruction* »;
  - ➢ EEMUA 159 «*Users' guide to the inspection, maintenance and repair of aboveground vertical cylindrical steel storage tanks*»;
  - ➢ API 570 «*Piping Inspection Code: In-service Inspection, Repair, and Alteration of Piping Systems*»,
  - ➢ API 2611 «*Terminal Piping Inspection— Inspection of In-Service Terminal Piping Systems*»;
  - ➢ API 571 «*Damage Mechanisms Affecting Fixed Equipment in the Refinery Industry*»;
  - ➢ API 580/581 «*Risk Based Inspection*»
  - ➢ API 584 RP «*Integrity Operating Windows*».
  - ➢ e/o similari sviluppate ed adattate alle esigenze delle singole aziende, per affiancare al degrado da invecchiamento anche l'analisi di rischio correlata

- **Organizzazione**. Gli stabilimenti, in relazione alla dimensione, complessità e tipologia impianti:

➢ sono strutturati con un **gruppo o singolo tecnico ispettivo e/o con un supporto ingegneristico interno ed esterno** per analizzare i fenomeni di degrado sulle singole apparecchiature e valutarne il degrado in fase costruzione e nel tempo.

➢ utilizzano **ispettori terzi e ditte qualificate per i controlli non distruttivi che utilizzano personale qualificato e certificato** secondo le norme EN 9712.

➢ oltre ai controlli non distruttivi standard, vengono **anche utilizzate tecnologie di controllo avanzate**, come MFL Floor scanning, UT Phased array, LRUT, ecc.

BACK-UP

ITALY Map of Seismic Acceleration with a probabilty of 10% to be exceeded in 50 years
(return interval time about 500 years)