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NEDIES PROJECT

Lessons Learnt from Storm Disasters

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Editors

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Mission

The mission of the Institute for the Protection and the Security of the Citizen is to provide research-based, systems-oriented support to EU policies so as to protect the citizen. The main application areas are cyber-security and the fight against fraud; natural, technological and economic risks; humanitarian security, non-proliferation and nuclear safeguards. The Institute will continue to maintain and develop its expertise in information, communication, space and engineering technologies in support of its mission.

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ABSTRACT

The NEDIES project is being conducted at Ispra by the Institute for the Protection and Security of the Citizen (IPSC), formerly the Institute for Systems, Informatics and Safety (ISIS), of the EC Joint Research Centre (JRC). The objective of the project is to support the Commission Services of the European Communities, Member State Authorities and EU organisations in their efforts to prevent and prepare for natural and environmental disasters and to manage their consequences.

A main NEDIES activity is to produce "lessons learnt" reports based on experience gained from past disasters. This report discusses lessons learnt from recent storm disasters. It is based on the contributions presented at a NEDIES meeting held at Ispra JRC on 3 and 4 May 2001.

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1. INTRODUCTION

NEDIES (Natural and Environmental Disaster Information Exchange System) is a project concerned with natural and environmental disasters, which occurred in EU Member States. It is carried out at the Institute for Systems, Informatics and Safety (ISIS) of the EC Joint Research Centre (JRC).

This report is based on the contributions presented at a NEDIES expert meeting on lessons learnt from storm disasters held in Ispra, at the JRC, on 3 and 4 May 2001.

Chapter 2 portrays the lessons learnt from various storm disasters experienced throughout Europe. The first contribution (Section 2.1) is about the storm that hit France during the last days of 1999. This is followed by a more detailed analysis of the disasters produced by the same event in the department of Meurthe-et-Moselle (Section 2.2). The third event described comes from Northern Ireland and addresses the lessons learnt from a storm in 1998 (Section 2.3). Also in 1998, a storm devastated Greece (Section 2.4), while a hurricane hit Denmark in the beginning of December 1999 (Section 2.5). From Italy, there is a contribution regarding a storm in October 2000 (Section 2.6) that affected many provinces in northern part of the country. Finally, the lessons learnt from a hurricane in 1999 are presented, from the point of view of a German electricity service provider, EnBW, from the private sector (Section 2.7). Electricity availability during a storm is paramount so as to ensure a more rapid response to crisis events. Without electricity essential instruments and equipments, such as hospital equipment, water pumps, information technology for response co-ordination, etc., are useless. This contribution differs from the others as it focuses only on the electrical networks of EnBW and its management during a crisis.

Chapter 3 summarises the various lessons learnt from the participating EU Member States and offers some conclusions arising both from the analysis of the lessons learnt contributions and the discussions made during the expert meeting.

This report was made for the European Commission Services, Civil Protection Authorities of the EU Member States and people involved in the management of any type of natural and environmental disaster. Although the report is concerned with storm disasters, the lessons learnt presented can also be of help in the prevention of, preparedness for and response to other types of disasters.

The report is included in the website (**http://nedies.jrc.it**) of the NEDIES project, thus it is also available to any interested public, and not only to experts in the area of storm disaster management. To assist the non-expert reader, an annex is provided, which contains selected storm terms and definitions.

2. LESSONS LEARNT

2.1 The Storms on December 1999 over France (France)

Patrick SAUVAGE (Ministry of the Interior, Defence and Civil Security Direction, Asnières sur Seine)

2.1.1 Date of the disaster and location

Storm 1 26 December 1999, at about 02.00, northern half of France (see Figure 1).

Storm 2 27 and 28 December 1999, at about 16.00, southern half of France, in particular, the western and central parts (see Figure 2).

2.1.2 Short description of the event

The storm on Sunday 26 December

A very deep depression (960 hPa at 07.00 in the vicinity of Rouen) crossed the north of the country very rapidly, from west to east, along a trajectory approximately following the 49th parallel. It hit Finistère at around 02.00 and reached Strasbourg at about 11.00 at a speed of 100 km/hr. The storm lasted a total of 9 hours.

It was accompanied by exceptionally strong winds, in particular, over an area of about 150 km in width, immediately to the south of the trajectory of the depression, along the following path: tip of Brittany – southern Normandy – Ile de France – Champagne Ardennes – Lorraine – Alsace and then Germany.

The storm was characterised by the fact that the depression became deeper as it crossed the land, probably due to a marked interaction with high-altitude air streams moving at nearly 400 km/hr at an altitude of 9 000 m. This was quite a rare event, because trend has it that bad weather from the Atlantic usually improves as it goes inland; in this case, the opposite had occurred.

Figure 1

Figure 2

The storm on 27 and 28 December

This second (also very deep) depression crossed the country during the afternoon of 27 and the morning of 28 December at a speed of 100 km/hr. During the morning of Monday 27 December, it fell to 965 hPa off Brittany and moved across the country from the tip of Brittany at around 16.00 along the line Nantes – Romorantin – Dijon, reaching Alsace at around 04.00 in the morning of 28 December, after which it moved off to the east. The total duration of the precipitation event was 12 hours.

This depression was accompanied by exceptionally strong winds, with the maximum speeds over the western and southern parts. The regions hardest hit were southern Brittany and the Atlantic coast, all areas to the south of a line from La Rochelle to Mâcon, including the Mediterranean coast, and Corsica.

To the north of the depression, there was snowfall over the north of Brittany and Normandy, and lighter, more intermittent falls over the west and southern part of the Paris region. The snowfalls were heavier in the north-east of the country.

2.1.3 Human consequences

92 people were killed and about 2 000 injured, particularly as a result of trees falling on dwellings, vehicles being crushed, accidents during hasty emergency operations on damaged properties (especially on slippery roofs) and rescue operations. The human cost was higher still if account is taken of the number of victims of accidents, which occurred later during repairs and restoration activities. For forestry operations alone, the National Forestry Office reported, four months after the storm, the case of four people who were killed while removing fallen trees.

2.1.4 Economics losses

The extent of the physical destruction was unprecedented: the financial cost of these storms probably exceeds 15.4 billion Euro. Here below are some examples of damages that were made by the storm:

- 3.5 million households (which corresponds to about 10 million people) lost their electricity supply;
- 2.5 million people no longer had access to drinking water;
- 2/3 of the railway network was damaged by 15 000 fallen objects;
- hundreds of roads have been interrupted or damaged;
- 193 million cubic meters of forest was destroyed, which corresponds to 3.5 times the annual production. The corresponding estimated loss is 6.15 million Euro.

2.1.5 Prevention measures and related lessons learnt

Because the storm was totally unexpected, there were no direct prevention measures carried out. However, at the national level, the specific plan for the changeover to the year 2000 (computer bug, seasonal festivities) was a decisive element, which greatly facilitated management of the crisis for various reasons:

- firstly, the various groups concerned (state authorities, industry, associations) had come together to prepare for this event;
- secondly, command structures with permanent manning and warning systems had been put into place for the New Year period;
- lastly, preventive measures had been put into place to protect the most sensitive points (distribution of generators, survey of places at risk, etc.).

Lessons learnt

⇛ The development of a code of conduct for the general public is required so that individuals react appropriately according to the particular situation.

⇛ There should not be any development of a specific plan as it would be underused given the exceptional nature of these events, but, rather, there should be frequent updating of the existing plans, the general introduction of a code of conduct and an increased number of training exercises.

⇛ For some companies (EDF, SNCF, France Télécom), the continued operation of networks must be guaranteed:

- *For the electricity grid*, power lines must be made able to withstand this kind of event and alternative means of power production (electricity generators) must be made more readily available and a rapid response force set up. EDF has taken all of this into account; it has launched a study and intends to propose ways of improving these deficiencies.

- *For the communications networks*, it has been found that the major operators in France did not pay sufficient attention to ensuring that their (fixed or mobile) networks were secure.

To overcome this shortcoming, several measures could be considered:

- the specific identification of areas which need underground lines in order to make them less vulnerable;
- the setting of minimum standards of independent action and a survey of installations to justify making power-generating equipment available to reduce vulnerability to disruptions in power supply;
- the development of a more relevant priority user management policy.

2.1.6 Preparedness measures and related lessons learnt

Although the French meteorological office (Météo France) did not accurately forecast what would occur, the information which was circulated enabled the rescue services to be put on alert.

Storm on 26 December

Météo France's numerical simulator clearly identified the depression in question and its trajectory, but underestimated its depth. An initial analysis suggests that the extreme violence of the winds was caused by disturbance at very high altitude and ground-level disturbance.

On 25 December, BRAM (regional weather alert reports) were put out by the CMIR (inter-regional weather centres) in the north of the country, the Ile de France, the north-east and the west. However, because the severe nature of the storm was underestimated, in particular the depth of the depression, the SCEM (central weather exploitation service) did not issue an "alarm" message on 26 December until 7.30.

Storm on 27 and 28 December

The "alarm" message was issued by SCEM on 27 December at 9.03. Following the usual procedure, the CMIR concerned forwarded this message via the BRAM to the centres in the Ile de France, the west, the north-east, the east, the south-west, and the south-east. During the course of the day, additional information was provided concerning the spread towards the north and an associated period of snow.

During the storms, the Météo-France weather forecasters worked closely together, at all levels, with the civil safety services.

In total, these two storms led to the issue of:

- 2 regional bulletins
- 11 regional bulletins on strong winds.

During the same period, there were also:

- 2 regional bulletins on heavy rain
- 1 regional bulletin on a storm
- 1 regional bulletin on snow.

Furthermore, given the specific nature of the storms (their force and extent) and the fact that they were exceptional and atypical, there was no particular plan in place to deal with the consequences. However, a large number of specific plans were used to simplify the management of this major crisis, in particular, at the local level.

Many Prefects in the departments put into action existing plans (ORSEC, emergency power plan, emergency accommodation plan) to deal with the situation.

- The ORSEC plan was therefore officially brought into operation in nine departments and its provisions were put into effect in a large number of other departments without any official instruction being given.
- Other plans, such as the emergency power and accommodation plans, were used to resolve some of the problems caused by the storms.

Lessons learnt

⇛ A new alert system is required. Thus, a reform of the weather alert system has already started in October 2000 and a new weather watch procedure will be introduced on 1 October 2001. This will replace the present alert procedure.

⇛ Since this type of crisis may hit several different departments or even regions, the ORSEC plan should be extended at the regional and national level as a matter of urgency.

2.1.7 Response actions and related lessons learnt

The command centres got up to speed quickly enough and the rescue services were quite rapidly deployed. There was a general mobilisation of effort and a massive mobilisation of resources, which enabled things to return to normal within a reasonable time frame given the severity of the situation.

It should be pointed out that all of the departments hit by the storms rapidly activated their operational defence centres. The regional command centres and the COGIC (national operational centres) started up almost immediately. This enabled a command structure to be put in place rapidly at all state levels.

Fire brigades and civil security personnel effort

Most of the potential resources of the fire brigades and civil security personnel were employed both locally and nationally. In the 70 departments hit, 150 000 firemen (90% of the total number) were called into action. Similarly, all resources in terms of personnel and equipment of the national civil security reserve were used:

- all available UIISC personnel (some were already working on the Polmar plan preparing for the transition to the year 2000 or working on floods abroad) were sent into the field: 555 men per day in December, 576 men per day in January;
- reinforcement helicopters from 14 different bases were deployed;
- the entire stock of power generators, tarpaulins, chainsaws and electric pumps held by the operational and logistical support establishments of the civil security brigade was made available;
- additional firemen from the departments not affected were sent to those, which were most severely affected: 259 men per day in December, 388 men per day in January.

Army effort

The army also made a substantial effort:

- An average of 8 500 military personnel a day were made available to the rescue authorities for operations involving accommodation, the removal of obstacles or aid to farmers in difficulty;
- Airborne transport from the three branches of the armed services, civil engineering, lifting and clearing equipment, power generators and various other equipment were also provided to support the operations being carried out by the other public services, in particular EDF.

The major national undertakings effort

The major national undertakings also deployed massive resources:

- EDF mobilised nearly 50 000 persons, including 43 000 within the undertaking itself. More than 4 200 grid specialists from French companies and 1 800 from foreign companies were also involved;
- French railways (SNCF) deployed 18 000 persons to restore the network;
- France Telecom made use of nearly 20 000 persons for the same purposes and SFR more than 300.

Private companies effort

Private companies were also broadly called upon to make equipment available (generators, tanks, tarpaulins), to provide transport services or for hauling operations.

International contribution

The international aid contribution must not be underestimated. The main beneficiary was EDF. About 20 countries helped by providing teams and specialised equipment which could not be obtained in France within such a short space of time.

Lessons learnt

Organisation of the chain of command

In order to optimise the efficiency of the chain of command, several points should be improved both nationally and locally.

Co-operation between ministries should be increased and COGIC should be confirmed in its role.

⇛ Crisis management on this scale requires the use of all resources available to the country. The representatives of all ministries who may be called upon to give an expert opinion or provide resources should therefore come together in a single place. Each ministry should therefore accept to make a concerted effort by sending a representative to the COGIC.

Strengthening the role of the "defence area"

⇛ The upward transmission of information is essential in crisis management. The role of the "area" as an intermediary reporting level should be approved. This would avoid any problems of information overkill and make it possible to obtain a rapid overview of the situation.

⇛ Confirm the role of co-ordination at the "area" level (may require a draft decree) and allocate rescue resources to that level (human and material resources).

Harmonise the organisation of the contact points and the operational procedures

⇛ Establish a single system of communication for all levels so as to save considerable time in the upward transmission of information, making summaries and managing additional resources.

⇛ Provide for the general use of a standard crisis management manual setting out the principles and rules for everyone to follow in the event of crisis management to avoid any differences in reactions and procedures.

Incorporate international co-operation more fully

⇛ Improve the way information is passed on to neighbouring countries. This will involve the need for a European information-gathering organisation, which may take the form of a Community watchkeeping centre.

⇛ Harmonise procedures for making requests and co-ordinate the distribution of resources in liaison with the public and private groups concerned so as to provide better monitoring of how resources are used.

⇛ Standardise the procedures to be followed and possibly harmonise the standards for certain equipment.

2.1.8 Information supplied to the public and related lessons learnt

Prior to the event

The information that will be issued during the event should be more significant, i.e. better arranged, clearer and, if necessary, expressed in standard terms, such as:

⇛ A scale of severity should be devised for events on the ground.

⇛ The event should be described in terms of other known events and what is likely to happen should be put in a way which will be understood by the public. This should be coupled with recommendations on what to do.

Thus, in preparing a standard methodology of dissemination, information will reach the public in a more efficient manner.

During the event

The information provided during a serious weather incident should be as direct as possible:

⇛ The information should be sent simultaneously to all services responsible for rescue and assistance (at national, regional and departmental level). A wide network of systems should be set up in order to ensure that the information arrives.

⇛ The information should be made permanently available to the public using existing vectors (Internet, the media, etc.).

Following the event

⇛ See lessons learnt in paragraph 2.1.7, sub-headings *"Strengthening the role of the defence area" and "Harmonise the organisation of the contact points and the operational procedures.*

2.2 The Storm on December 1999 in the Meurthe-et-Moselle Department (France)

Bernard MODERE' (Fire and Emergency Services, Meurthe-et-Moselle)

2.2.1 Date of the disaster and location

26 December 1999, Meurthe-et-Moselle.

2.2.2 Short description of the event

The storm, which affected the northern half of France on the morning of 26 December 1999, did not spare the department of Meurthe-et-Moselle (in the north-eastern quarter of France). In the southern half of the department, two-thirds of the 5 000 km² making up Meurthe-et-Moselle was hit by gusts of wind of 150 km/hr while maximum wind speeds over the department never go above 120 km/hr. Damage was considerable, in particular to buildings (roofs torn off) and damage to roads and railways which were obstructed (in particular the railways, where overhead power lines and signals were destroyed).

There were two additional problems: interruption of power supplies following damage to high and low voltage lines. This led to power cuts, in particular at homes for the elderly and at farms (making it impossible to milk cows and interrupting cold chains). There were also, though to a lesser extent, problems in telephone communication following the destruction of overhead cables, but in particular the gradual breakdown of mobile telephone relays as emergency batteries ran out (between 24 and 48 hours). It was quite fortunate that the disaster occurred at a favourable time, namely on the day after Christmas, which happened to be a Sunday, a day when there is very little human activity. Consequently, there were no serious human consequences.

Moreover, damage to industrial installations could be remedied relatively swiftly because of the low level of economic activity between Christmas and the New Year. It should be noted that the level of mobilisation of the public services was particularly high, which can be explained from the fact that emergency units were in a state of vigilance and staff was on standby because of the millennium bug (31 December 1999). In particular, there was an extremely rapid response by the fire and emergency service, largely based on volunteers, as all those involved were individually aware of the seriousness of the situation.

2.2.3 Human consequences

Although the storm had only claimed the life of one person, 17 people were seriously wounded, 11 were slightly wounded, 23 had breathing problems and 27 victims suffered from carbon dioxide poisoning.

2.2.4 Economic losses

Because the storm event occurred between Christmas and New Year, economical activities were luckily reduced to the minimum. However, infrastructure and agriculture were heavily affected. Although a precise amount cannot be quoted for the moment, a qualitative description of damages can be shown:

- damage on buildings, especially roofs;
- collapse of light constructions;
- destruction of works, such as high voltage pylons, mobile telephone pylons and hertzian relays;

- damage to power and water supplies;
- 90% of mobile network was temporarily damaged;
- railway network was disrupted;
- agriculture industry was hit hard because the interruption of power supply provoked difficulties in the management of breeding processes such as: the blockage of the cold chain, impossibility to milk the cows, interruption of automatic feeding;
- 8.3 millions cubic meters of forest area was devastated, which corresponds to 5 years of exploitation.

2.2.5 Prevention measures and related lessons learnt

It should be noted, first of all, that this type of disaster is totally unforeseeable, reportedly occurring only about once every 200 years. However, there are a number of preventive measures for such occurrences whose effectiveness in practice proved very mediocre.

Weather alert

The French meteorological office (Météo France) has used weather alerts for years. Météo France publishes daily weather bulletins with alerts for major weather phenomena (storm, snow, heavy rain). In this case, an alert was issued but it went out late and greatly underestimated the severity of the storm.

Power supply

Each department in France has an electricity emergency plan designed to provide mobile facilities to establishments requiring permanent power supply. Major establishments, e.g. in the health sector, have their own generator, making them independent in the event of a protracted power cut. Lower electricity charges in cases where generators can be used instead of the national grid during winter have led many establishments to acquire means of independent electricity generation. Unfortunately, medium-sized health establishments are in no way obliged to get hold such equipment and this made it necessary for the public services to focus their efforts on this type of problem. There is no other major scheme in our region to cope with the consequences of a storm.

Lessons learnt

General observations

⇛ Because of the alert status of the various existing services with regards to "the bug of the year 2000", they were already pre-mobilised and were unknowingly already prepared for the storm.

⇛ Because the storm event occurred during the period between Christmas and New Year, economical activities were minimal and people were not in circulation. If the event had not occurred during the holidays, there probably would have been more casualties and economical losses could have been astronomical.

⇛ The existing emergency services had reacted very efficiently, particularly the fire brigade volunteers.

Observations regarding the request of services

⇛ Overflowing of the departmental operational centre (CODIS). It was necessary to set up devices to receive and manage multiple calls; classical hardwares of alert treatment were inadequate.

⇛ Extreme request of the intervention teams, who, in parallel, had to maintain a level of security that also abided with the rules.

⇛ A classical centralised management of interventions was impossible; therefore, it was necessary to have local autonomous teams, which would face to the emergency calls, received either directly or by the operational centre.

⇛ Transmissions for public emergency services are of great importance: they must become autonomous and secured, and ought not to go through the failures of the phone operators.

⇛ It is important that a search for an optimal integration of emergency services is carried out:
- on the level with the cell of crisis;
- on the level with the places of intervention.

⇛ It is necessary to develop inter-services cultures

⇛ Regular updates of the planning documents are required.

⇛ Organization of regular exercises is needed in several directions:
- exercises for executives
- transmission exercises
- interdepartmental, departmental and infra-departmental exercises on the ground.

⇛ It is necessary collaborate with the media, so that they become correctly and regularly informed. Media can be a fundamental ally for the management of a crisis.

⇛ Preservation of a privileged contact with local elected members is necessary to assure coherence from the summit of the command chain to the local levels.

⇛ It's interesting to have extra-national reinforcements in this sort of situation when a country suffers from such an important disaster.

2.2.6 Preparedness measures and related lessons learnt

As indicated above, in dealing with this disaster it was possible to benefit from a vigil, i.e. the fact that measures had been taken so as to be ready in the event of a crisis caused by the millennium bug. Accordingly, it proved easy to mobilise emergency services thanks to preparations made during the preceding weeks. One cannot say that there was a ready-made emergency plan, but there was a contingency plan.

2.2.7 Response actions and related lessons learnt

The response phases can be grouped into two broad categories:

A first reaction phase

In this phase, the public services moved into action by themselves to provide emergency assistance, i.e. the fire brigade, the police, the gendarmerie and the emergency medical services. Each service became aware of the scope of the disaster and managed to call up the necessary staff without having recourse to specific procedures. It has already been stated above that in the case of firemen this was done quite successfully thanks to the fact that major use was made of volunteers spread over large number of locations throughout the department.

A second, well organised, phase

The setting-up of a crisis unit at the Prefecture and the mobilisation of identical measures in the major towns were rendered easier by the preparations made in the preceding months in connection with the expected millennium bug.

All the technical facilities were ready and the people responsible had been designated: each service was at full strength in time.

One may qualify these positive points by highlighting the severity of the crisis which did not only consist of an electricity or informatics problem as feared because of the millennium bug but a more general problem of protecting property because of destroyed roofs and clearing obstructed roads and railway lines.

The crisis centres had to focus their action on these last two points without however ignoring the problem of power supply.

The number of appeals to the public services for help was extremely high. For instance, the departmental fire and emergency operations room received more than 30 000 calls in a matter of three days, involving 9 000 operations. Under normal circumstances, they would have had to follow up not more than 400 calls.

Stocks of emergency material and equipment (generators and tarpaulins in particular) were quickly exhausted. The storm also affected 40 other departments, making it impossible to get reinforcements from outside. This proved all the more unfortunate as two days later the southern half of the country was hit by another storm. Extra tarpaulins were obtained by requisitioning all tarpaulins in the department; in particular from farming co-operatives, followed by the establishment of six distribution points in the department operated by the fire brigade.

As regards electricity generators, the search for replacement facilities was very limited, as virtually all private generators had already been rented out to factories or administrations expecting possible power cuts caused by the millennium bug.

Scant facilities were acquired from the army and some reinforcement was obtained from neighbouring countries, though relatively late.

On the whole, the population considered that the response from the public services had been satisfactory because their mobilisation was quite visible and people were fully aware of the extreme gravity of the situation out of all proportion with the emergency facilities available.

2.2.8 Information supplied to the public and related lessons learnt

Prior to the event

Unfortunately, there is nothing that can be said on this point, given the sudden and violent nature of the occurrence and the impossibility of foreseeing this storm.

During the event

Communication proved to be a sector of fundamental importance in circumstances of this kind. The information provided convinced the population of the seriousness of the situation and the limited means available to the public services to deal with the problem. Accordingly, the media provided regular and ongoing information, with the emphasis on advice to private individuals:

- precautions necessary when covering damaged roofs with a tarpaulin so as to avoid the risk of falling;

- the proper use of generators to prevent carbon oxide poisoning where such equipment is used in confined spaces;
- precautions to be taken when piling up fallen trees uprooted by the storm.

Progress reports on restoring power supply and communications made the population aware that problems were gradually being solved.

Following the event

The main action consisted of reports submitted to each mayor on the work done by each service. A damage inventory and a compensation scheme were initiated immediately in conjunction with the mayors of the department through meetings per sector.

While most problems of power supply could be solved, a secondary problem proved to be the massive destruction of forests with the following consequences:

- enormous quantities of wood placed on the market (insufficient woodcutting facilities), causing the market to collapse;
- the predictable drop in revenue of forestry communities over a two or three year period (lack of sustained revenue, and reforestation);
- increased fire risk in forests as a result of the damage done there while the region is not adequately equipped for this kind of disaster.

2.3 The storm on December 1998 in Northern Ireland (UK)

Bill CLEMENTS (Central Emergency Planning Unit, Belfast)

2.3.1 Date of the disaster and location

26-31 December 1998, whole of Northern Ireland.

2.3.2 Short description of the event

Northern Ireland is part of the United Kingdom and the European Union. It has a land area of some 5 500 square miles (13 500 km^2) which is slightly less than half the size of Belgium. It has a population of approximately 1.5 million, and has one major city, Belfast, with a population of approximately 300 000. The rest of the province is mainly rural.

On 24 December 1998 the Meteorological Office, London issued an early warning of severe gales expected over the whole of Northern Ireland for the next 72 hours. This was followed up by two further warnings on 25 and 26 December and a flash warning of severe gales, with gusts up to 140 km/hr, at 12.57 on 26 December. The wind grew in force throughout the morning of 26 December, peaked in the evening and finally eased at around midnight.

The highest 10 minute mean wind speed recorded on 26 December was 56 knots per hour (about 100 km/hr) (Violent Storm Force 11) and gusts of 84 knots per hour (about 155 km/hr). It should be noted that the measuring stations are generally located in low open ground or sheltered forest locations and therefore some inland and mountain areas experienced higher speeds than these. The duration of the storm (Gale Force 8 or greater for over 10 consecutive hours) is also the longest on record.
Records would suggest that a storm of this magnitude would have a return period of greater than 35 years. The storm was followed by more severe weather. On 27 December the Meteorological Office issued a flash warning of heavy snow affecting the whole of Northern Ireland, and on 28 December a weather watch of potentially severe weather was issued for the following 48 hours.

2.3.3 Human consequences

There was one fatality arising from the storm, which occurred when a motorist crashed into a tree, which had fallen across a road. There are no details of injuries resulting from the storms.

Up to 10 families were made homeless following structural damage to their properties. Although figures are not available for private property damage was caused to 80 000 homes owned by the Northern Ireland Housing Executive. For health and safety reasons it was not possible to commence repairs until weather and access conditions had improved.

2.3.4 Economic losses

There are not complete figures on material losses and response action costs available for all the organisations involved. However, the repair costs, cost of tree removal and loss of revenue from timber was approximately 5.8 million Euro. Here below are examples of the damages that the storm had caused.

The main direct effects of the severe weather were:

- damage to overhead power cables and poles;
- fallen trees;
- structural damage to property.

Following on from these were some indirect effects:

- disruption to power supplies due to physical damage to cables and poles for a very large proportion of the country;
- disruption to water supplies, due to loss of electricity and failure of back up generators;
- a small number of people made homeless or having to be moved from their homes due to structural damage or loss of power;
- difficult and dangerous driving conditions for emergency responders and leisure travellers due to high winds and fallen trees;

Pressure on the telephone system as people tried to report electricity faults or enquire about reconnection plans, causing temporary overload at some exchange.

2.3.5 Prevention measures and related lesson learnt

Prevention measures

Building Regulations which are currently in place in Northern Ireland and the reminder of the United Kingdom take into account typical loadings imposed on any structure. At the heart of these regulations lie a variety of Codes of Practice and British Standards which ensure that the design of structures and the products used in their construction are suitable for use in this part of the world in terms of both imposed loading from the building and loadings imposed by nature.

The Northern Ireland electricity networks are designed and constructed to UK standards and are similar to those used by the National Grid and all of the GB Regional Electricity Companies. Variances are at component level rather than in design parameters.

Lessons learnt

⇛ There should be better inter-organisational co-operation between public service organisations to allow all concerned to develop integrated work procedures which would take account of organisations' priorities and limitations;

⇛ More contingency is needed to be built into operating procedures (e.g. Northern Ireland Housing Executive had difficulty in obtaining sufficient building materials to allow repairs of damaged homes to be carried out);

⇛ It might be valuable for some organisations to undertake some form of public education exercise to make people aware of what they could expect from the public services or how they could access help;

⇛ It is necessary to have available additional generators, water tankers and distributors of fuel and resources for drawing on alternative suppliers and additional assistance with manning levels.

2.3.6 Preparedness measures and related lesson learnt

Preparedness measures

Northern Ireland Departments are responsible for ensuring that they have arrangements in place to deal with any emergency affecting their areas of responsibility.

Whilst water supplies are the responsibility of the Water Service (an agency of the then Department of the Environment for Northern Ireland) other utilities such as oil, gas, electricity and telecommunications are privately owned. The preparation of emergency planning arrangements is therefore the responsibility of the operators. Regulators issue licences to run the gas, electricity and telecommunications networks. These licences can specify standards on continuity of supply and quality of service. However, companies can claim exemption in emergency circumstances.

The following are the preparedness arrangements, which were in place at the time:

Northern Ireland Electricity (NIE)

- was able, with the help of British Telecoms (NI), to provide call handling facilities at short notice;
- held a special needs register, which worked well.

British Telecoms (NI)

- had contingency plans for the storm and an Emergency Restoration Plan, which had been exercised prior to the event thus preparing staff;
- had extensive availability of back up generators, which enabled it to maintain most of its network.

Water Service

- had in place a Major Incident Plan and on-call system, which worked well.

The Northern Ireland Housing Executive (NIHE)

- receives forecasts from the Met Office, so was prepared for the storm;
- had a well practised emergency repairs service, developed for bomb situations in the past, which worked equally well for dealing with storm damage;

- although BTNI was able to maintain the phone system, had it failed NIHE had available a full standby facility using 200 mobile phones.

Department of Health and Social Services (DHSS)

This department is now known as the Department of Health Social Services and Public Safety (DHSSPS) and it consists of a range of agencies, 4 Health and Social Services Boards (including the NI Ambulance Service (NIAS)) and 19 Health and Social Services Trusts which provide a range of both acute and community services:

- each of these organisations has a range of contingency plans covering their areas of responsibility. These appeared to work well;
- NIAS had contingency plans for generators, staff and working practices, all of which generally worked well.

Social Security Agency

- had a contingency plan for emergency payments, which worked well.

Maritime and Coastguard Agency

- had back-up power supplies and contingency plans for repairs, which with one exception worked well;
- accurate and timely forecasting of the storm had alerted commercial vessels to danger, and as there were few leisure craft in use, so maritime risks were lower than at other times.

Lessons learnt

⇛ NI Housing Executive now has the capacity to pass information on to its tenants without them having to contact the utilities individually.

⇛ The value of joint training and exercising in developing an integrated approach to emergencies was recognised. The Central Emergency Planning Unit maintains a register of exercises which organisations across the public sector and the utilities intend to hold throughout the year. Other organisations have the opportunity, and indeed are encouraged, to participate in these exercises with the aim of developing a greater understanding of each other's roles and to stimulate and cement contacts and co-ordination across and between those organisations responding in an emergency situation.

2.3.7 Response actions and related lessons learnt

All government departments in Northern Ireland have emergency plans, based on the principles of Integrated Emergency Management, for their areas of responsibilities. However, the ongoing severe weather hampered the ability of many of the public service organisations to respond immediately to the incident, thus delaying the repair process. While essential repairs were attempted, operations were further hindered by the continuing severe weather. In addition, weather conditions made travelling hazardous for other organisations such as the Northern Ireland Ambulance Service, the Maritime and Coastguard Agency and the Social Security Agency attempting to respond to public need. The main effects of the storm on the emergency services and a range of public services and utilities and their response to these were:

- repair/reinstatement of essential infrastructure as soon as it was safe to do so;
- clearance of fallen trees and other debris from roads and the vicinity of electricity cables to facilitate emergency services and repair teams;

- signposting of traffic hazards and roads closed;
- making safe damaged structures to ensure public safety;
- activation of contingency plans for power interruptions, mostly by use of backup generators (some generators required technical support);
- damage assessment and emergency repairs or weatherproofing, followed by full repairs in the longer term;
- introduction of some emergency welfare provision, involving both statutory and voluntary agencies.

Most of the major problems encountered during the period 26 to 31 December related to electricity supply problems. The net result of damage to the electricity transmission and distribution systems was that a large proportion of electricity customers (especially outside Belfast City) suffered some power failure during 26 December, with a small number continuing to experience difficulties for up to a week. Most major essential services, such as hospitals and other utilities have backup generators to provide at least some electricity during power grid failures. Some such organisations had inadequate generating capacity or experienced technical problems with generators. Potentially the most serious problems were failures in water service treatment works and pumps, which led to interruptions to main water supplies in some areas. Problems were greatest for vulnerable people in the community and those who relied on electrically powered equipment for medical or mobility needs.

Lessons learnt

Communications

⇛ Organisations experienced difficulty with communications for two main reasons. Firstly, damage to or overloading of systems as a direct result of the storm and secondly poor liaison links between organisations where contact information was inadequate. The electricity provider was completely overwhelmed by the sheer volume of calls from members of the public wishing to report problems with their power supplies. When this call handling system became overloaded the public resorted to phoning other emergency numbers such as the 999 system (police/fire/ambulance), public health professionals etc. This in turn placed a significant strain on these systems. The situation was further compounded, as these organisations did not have a mechanism for passing on this information other than by public lines, which were already jammed. Subsequently, the electricity provider has invested heavily in making the call handling system much more robust. Inter-agency phone numbers have been developed so that organisations may communicate with each other directly rather than using the same numbers.

Inter-agency co-operation

⇛ The storm clearly showed the extent of the interdependence between public service organisations. Many of the problems encountered were the result of knock on effects of the loss of power supplies. Furthermore, the ability of organisations to respond also depended on the activities of others. Examples are that before electricity repairs could be effected the engineers had to have the roads cleared of fallen trees, also roads could not be cleared of cables etc until the electricity provider confirmed it was safe to do so. It was agreed that better inter-organisational co-operation between public service organisations to allow all concerned to develop integrated work procedures, which would take account of organisations priorities and limitations was required. As a result an Integrated Emergency Planning Forum (IEPF) was established "to promote effective communication and co-ordination between those organisations which provide critical infrastructure services within Northern Ireland in the event of an emergency". The IEPF, under the Chairmanship of the Head of the Central Emergency Planning Unit, meets three times per year. The Forum's members are drawn from a wide range of interests including government departments, the Emergency Services, the utilities such as British Telecoms (NI), the oil, gas and electricity industries and public transport providers.

2.3.8 Information supplied to the public and related lessons learnt

There are no formal arrangements in place to warn the public in the event of an emergency. NIE has a centralised call handling facility, the details of which were available in the telephone directory. This number was later publicised on TV channels.

BTNI (British Telecom Northern Ireland) had a helpline operating. Again the details of this were available in the telephone directory.

NIE recognised that in December 1998 public expectations had not been met and has since written to each householder in Northern Ireland giving contact details for use in an emergency and has been endeavouring to agree protocols with the broadcast media for the provision of customer service information. NIE has also enhanced its call handling arrangements.

Following the event it was agreed that in advance of such a situation there was a need to provide public information on how to cope in an emergency. These messages could then be reinforced through local community links.

To mirror action being taken in Great Britain the Central Emergency Planning Unit has drafted a paper outlining, and seeking agreement across NI Departments and other organisations as to where responsibility would lie for alerting the public for a range of incidents.

2.3.9 Further comments

At the time of the December 1998 Storm Northern Ireland was subject to Direct Rule from Westminster and had 6 NI Departments together with the Northern Ireland Office, a Whitehall Department.

On 2 December 1999, as a direct result of the Belfast (Good Friday) Agreement, power was devolved to the NI Assembly and its Executive Committee of Ministers. 108 members were elected to the new NI Assembly in June 1998. The Assembly agreed the functions of the 11 Departments in February 1999.

These developments have resulted in a greater degree of public expectation and local accountability to deal with future incidents affecting the population.

2.4 The Storm on March 1998 in Attica and Peloponnese (Greece)

Olga KAKLIAGOU and Konstantinos HOLEVAS (General Secretariat for Civil Protection, Athens)

2.4.1 Date of the disaster and location

25 and 26 March 1998, entire country affected.

2.4.2 Short description of the event

A deep low generated in the Golf of Genoa moved south-eastwards towards the maritime area south of Crete and caused extreme weather phenomena during 25 and 26 March 1998 over the area of Greece. The trajectory of the depression over the relatively warm Mediterranean Sea surface in association with the low velocity of the system resulted in the enhancement of the system, with excessive water vapour. The blocking of the Greek Peninsula caused the development of a strong convergence zone. As a result, intense rainfalls, snowfalls and gale winds occurred.

The extreme weather events followed the deep low pressure, which affected mostly areas located in Southern Greece. The amount of rain in Athens (24 hr) was 140 mm, while the mean annual precipitation is 376 mm. The depression was accompanied by strong south south-east winds over the Southern Greece. Gale winds (over 50 knots, reaching in some cases 70 knots) were evident over the Attica peninsula as well as over the Peloponnese and Southern Aegean. The depression moved to the east and the synoptic circulation gradually weakened after 28 March.

2.4.3 Human consequences

There were no storm victims reported on the Greek mainland, but there was one fatality on the island of Rodos. In Attica, a total of 2 000 passengers had trouble with their flight during the event. It was also reported that there were trapped people in mountain areas during the storm.

2.4.4 Economic losses

Although the exact costs incurred by the storm are still not available, the passage of the depression over the area of Greece caused several damages in the greater percentage of the Greek territory. The mostly affected areas were Attica and Peloponnese.

Economic losses in Athens and Attica

- During the first hours of the storm event electricity supply problems were reported in several parts of Greece. On 26 March the gale winds resulted to the fall of 5 transmission towers of the Electricity Company in the vicinity of Athens and caused the first major problem in electricity supply in Attica. A few hours later damages occurred also in the electrical substation in Distomo (Voiotia) and in an electrical supply line in Aspropyrgos. These incidences caused a black out in Attica and problems in electricity supply in Eubea.
- Major flood events occurred in the western areas of Athens (Ano Liosia). 400 hectares of inhabited area was flooded. 1 000 persons reported homeless during the first day. For the recovery process heavy machinery of the municipality of Ano Liosia and Athens were used.

- Flooded roads and houses, damages to roads were also reported in Northern Athens (Gerakas, Stavros, Glyka Nera). In southern regions of Athens except of flooded roads and points where the asphalt has been subsided, the major problem was caused from the 5 000 fallen trees. 3 000 trees only fell in an athletic centre (Golf).
- Problems in water supply were evident in several regions following the problems in electricity supply. Same problems occurred in the main sewage plant in Psitalia.
- The airports in Attica were closed because of the gale winds. All the flights from Athens were cancelled and the flights to Athens were redirected to Thessaloniki or Kavala airport in Northern Greece. A total of 2 000 passengers had trouble with their flight during the storm event.

Economic losses in the Peloponnese

The extreme weather events in Peloponnese (heavy snowfalls, violent winds) resulted in:

- blockade of access to great number of villages;
- blockade of the great part of the road network and transportation problems;
- problems in electricity supply and in telecommunications;
- interruption of railway;
- damages in buildings and houses;
- flooding events;
- extended damages to cultivation;
- 300 cars were blocked in a tunnel during 25 March. The event ended on 26 March, late in the evening.

Economic losses in the rest of Greece

- Northern Greece: damages in buildings, major disasters in cultivation, a great number of villages blocked (some of them till 31 March in Thrace).
- Thessaly (Central Greece): flooding events, heavy snowfalls in mountain areas resulted to the blockade of villages (some of them till 27 March).
- Eubea: extended damages in road network, flooding events, disasters in buildings. One of the most serious events was the landslide that resulted in the evacuation of seven houses and serious damages in other. Structures were fallen and roads were extended damaged.
- In Crete: major disasters in cultivation.
- In Dodecanese and Cyclades: one victim in Rodos island and problems in electricity supply.

Additional considerations

- Problems arise in electricity supply, telecommunications, water supply and transportation.
- Over 500 villages in the country were blocked in the first day.
- Closed harbours resulted to the isolation of the islands.
- Trapped people in mountain areas.

2.4.5 Prevention measures and related lessons learnt

The preventive measures are taken at national, regional and prefecture scale. These are mainly the flood prevention infrastructure works and networks. The General Secretariat for Civil Protection (GSCP), established in 1995 by law under the Ministry of Interior, issues measures to be taken at local and regional scale concerning flooding events, heat waves and forest fires. Further, a recent campaign starts nowadays aiming at disseminate self-protection information to the general public.

Lessons Learnt

- ⇛ Periodic maintenance of infrastructure networks such as water supply, electricity and telecommunications should be carried out in a systematic way.
- ⇛ Information to the public was developed during the last years but it is still an area where more work has to be done.
- ⇛ Information databases (for means, staff, etc) and GIS systems to support the decision making procedures must be developed.

2.4.6 Preparedness measures and related lessons learnt

Emergency Planning

The general guidelines to cope with disasters are provided by the national emergency plan named "Xenokrates" issued by GSCP. The authorities involved in cases of emergency are Ministries, the Regions and the Prefectures of the country. In each Ministry involved, Region and Prefecture there is a Civil Protection Department. The Ministries that are involved in cases of emergency are:

- Ministry of Public Works and Environment: 10 plans concerning earthquakes, floods, snowfalls, landslides, environmental pollution, technological risks etc.
- Ministry of Development: 3 plans concerning radioactivity, chemical and industrial accidents, explosions, nuclear emergencies, transportation and storage of chemicals.
- Ministry of Health: 3 plans concerning: drought, frost, heat waves and epidemic cases.
- Ministry of Public Order: 2 plans concerning fire fighting and rescues in urban and forest areas, terrorism.
- Ministry of Marine: 2 plans concerning search and rescue in the sea and marine pollution.
- Ministry of Transportation and Telecommunications: 2 plans concerning telecommunication problems and major transport accidents.

The 13 Regions and the 54 Prefectures of the country draw up their emergency plans that constitute part of the national emergency plan.

Emergency Management

Emergency Management is organised in three administrative levels: national, regional and local. The GSCP is the competent authority for the management of natural, technological and other type of disasters, as well as the co-ordination of all action forces related to Civil Protection at national level. The interministerial co-ordination body (SDO) is set up to reinforce the General Secretariat for Civil Protection, to co-ordinate the governmental measures and activities and implement the national policy in cases of major disasters. The interministerial co-ordination body is chaired by the GSCP.

At the local level, there is a prefecture co-ordination body (SNO) chaired by the Prefect. This authority is responsible for the decision-making and management of emergency situations at local level. The GSCP takes over the co-ordination of the operations if this is asked from the Prefect.

The emergency situations are characterised according the general emergency plan by the magnitude and their consequences. The GSCP has the responsibility to rank a disaster according to the criteria and to activate the needed Civil Protection forces.

The local Civil Protection services and the local authorities take over the main emergency management. The co-ordination level is modified according to the characterisation of the event. If the event is local, or the consequences are limited, then the Prefect co-ordinates the operations. When necessary, the Prefect gathers the prefecture co-ordination authority. If the disaster gets over the boundaries of the prefecture, or the consequences can not be affronted by the local means, then the regional authorities decide to mobilise means from neighbour prefectures. In case the disaster can not be confronted in the second level of co-ordination or widely disaster occur then the GSCP takes over the co-ordination of management.

Civil Protection Services

The main public rescue services involved in case of emergencies are:

- Fire Brigade (EMAK)
- Emergency Medical Care Service (EKAV)
- Earthquake Planning and Protection Organization (EPPO)
- Coast Guard
- Police
- Armed forces
- State Organisations like the Electricity Company and the National Weather Service
- Local authorities
- The Red Cross
- Volunteer organisations.

Warning and Alert - Weather forecast

Weather Forecast plays an important role according to extreme weather events. The National Meteorological Service (NMS) is the competent service that provides weather forecast. When extreme weather events are forecasted, NMS issues warnings (for storms, heavy rainfall, thunderstorms, gale winds, heat waves). On 24 March, NMS issued a warning for extreme weather events for the time period between 25 and 27 March. Every day, the GSCP receives the weather bulletin and warnings for severe weather from NMS. The received warnings are then communicated to the Civil Protection Offices in the Regions and Prefectures that are going to be affected, and also to the corresponding General Secretaries of the Regions and Prefects. The warning is further communicated to the Civil Protection Office of the Ministry of Public Works and Environment or to the Ministry of Health (according to the weather event), as these Ministries are responsible for the emergency planning in those cases where weather events cause disasters (and their consequences).

Lesson Learnt

⇛ Although there has been a progress in Weather Forecasting since 1998, with improved forecasting systems there is a need for weather forecast on a local basis.

⇛ Early Warning Systems should be improved and be more effective.

⇛ New technologies (e.g. informatics and networking) should be used to facilitate exchange of emergency information among Civil Protection Services.

2.4.7 Response actions and related lessons learnt

The main governmental instructions for the recovery were: (i) to give priority to the problems in electricity supply, (ii) to inform the public, (iii) to speed-up emergency services and response.

Main events in Attica

Electricity Supply

The recovery from the black out lasted 5 hours, but some regions in Athens were without electricity for more than 10 hours because of local damages. During 26 March staff of the Electricity Company checked 96 km of transmission power line. The Electricity Company programmed 3 hourly interruptions in the electricity supply in order to prevent extended black out in Athens. One of the consequences of the repeated problems in electricity supply was a major traffic jam in Athens as the traffic lamps, trolleys and subway could not operate.

The site of the damaged transmission towers was closed because of the heavy snowfalls. In this case, as has been done in several others, army forces, heavy equipment and people from the Organisations and Services co-operated. Two of the transmission towers were found in a coulee and the other two had extended damages. These 4 towers had to be replaced. The works would last around one month. During the next days of the main event, the problems in electricity supply continued as several damages occurred in local electricity centres. On 30 March all the problems were recovered. Exception was a number of houses in southern Athens that continued to have problems with electricity supply for a few days.

The Fire Department received more than 600 calls during the night 25 to 26 March. 20 groups and 60 persons were involved during the first hours of the event. During the days of the storm the police made extended checks mostly during night hours to prevent crime actions.

Flooded areas in Western Athens

The Water Service (EYDAP) received 500 calls until 26 March late in the evening, when the great part of the problems in flooded areas was solved. The company used 50 groups of employees and 10 vehicles. For the rescue of trapped people, army forces with 5 boats and divers had to interfere. 200 houses remained flooded till 27 March. Two days later the water was pumped from the last houses.

The municipality of Ano Liosia received a total of 1 062 calls from 25 March. The municipality supplied the food to 20 families. Two local public restaurants offered food and the NGO, Doctors of the World, gave blankets to the homeless.

Main events in the Peloponnese

The GSCP co-ordinated the assistance provided to the prefectures of Korinthia and Arkadia in Peloponnese, as they were two of the most affected areas from the severe weather.

The Prefect of Arkadia asked from GSCP assistance for the rescue of the citizens (300 cars) blocked in a tunnel. During that time the flight of helicopters was prohibited because of the weather events. To confront the situation, army forces with heavy machinery were involved. Medical assistance and food was sent from the Prefecture. People had to spend the night in their cars. The event ended on 26 March, late in the evening.

Several rescue operations have been organised as people were trapped especially in mountainous areas in Central and Southern Greece.

Lesson Learnt

⇛ The emergency response procedures need a simplification.

⇛ More volunteers are needed.

⇛ Calls to emergency numbers from public phones should be encouraged.

⇛ Existing infrastructure of local and regional emergency management services should be periodically updated.

2.4.8 Information supply to the public and related lessons learnt

Prior to the event

The warning issued from National Weather Service was communicated to the Civil Protection Office of the Ministry of Public Works and to regional and local authorities. The public was informed through the media about the weather forecast and the severe weather events to be expected. It is a usual phenomenon that people give no special attention to the information about severe weather before a storm strikes.

During the event

Guidelines were given through the media about the actions that have to be done. The GSCP issued advises to the public in order accidents and panic to be avoided and to ease the operations undertaken by the emergency services.

After the event

Recovery efforts and state measures information was provided through the mass media.

Lesson Learnt

⇛ Further information campaigns especially on self-protection measures should be organised.

⇛ Explanations about the weather phenomena and their evolution must be provided.

⇛ The information should clearly specify the regions that are going to be affected.

⇛ Information during the event helps to minimise the panic and assures that measures for the recovery are in action.

⇛ A clear picture with relevant information about the places and persons affected should be provided after the event by the media.

⇛ Rehabilitation procedures should be simple and clear so that confusion among the affected population is avoided.

2.5 The Hurricane on December 1999 over Denmark (Denmark)

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2.5.1 Date of the disaster and location

3 December 1999, whole of Denmark.

2.5.2 Short description of the event

On 3 and 4 December 1999, Denmark was struck by the most violent hurricane of the 20th century[1]. The hurricane swept in across the country from the North Sea in an easterly direction in the middle of the afternoon of 3 December (between 15.00 and 16.00), reaching Bornholm in the evening (about 9.00). It hit the whole country, except the northern part of Jutland, with winds of hurricane strength and gusts of 40 to 50 m/s. Worst hit were southern Jutland and the south-west Jutland coastal mudflats, with a wind speed of up to 38 m/s and gusts of more than 50 m/s[2,3]. The water level in the coastal mudflats of South-western Jutland and the southern part of Ringkøbing fjord rose to more than 5 meters above normal in places.

The hurricane caused considerable damage, chiefly in the shape of destroyed or collapsed buildings, uprooted trees, disrupted power supplies and flood damage, etc. Such violent meteorological phenomena are rare in Denmark, and the hurricane proved to be a major test for the emergency preparedness services as a whole. The extensive nature and simultaneous occurrence of the damage and destruction meant that all available forces had to be used to provide assistance and prevent any further deterioration in the situation.

An evaluation report covering all the central organisations concerned and consisting of a compilation of the experiences was afterwards produced. The focus of the report is on co-operation, communication and information issues. More specifically: raising the alarm and calling for assistance, resources, cross-body co-operation and warning/action of the public. The report is a series of conclusions regarding the experience as a whole, and 10 recommendations are made for future emergency preparedness services. The report is based on contributions from the municipalities, the police, the Falck rescue corps (private entrepreneur), the military defence authorities and the Danish Emergency Management Agency.

2.5.3 Human consequences

Six people died, and out of this total, five were killed on the roads, four of them as a result of falling trees[4]. The Danish National Institute for Public Health has carried out a random check on casualties connected to the hurricane treated in 5 hospitals[5]. The investigation showed that approximately 833 people across the country were so seriously injured that they sought treatment[6]. An actual count of numbers was not made.

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[1] See Danish Meteorological Institute (DMI) Report of 9 December 1999.
[2] See DMI Report of 9 December 1999.
[3] See DMI wind strength table: More than 32 m/s = hurricane, 29-32 m/s = severe storm, 25-28 m/s = storm.
[4] Information from a press article.
[5] The hospitals are: Esbjerg, Frederikssund, Glostrup, Herlev and Randers. These cover a representative cross-section of about 15% of the population. The representativeness must been seen in relation to the geographical extent of the area affected by the hurricane.
[6] 82% were injured in accidents at home/during recreational activities, 13% in traffic accidents and the remaining 5% at work.

2.5.4 Economic losses

The material cost of the hurricane is estimated to about 350 000 reported damages, amounting to approximately 1.8 billion Euro[7]. In addition, there were 400 to 500 instances of damage due to flooding. About 400 000 homes were without electricity for a shorter or longer period of time because of the hurricane[8].

2.5.5 Prevention measures and related lessons learnt

Prevention measures

All Danish municipalities have a local emergency plan, partly based on risk assessments. In the south-western part of the country, the issue of flooding is specifically addressed. Furthermore, the regional authorities tailor land use plans. As for building codes, there are rules and codes specifying which construction requirement a building must meet. These take wind and weather related precautions into account.

Since meteorological phenomena like hurricanes are extremely unusual in Denmark, no plans took the specific case of a hurricane into account. Such an emergency situation, where injuries and damages happen almost simultaneously, affects so many sectors and is so geographically widespread the authorities and population were not totally prepared for.

Lessons Learnt

- ⇛ The lessons learnt from the hurricane have resulted in widespread revisions of plans locally, regionally and centrally. The National Commissioner of Police have added a chapter on natural disasters to their general emergency plan, and all over the country revision of local plans have been conducted so as to take into account such large scale, multi-facetted and geographically widespread emergencies.
- ⇛ With regards to the power supply sector, a separate analysis has been conducted in order to disclose how the vulnerability may be reduced. Furthermore, the sector's capacity for emergency information has been enlarged.
- ⇛ In light of the experiences from the hurricane the dykes in the southern part of Jutland have been investigated in order to reveal whether they are adequately constructed.
- ⇛ With regards to building codes, investigations of the damages have revealed that the houses, which collapsed or were seriously injured in general did not live up to the standards prescribed. The lesson learnt from this is that the standards are appropriate and abiding to them necessary.

2.5.6 Preparedness measures and related lessons learnt

Preparedness measures

Generally, the responsibility for dealing with prevention and response to emergencies in Denmark is municipal, vested in a co-operation between the local police and preparedness service. As mentioned, all municipalities have an emergency plan. In supplement to the municipal fire and rescue services, the Danish state trains and equips

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[7] Source: Danish Financial Supervisory Authority

[8] Source: The newspaper *Politiken* of 9 and 18 December 1999.

a Preparedness Corps, which assists the municipalities when needed. The national defence may also assist, when all other resources have been exhausted.

The hurricane struck on the worst possible time. It was a Friday afternoon, and many places the weekend had already begun. Furthermore, no one had experience or imagination to foresee the emergency situation that was to evolve, and prevention measures could not possibly have taken this into account. In most places, the preparedness measures where thus initially applied almost in accordance with general standards and routines. As the situation evolved more measures were naturally taken.

The hurricane swept over the country, initially hitting the western regions, and the regions that were hit last, thus had time to prepare themselves better. In the eastern parts, the police, preparedness and other partners were more ready. Common command centres were put up and extra people were called on in advance.

Lessons Learnt

- ⇛ The warning and alert phase did not evolve optimally. In some areas/regions no special measures were taken beforehand to prepare for an optimal response to the situation. To better the possibilities for sufficient preparedness measures in the future, a new agreement has been signed by the Danish Meteorological Institute, The Police and Danish Emergency Management Agency. The agreement ensures a more direct and timely warning in case of major meteorological alerts. The warning will be issued to the two central agencies, which without delay passes the warning on to the local authorities. The warning contains facts and details about the coming weather phenomenon and its probable results in terms of kind and scale of damages to be expected, timeframe etc.
- ⇛ The hurricane has triggered widespread revision of emergency plans locally and centrally.

2.5.7 Response actions and related lessons learnt

Response actions

Most of the tasks faced by the emergency preparedness services consisted of closing off and clearing of roads, freeing of trapped animals, establishment of emergency power supplies, propping up buildings and covering up the roofs, etc., plus finding accommodation and looking after travellers who were unable to complete their journeys. On top of these tasks came more usual preparedness tasks like fires, traffic incidents, etc. In southern Jutland, action had to be taken on the flood damage and to evacuate the people affected, since four of the area's dykes had been damaged.

No overall national plan was adopted. As mentioned, the municipalities are responsible for providing a proper response to emergencies, and when their resources are exhausted the national rescue corps can be called on. This naturally happened, and the military defence was furthermore called on in some instances.

Lessons Learnt

- ⇛ On site co-operation functioned very well. This may be a result of the fact that Danish police and rescue personnel are trained together, hereby receiving the same training in on site management.

- ⇛ The overall "strategic" co-ordination and general overview was, however, somewhat lacking during the first 24 hours. Regional command centres with liaison officers from affected services would have bettered conditions for this overall co-ordination and overview.
- ⇛ A general observation was that the well-known working relations functioned perfectly, and unknown or less common relations caused initial problems, especially regarding communication. The transport and power supply sectors are examples of these not so common relations.
- ⇛ Following this realisation there has been widespread action locally, and to some extent centrally, to include these partners, who are not part of the daily preparedness environment, in plans, evaluation meetings and drills.
- ⇛ Another recommendation may seem almost self evident, yet it nonetheless needs attention since it is an essential timesaver in the midst of a disaster, when time is most precious and most sparse. Lists of supplementary material available form all kind of partners and contact information need to be continuously updated.
- ⇛ Better cross-organisational radio communication systems would have helped. Investigations on how to meet this need are ongoing.
- ⇛ Finally, a detailed general standard for the prioritisation of tasks proved desirable in this situation where so many mishaps needed attendance basically at the same time. The National Commissioner of Police has now proposed such a standard to the local police authorities.

2.5.8 Information supplied to the public and related lessons learned

Prior to the event

The word "hurricane" was used for the first time by the DMI (Danish Meteorological Institute) on Tuesday 2 December, at 10.30 am, in a 7-day forecast. An announcement was later made by the TV weather presenters on national TV. The DMI provided continuous updates on the situation on the Institute's homepage, which is estimated to have been visited 58 000 times on 3 December (the normal number of visitors is 10 to 15 000).

During the event

Wherever the hurricane struck, the public were advised by several bodies - the police, the emergency preparedness service chiefs, etc. - to stay indoors since it was considered to be extremely dangerous to stay out in the open.

Following the event

Media coverage was massive during and after the hurricane.

<u>Lessons Learnt</u>

In Denmark, public safety is extremely rarely – approximating never - threatened by major natural catastrophes. This fact is probably one of the explanations for the public's initially very relaxed response to the alert warning. This relaxed attitude proved to be a major problem, for initially, many Danes simply continued to do whatever they were about to, almost as if it was a normal Friday afternoon/evening in the beginning of December. The combined effect of weekend and, Christmas shopping and celebrations, contributed to making the day particularly ill-suited for a hurricane.

Accordingly, too many people were out on foot or travelling by car and mass transit hereby jeopardising their own safety. Furthermore, the uniqueness and sensational character of the situation made people curious and adventurous, a fact that further contributed to the problem.

Taking into account the situation, the number of casualties was tolerable, but more as a consequence of good fortune and professional rescue work than anything else. The following lessons have been learnt as a consequence of this rare event.

- ⇛ The central agencies and the media agreed on issuing more formal warnings and using more direct language in similar situations in the future. The risk obviously needs to be communicated more bluntly to the Danes.
- ⇛ The capacity of the 112 emergency terminals wasn't quite sufficient in the situation. When people realised the acute severity of the situation because their house was suddenly without roof or because power supply disappeared, most of them called 112, regardless of whether their problems were acute in nature or not. Accordingly, the operators and the phone system couldn't quite deal with the very large number of simultaneous calls.
- ⇛ The public need better advice on who to call, when they face a serious but not necessarily acute or life threatening problem. Thus, a recommendation for the municipality is to establish a hotline service proving information and guidance to the public.

2.6 The Storm on October 2000 in Piedmont, Liguria and Aosta Valley (Italy)

***Fabrizio COLCERASA** (Ministry of the Interior, Rome)*

2.6.1 Date of the disaster and location

15 October 2000, North-western areas of Piedmont and Liguria, South-eastern area of Aosta Valley.

2.6.2 Short description of the event

On Wednesday 11 October, weather forecasts warned against severe rainstorms approaching north-west Italy. On 14 October, low pressure systems became settled on northern Italy instead of moving eastwards, as usual, because of high pressure on the Balkans area. In two days, 14 to 15 October, rainfalls totalled 600 mm, equal to 50% of the one-year average in the same area. The first signs of the coming disaster appeared in many areas of the Pre-Alps in Piedmont region. The most affected river basins were Tanaro and Toce (in northern Piedmont) and western Dora Baltea (the upper course of the Po).

On Saturday 14 October, hydrometer levels exceeded alert values for Tanaro river, in Alba (CN), and alarm values for Po river, in Crescentino (6.12 meters) and Isola S. Antonio (8.40 meters), close to the confluence with Tanaro. On that very day, the Prefecture of Alessandria alerted by fax its Joint Operational Centre (COM - Centro Operativo Misto) and those located in Aqui Terme, Castelnuovo Scrivia, Felizzano, Ovada, Bergamasco, Predosa and Casale Monferrato. At 10.00, the Po River Authority (Magistrato del Po) reported the river had swelled and the water level was due to increase substantially in a few hours. An alert became an alarm. In the evening the National Operational Centre at the Ministry of the interior ordered the Fire Brigade stations in Piedmont to recall all fire-fighters (even those off-duty) and alerted the Regional Rescue Convoys (RRC)(*) of neighbouring regions.

On Sunday 15 October rain did not stop. The affected rivers increased steadily. People tried to limit damage by piling up sandbags or installing containment barriers, but in most cases these actions proved ineffective. Municipalities of Morano and Balzola were flooded. However, effective efforts were made to reassure citizens and convince them not to leave their homes, but to move to the upper floors if necessary.

On Monday 16 October, there was a series of floods in several municipalities along the Po and its tributaries. Rescue Co-ordination Centres (CCS) were set up at each Prefecture, while Joint Operational Centres were activated in each municipality. The event activated the civil protection plan for emergencies of class C (national calamities) provided for by Law n. 225/1992. The RRC of Emilia Romagna and Lombardy were sent to Piedmont and Liguria. Extensive flooding was reported also in the succeeding days and it caused disruption and damage along the whole Po basins till the Adriatic.

Between 14 and 29 October, in Piedmont region 3 624 rescue were carried out by the Fire Brigade, grouped as follows:

- road accidents	51
- people rescue	520
- landslides	147
- draining of water	482
- building collapses	264
- other	1 100

and 1 060 missions were carried out by special teams together with Fire Brigade helicopters.

2.6.3 Human consequences

Four persons lost their lives and 11 persons were injured, 8 040 people were temporary evacuated and 1 584 were left homeless at the end of this catastrophe.

2.6.4 Economic losses

Expenses for rescue, response and follow-up operations totalled 800 million Euro. The breakdown of the economic loss is as follows:

- material losses	50 million Euro
- response action costs	750 million Euro

2.6.5 Lessons learnt in the prevention phase

⇛ With regards to their respective competence, the prompt and precise alarm from the Department of Civil Protection, COMI (Centro Operativo Ministero Interno – Operational Centre of the Ministry of Interior) and Veglia Meteo, allowed the management of available resources, thus anticipating the event and ensuring an adequate response during the most acute crisis;

(*) Regional Rescue Convoys is a convoys of Fire Brigade vehicles carrying tents/lavatories/field kitchens/beds/food and special appliances (like bulldozers) for initial relief operations and emergency assistance.

2.6.6 Lessons learnt in the preparedness phase

⇛ The Emergency Plan and the relations among the Local Authorities, the Regions and other Administrations, representing the Civil protection System, worked in a satisfactory way.

⇛ Some difficulties arose as regards radio and telephone communications. Most requests concern the development of radio links and more mobile telephones.

⇛ The most serious lacks concerned the supply and transport of the RRC as well as the special equipment needed for base camps: mobile chemical toilets and air tents.

⇛ Further lacks regard vehicles and equipments, in particular:
- boats or amphibious vehicles
- water-scooping machines
- generators
- lorries for the transport of people and materials
- bulldozers.

2.6.7 Lessons learnt in the response phase

⇛ There was a good operational integration between volunteers and permanent firemen; with this respect, in fact, for those areas in which the number of volunteers is not remarkable the Regional Inspectorates underlined the need to improve and develop this component for a better territory management.

⇛ Some lacks of supplies, technologies and personnel, as well as the absence of the accounting and administrative procedures provided for in the circular n. 28/91, especially referring to the state of readiness, caused some problems of functioning regarding the RRC.

2.6.8 Information supplied to the public

Information supplied to the public occurs at all levels in Italy: ministerial, regional and local, for all the disaster management phases.

2.7 The Impact of the December 1999 Hurricane on the Electrical Grid of Baden-Württemberg (Germany)

Thomas HILLER (En BW Regional AG, Stuttgart)

2.7.1 Date of the disaster and location

26 December 1999, Baden-Württemberg.

2.7.2 Short description of the event

The storm entered the state Baden-Württemberg on 26 December around 9.00. The wind velocity exceeded locally 200 km/hr. Earlier this day, the storm had already crossed France causing immense damages (as reported in Sections 2.1 and 2.2 of this report). In the evening, the storm left the state to the east, its force diminished.

Around 5 000 failures occurred in the EnBW electricity grids, mainly caused by damaged overhead lines. The high voltage and the extra-high voltage grid (only ca. 100 faults) were much less affected than the medium and low voltage grids.

Directly after the storm, 540 000 customers were without supply. 24 hours later, on 27 December, the restoration of supply made good progress. By this day, supply for 400 000 customers had been restored. The restoration of supply was completed on 1 January 2000, around 16.00.

2.7.3 Human consequences

Not available to the author.

2.7.4 Economic losses to the electrical grid of Baden-Württemberg

The economic losses regarding EnBW totals to approximately 17 million Euro.

2.7.5 Prevention measures and related lessons learnt

The electrical networks of EnBW are planned and operated with high redundancy. In the high and extra-high voltage grid, a single electrical fault on an overhead line circuit causes no outages. In the medium voltage grid, the outage durations are normally shortened to the time needed for switching measures. Only in the low voltage grid, the reparation time of the damaged electrical equipment determines the outage duration.

Damages to equipment caused by high wind velocities can not be completely prevented. Overhead lines and air-insulated switchgear comply with European and national standards. For economic reasons, further reinforcements were not taken into account.

The percentage of underground cable in the EnBW grids is comparably high (medium voltage grid: ca. 50 %, low voltage grid: ca. 65 %). The effect of the storm would have been much worse if this had not been the case.

As a conclusion, there is no economic way to prevent damages caused by heavy storms. Measures can be taken to improve grid structure, but additional optimisations of the EnBW grids are not planned.

2.7.6 Preparedness measures and related lessons learnt

Preparedness measures consist mainly of the fast internal information dissemination. The grid control centres report serious faults to the concerned units and to the management.

After the storm, several problems of the internal information dissemination have been analysed:

- Slowness of information channels;
- Delay in the management of information;
- Partial insufficiency of the quality and quantity of data provided.

Several measures were taken to improve these information channels:

- An internal definition for a "serious grid fault or incident" was created. It enables the grid control personnel to decide quickly if the fault or incident has to be reported immediately.

A fault or an incident can be considered as serious, if at least one of the following criteria is fulfilled:

- Grid faults with interruption of supply for several villages or town districts;
- Significant damages;
- Faults in the extra-high voltage grid (380 / 220 kV);
- Incidents with extraordinary relevance to public relations;
- Terror attacks;
- Fatal accidents or accidents with seriously injured persons;
- Other incidents with comparable importance.

Data collection forms have been developed. There include a list of all recipients, check boxes for the main facts and a well-selected collection of data fields.

The principal information flow is described in Figure 3.

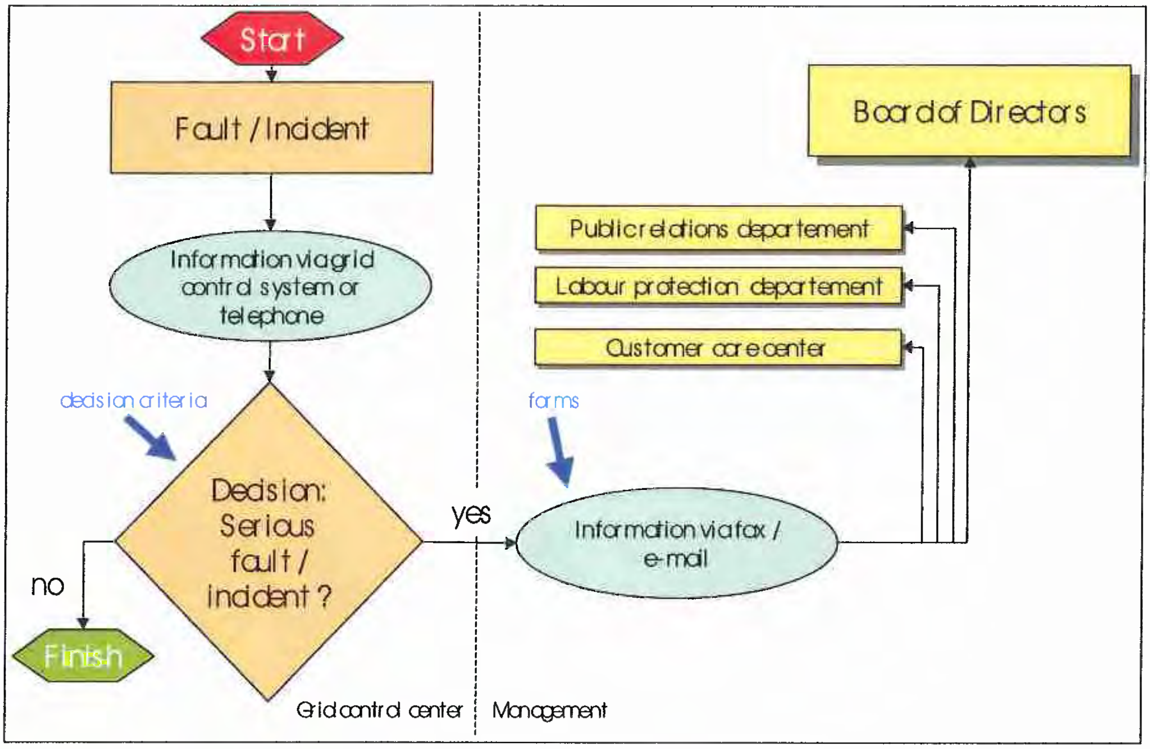

Figure 3 - Information flow

After the information flow has taken place, the board of managers decides, if the fault or incident has to be treated as a crisis. If the answer is "yes", the members of the three crisis management levels will be immediately convoked (Figure 4).

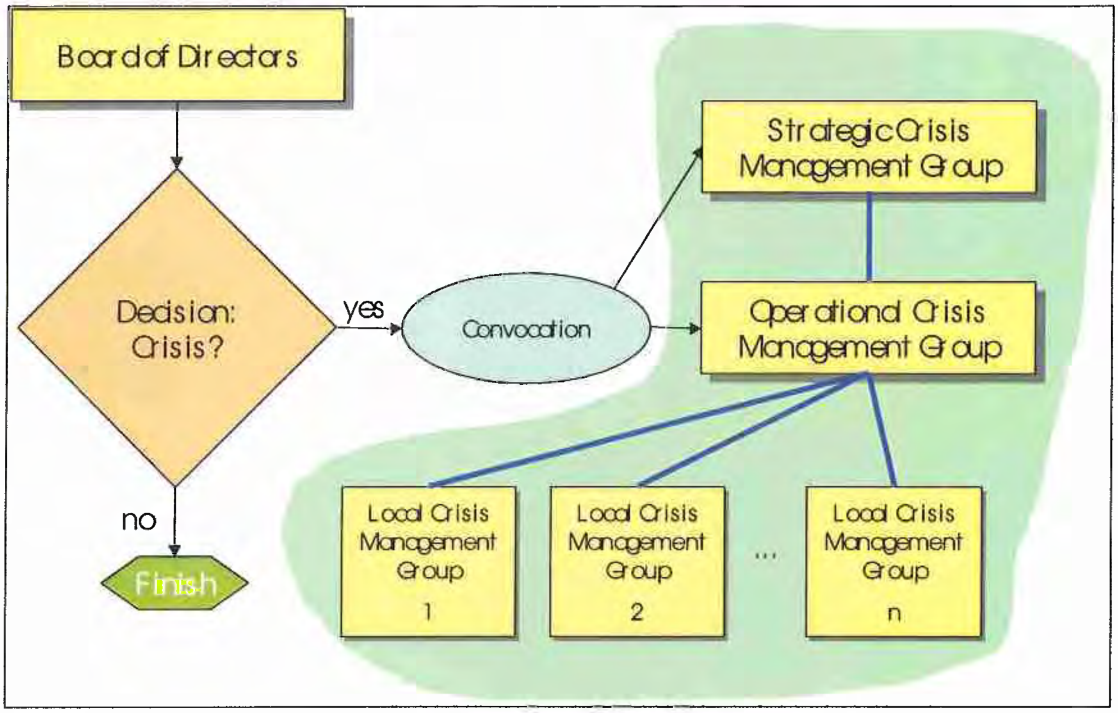

Figure 4 - Crisis decision

2.7.7 Response actions and related lessons learnt

During the response phase, numerous switching measures and reparation works have to be organised and co-ordinated. This is done mainly by the grid control centres and the local crisis management groups. Super regional co-ordination of resources is the main task of the operational crisis management group. The crisis organisation is headed by the strategic crisis management group, consisting of the members of the board. The crisis management groups are described in Table 1.

Table 1 - Members and tasks of the crisis management groups

Group	Members	Tasks
Strategic Crisis Management Group	Members of the boards of the EnBW grid operating subsidiaries	- Observation of the situation - Strategic decisions - Instructions for the Operational Crisis Management Group - Contact to federal authorities - Communication with other utilities - Public relations (together with the PR department)
Operational Crisis Management Group	Relevant executives of the EnBW grid operating subsidiaries	- Implementation of the crisis management strategy - Information collection and distribution - Contact to Local Crisis Management Groups - Co-ordination of resources - Contact to local authorities

Group	Members	Tasks
Local Crisis Management Group	Heads of the grid operation departments (380 / 220 / 110 kV grid operation, 380 / 220 / 110 kV grid service, 20 kV and 400 V grid operation, grid control centres, ...)	- Specific management of their departments - Provision of information to the Operational Crisis Management Group - Co-ordination of the local resources - Request for additional resources to the Operational Crisis Management Group

Lessons learnt

⇛ As a lesson learnt from the storm event, the crisis organisation has been more clearly defined and further elaborated. Guidelines for staff have been developed and distributed.

2.7.8 Information supplied to the public and related lessons learnt

Prevention phase

There is no economic way to prevent storm damages to electrical grids completely. Overhead lines and air-insulated switchgear comply with European and national standards. For economic reasons, further reinforcements are not discussed within Germany.

Preparedness phase

After the storm, several problems of the internal information dissemination have been analysed:

- Slow information channels
- Information the management delayed
- Quality and quantity of given data partly not sufficient

Several measures were taken to improve these information channels:

- An internal definition for a "serious grid fault or incident" was created. It enables the grid control personnel to decide quickly if the fault or incident has to be reported immediately.

A fault or an incident can be considered as serious, if at least one of the following criteria is fulfilled:

- Grid faults with interruption of supply for several villages or town districts
- Immense damages
- Faults in the extra-high voltage grid (380 / 220 kV)
- Incidents with extraordinary relevance to public relations
- Terror attacks
- Fatal accidents or accidents with seriously injured persons
- Other incidents with comparable importance

- Data collection forms have been developed. There include a list of all recipients, check boxes for the main facts and a well-selected collection of data fields.

Response phase

The most crucial problem during and after the storm event was the immense demand of the customers for telephone communication. The hotline numbers were overloaded with customer calls and therefore almost continuously busy. This obstructed the internal communication necessary for switching measures to restore the power supply. Considering the extraordinary stress for the grid control staff in such situations, customer calls can be an unbearable burden. To bring this situation, the following aims were to be reached:

- Uniform, free of charge phone hotline;
- Task sharing between grid control centres and customer care centre with respect to their specific competence;
- Fewer customer calls in the grid control centres;
- Better accessibility of EnBW via phone during major crisis situations.

A new process involving the customer care centre, a call centre with over 50 operators during the main business hours has been established. In future crisis events, the customer care centre will be the main place for the information dissemination to customers. The complete process is shown in Figure 5 and Figure 6.

The public relations department provides information to the press and to other media. During the last event, no problems occurred. There were no complaints from customers or from the public.

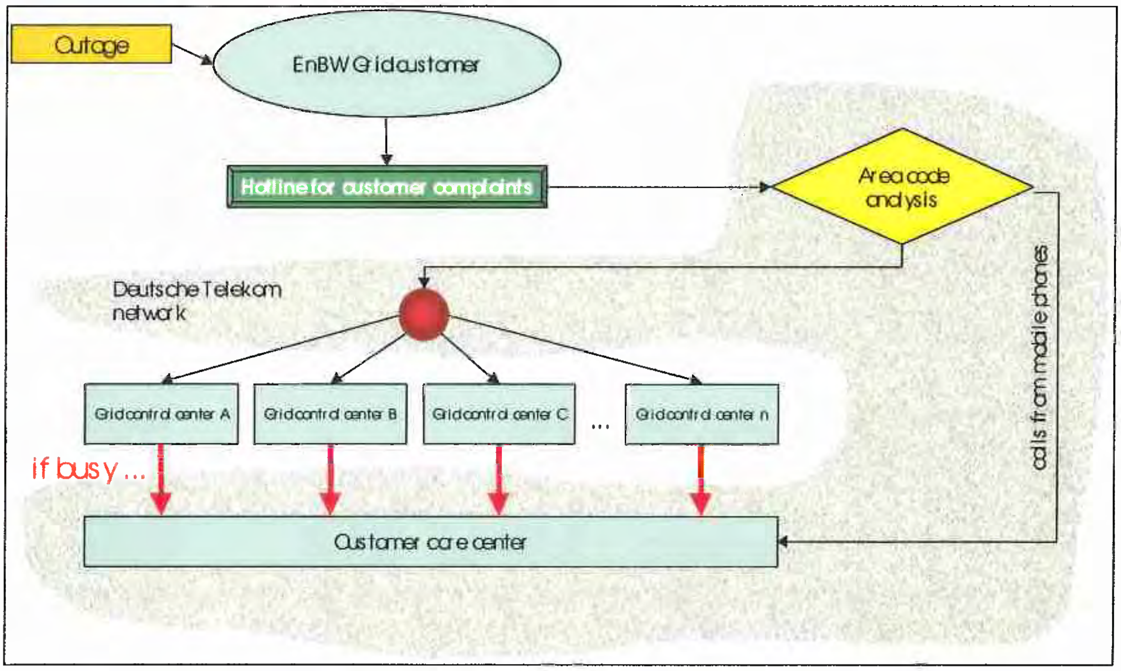

Figure 5 - Reaction to telephone calls during crisis events

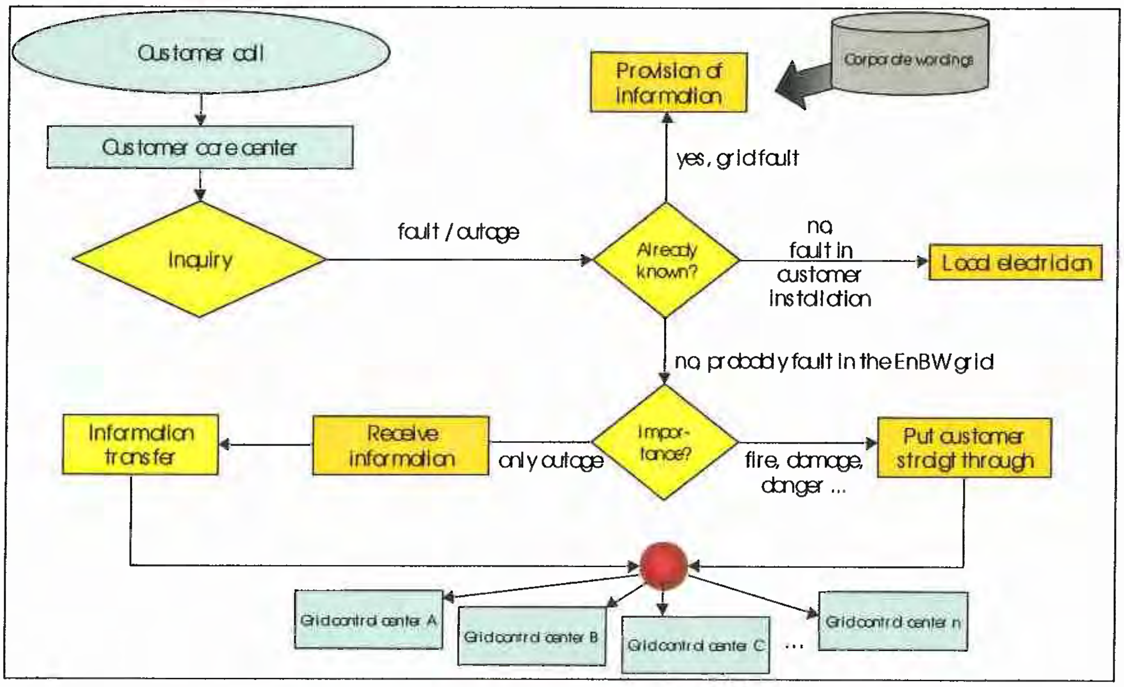

Figure 6 - Customer call answering process

3 RECAP OF LESSONS LEARNT AND CONCLUSIONS

Alessandro G. Colombo and Ana Lisa Vetere Arellano (EC, Joint Research Centre, Ispra)

It can be observed from the contributions in this report that storm disasters are also quite common in Europe. Storms can come in various shapes and sizes as can be observed in the various contributions in this report from EU Member States:

- Severe rainstorm of 15 October 2000 (Italy)
- Hurricane of 26-28 December 1999 (France and Germany – 3 contributions)
- Hurricane of 3 December 1999 (Denmark)
- Storm of 26-31 December 1998 (Northern Ireland)
- Storm of 25-26 March 1998 (Greece).

Because of the various types of storms that exist, an attempt has been made to portray the differences amongst them in Annex A. Figure A1 offers a tentative classification according to wind speed, whilst Figure A2 is a tentative classification according to geographical location. In addition, Table A1 provides definitions for other terms that are related to storms, whilst Table A2 offers some interesting facts regarding tornadoes and tropical cyclones. In Europe, the most common storms are thunderstorms and hurricanes. However, tornadoes also can occur once in a while, such as the recent whirl wind that struck north of Milan, Italy on 7 July 2001, which caused severe damage to infrastructure an injuries to at least 35 people.

Many lessons have been learnt, as it can be observed in the contributions of the experts collected in this report. This chapter aims to summarise the lessons learnt, which are grouped according to the main disaster management phases: prevention, preparedness and response. Furthermore, where relevant, the lessons learnt have been grouped into the following areas:

- Regarding coordination of activities
- Regarding infrastructure
- Regarding the public
- Regarding the media.

Lastly, lessons learnt regarding the dissemination of information during the three above-mentioned phases of disaster management are also summarised.

It is important to bear in mind that the lessons learnt are not ordered according to their importance, but mainly according to "logical" considerations.

3.1 Lessons learnt concerning prevention measures

Regarding coordination of activities

⇛ Given the exceptional nature of these events, a specific plan would be underused; however, there should be frequent updating of the existing plans (locally, regionally and centrally), the general introduction of a code of conduct and an increased number of training exercises.

⇛ There should be better inter-organisational co-operation between public service organisations to allow all concerned to develop integrated work procedures, which would take account of organisations' priorities and limitations.

⇛ It is essential that forecasting systems are continuously updated and improved, especially weather forecast on local basis.

⇛ It is necessary to set up devices to receive and manage multiple calls; classical hardwares of alert treatment tend to be inadequate.

⇛ Organization of regular exercises is needed in several directions:
- exercises for executives,
- transmission exercises,
- interdepartmental, departmental and infra-departmental exercises on the ground.

⇛ It is important that information databases (for means, staff, etc) and GIS systems are better developed to support the decision making procedures.

⇛ Regular updates of the planning documents are required.

⇛ Preservation of a privileged contact with local elected members is necessary to assure coherence from the summit of the command chain to the local levels.

⇛ As a classical centralised management of interventions tends to be in practice impossible, it would be advisable to have local autonomous teams, which would face to the emergency calls, received either directly or by the operational centre.

⇛ It is important that a search for an optimal integration of emergency services is carried out:
- on the level with the cell of crisis,
- on the level with the places of intervention.

⇛ It is necessary to develop inter-services cultures.

Regarding infrastructure

⇛ The continued operation of networks must be guaranteed:

- *For the electricity grid*, power lines must be made able to withstand severe storm events and alternative means of power production (electricity generators) must be made more readily available and a rapid response force set up.
- *For the communications networks*, it must be ensured that the major telecommunications operators should pay sufficient attention in securing the functionality of their (fixed or mobile) networks during a severe storm.

⇛ To further ensure that networks remain in operation, several measures should be considered such as: specific identification of areas which need underground lines in order to make them less vulnerable; setting of minimum standards of independent action and a survey of installations to justify making power-generating equipment available to reduce vulnerability to disruptions in power supply; development of a more relevant priority user management policy.

⇛ It would be necessary to have available additional water tankers and distributors of fuel and resources for drawing on alternative supplies and additional assistance with manning levels.

⇛ Periodic maintenance of infrastructure networks such as water supply, electricity and telecommunications should be carried out in a systematic way.

⇛ It must be ensured that adequate building codes exist so that damage to infrastructure can be reduced.

Regarding the public

⇛ The development of a code of conduct for the general public is required so that individuals react appropriately according to the particular situation.

⇛ Great importance must be given to transmissions for public emergency services: they must become autonomous and secured, and ought not to go through the failures of the phone operators.

⇛ Some organisations could find it valuable to undertake some form of public education exercise to make people aware of what they could expect from the public services or how they could access help.

Regarding the media

⇛ It is necessary collaborate with the media, so that they become correctly and regularly informed. Media can be a fundamental ally for the management of a crisis.

3.2 Lessons learnt concerning preparedness measures

Regarding coordination of activities

⇛ Further development of Weather Forecasting Systems, especially on the local scale needs to be carried out.

⇛ Further development of Early Warning Systems should be carried out.

⇛ Further development of Alert Systems should be carried out.

⇛ It is necessary to improve the possibilities for sufficient preparedness measures in the future, where an agreement could be made amongst the main actors in disaster preparedness (such as the one signed by the Danish Meteorological Institute, The Police and Danish Emergency Management Agency). Such an agreement would ensure a more direct and timely warning in case of major meteorological alerts.

⇛ A ready-made emergency plan should be available in case of a severe storm, along with a contingency plan, at all levels.

⇛ The value of joint training and exercising in developing an integrated approach to emergencies must be recognised. Organisations should have the opportunity, and should be encouraged, to participate in these exercises with the aim of developing a greater understanding of each other's roles and to stimulate and cement contacts and co-ordination across and between those organisations responding in an emergency situation.

⇛ Revision of emergency plans should be carried out locally and centrally, so as to ensure better preparedness.

⇛ Inter-relations amongst the Local Authorities, the Regions and other Administrations, representing the Civil protection System, should be improved.

Regarding infrastructure

⇛ It is necessary to avoid difficulties arising with regards to radio and telephone communications (mobile and landlines) during a storm event.

⇛ It is important to ensure that there are no lacks in the supply and transport of the Regional Rescue Convoys, as well as the special equipment needed for base camps, such as mobile chemical toilets, air tents, etc.

⇛ It must be ensured that there are enough vehicles and equipment, in particular:
- boats or amphibious vehicles
- water-scooping machines
- generators
- lorries for the transport of people and materials
- bulldozers.

3.3 Lessons learnt concerning response measures

Regarding coordination of activities

⇛ Emergency response procedures should be made simple, but efficient.

⇛ Better task prioritisation is required.

⇛ Availability of more volunteers is necessary.

⇛ Calls to emergency numbers from public phones should be encouraged.

⇛ Existing infrastructure of local and regional emergency management services should be periodically updated.

⇛ Better inter-organisational co-operation between public service organisations should be guaranteed, as such a co-operation will allow all concerned to develop integrated work procedures. This in turn would take account of organisation priorities and limitations. A common forum, such as the Integrated Emergency Planning Forum (IEPF) in Northern Ireland could be established so as "*to promote* *effective communication and co-ordination between those organisations which provide critical infrastructure services in the event of an emergency*".

⇛ Co-operation between ministries should be increased, as crisis management on this scale requires the use of all resources available to the country. The representatives of all ministries who may be called upon to give an expert opinion or provide resources should therefore collaborate closely together.

⇛ A "clearing-office" (a single system of communication) for information dissemination and allocation of resources (human and material resources), should be established and strengthened as part of the coordination structure in crisis management.

- The "clearing-office" should be promoted as an intermediary reporting level (upward and downward transmission) so as to avoid any problems regarding information dissemination that may arise, and to make it possible to obtain a rapid overview of the situation.
- The "clearing-office" should also include amongst its tasks the harmonisation of procedures for making requests, standardisation of certain equipment and co-ordination of resources distribution, in liaison with the public and private groups concerned, so as to provide better monitoring of how resources are used. It should also ensure that stocks of emergency material and equipment (generators and tarpaulins in particular) do not run out.

⇛ A standard crisis management manual, which sets out the principles and rules for everyone to follow in the event of crisis management, could be of use to avoid any differences in reactions and procedures.

⇛ It is essential that international co-operation is more fully incorporated in the co-ordination structure, so as to improve the way information is passed on to neighbouring countries. This could involve the need for a European information-gathering organisation, which may take the form of a Community watchkeeping centre.

Regarding infrastructure

⇛ In order to improve communications, it is essential to ensure that the overloading of communication systems as a direct result of the storm should be avoided. An alternative mechanism for passing on information between organisations, other than by public lines, should be established, so as to avoid any unnecessary jamming.

⇛ Ensure that the electricity provider does not become completely overwhelmed by the calls from members of the public wishing to report problems with their power supplies, as this would avoid putting a significant strain on these systems.

3.4 Lessons learnt concerning dissemination of information to the public

Prior to the event

⇛ Information should be better arranged, clearer and, if necessary, expressed in standard terms, such as:

- A scale of severity should be devised for events on the ground.

- The event should be described in terms of other known events and what is likely to happen should be put in a way which will be understood by the public.
- The above two approaches could also be coupled with recommendations on what to do.

During the event

⇛ The information provided during a serious weather incident should be as direct as possible.

- The information should be sent simultaneously to all services responsible for rescue and assistance (at national, regional and departmental level). A wide network of systems should be set up in order to ensure that the information arrives.
- The information should be made permanently available to the public using existing vectors (Internet, the media, etc.).

Following the event

⇛ A "clearing-office" for information (see paragraph **Lessons learnt concerning response measures**) should be used as a centre for the dissemination of information to the public.

⇛ Information campaigns, especially on self-protection measures, should be organised for the public.

⇛ Explanations about the weather phenomena and their evolution should be provided to the public.

⇛ The information should clearly specify the regions that are going to be affected.

⇛ After the event, close collaboration with the media is essential so that they will be able to give a clear picture of the situation to the public, with relevant information about the places and persons affected.

⇛ Rehabilitation procedures should be simple and clear so that confusion among the affected population is avoided.

3.5 Conclusions

3.5.1 Key lessons learnt

It can be observed that there are **key lessons learnt** that most of the EU Member States have in common. In particular, improvements are required in the following areas:

- **Forecasting, alert and warning systems**
- **Strategic co-ordination**
- **Role designation**
- **Task prioritisation**
- **Training and formation of all stakeholders**
- **Allocation of material and human resources**
- **Availability of resources**
- **Inter-disciplinary collaboration**

- **Inter-organisational collaboration**
- **International co-operation**
- **Communication strategies**
- **Dissemination of information to the public.**

3.5.2 Main topics discussed

During the meeting, the following topics were discussed in detail:

- **Forecasting**

  Everyone agreed that with better forecasting systems, the impact of a storm event could be reduced. Furthermore, an efficient network of forecasting systems, alert systems and warning systems should be established. This way lives may be saved, infrastructures may be salvaged and economic loss may be reduced.

  The importance of cross-boundary collaboration in this area was also stressed, as a storm path may cover several countries.

- **Homogenisation of training and formation of civil protection procedures**

  It was pointed out that DG Environment has supported initiatives in the area of training and that there are also multi-lateral training agreements amongst Member States (e.g. in Scandinavia). Everyone generally agreed that more training and formation is still required in this area, but there was a split between those in favour of a homogenisation of training and formation of civil protection procedures and those that were not so favourable.

  The argument in favour was that due to the transboundary aspects of natural hazards, collaboration amongst actors coming from different Member States could become more efficient. However, it was also highlighted that there were obstacles, which are very difficult to overcome such as:
  - National philosophy varies from country to country
  - Civil protection procedures vary from country to country
  - Eleven different languages are spoken in the fifteen Member States.

- **Harmonisation of co-ordination procedures**

  There was a particular discussion regarding this issue. Co-ordination procedures vary significantly from country to country and different actors are responsible for the same task. Harmonisation would mean the majority of the countries having to change their usual operations. Not only would it take time to agree upon an accepted harmonisation methodology, given the existing heterogeneity across Europe, but also, it will take time to become efficient, as actors have to get used to the new approach.

  On the other hand, it was pointed out that some procedures could be harmonised, without having to revolutionise entire national procedures, such as: strategy of evacuating victims or setting up different types of rescuing methodologies.

- **Standardisation of dissemination of information**

  To the public

  There was more agreement with regards to an international standardisation of information dissemination to the public. It was also suggested that the European emergency number of 112 should be multi-lingual so that tourists may also access this number. Information to the public must be given in a language that can be easily understood. It must be simple and clear.

Amongst organisations

With regards to the standardisation of information dissemination amongst organisations in the EU, there is an important obstacle to consider: because of the heterogeneity of disaster management methodologies that exist in the EU, it will be very difficult to agree upon a common approach. Perhaps it is not necessary to have a standardisation in this area. However, if there is a trans-boundary storm event, some sort of common language and methodology of information dissemination amongst countries should be established.

3.5.3 Final considerations

In conclusion, the Member State experts have highlighted the fact that meetings, such as the **NEDIES Expert Meetings on Lessons Learnt**, are very useful to them. Some reasons, among others, are mentioned here below:

- they are made aware of the similarities and differences in approach to coping with disasters in the different countries of the European Union,
- they are able to exchange lessons learnt in disaster management,
- they are able to have a roundtable discussion regarding disaster management at various scales: international, national, regional and local.

ACKNOWLEDGEMENTS

All the participants in the NEDIES meeting held at the JRC Ispra on 3 and 4 May 2001, at which the contributions to this report were presented, are kindly acknowledged for their participation in the discussion and suggestions.

Annex - Storm terms and definitions

There are many types of storms commonly known. Here below is an attempt to portray differences amongst them. Figure A1 offers a tentative classification according to wind speed, whilst Figure A2 offers a regional specific classification. In addition, Table A1 provides definitions for terms that are related to storms. Lastly, there are interesting facts regarding tornadoes and tropical cyclones, which are both atmospheric vortices; however, they have little in common as can be observed in Table A2.

Hurricanes/Typhoon/Severe tropical cyclone/ Severe cyclonic storm/tropical cyclone

maximum sustained surface winds ≥ 66 knots (124.5 km/hr)

source: http://isu.indstate.edu/welsh/ua/h.htm

Tropical/Sub-tropical storms

27 knots (51 km/hr) ≤ maximum sustained surface winds < 66 knots (124.5 km/hr)

source: http://isu.indstate.edu/welsh/ua/t.htm

Tropical/ Sub-tropical depressions

maximum sustained surface winds < 27 knots (51 km/hr)

source: http://isu.indstate.edu/welsh/ua/t.htm

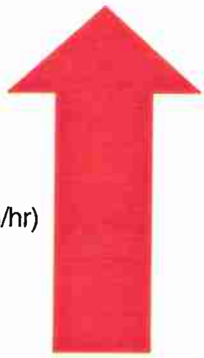

Figure A1 - Tentative storm classification according to maximum sustained surface winds

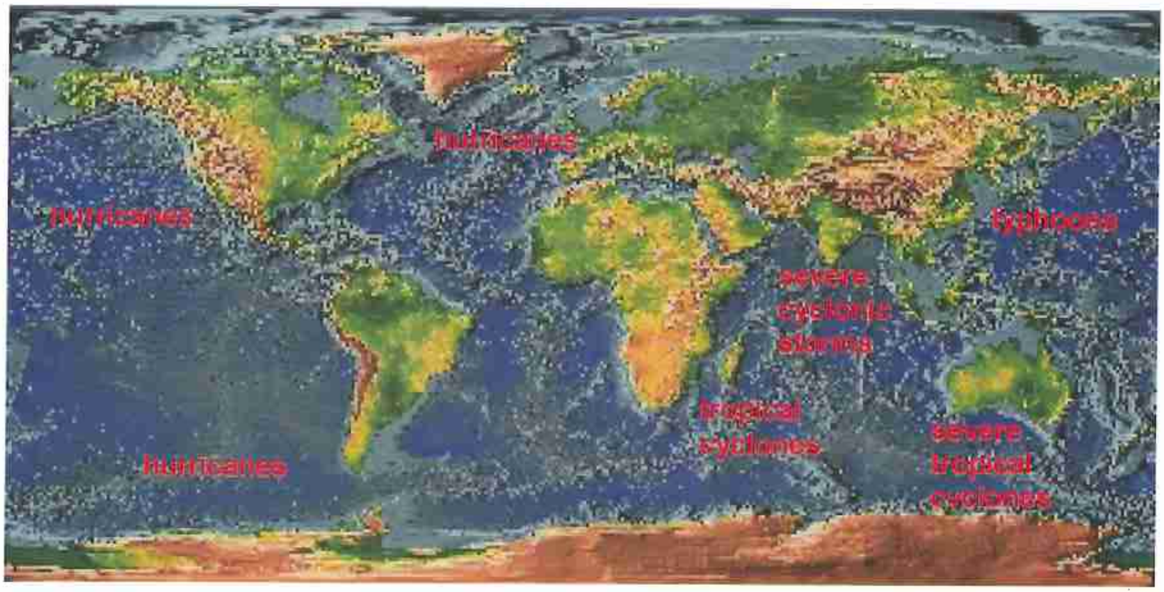

Figure A2 - Tentative storm classification according to geographical location
source: http://www.aoml.noaa.gov/hrd/tcfaq/tcfaqA.html#A1

Table A1 – A definition of storm and some storm types

EVENT	DEFINITION
Storm	A disturbance of the atmosphere marked by wind and usually by rain, snow, hail, sleet, or thunder and lightning *source:* http://isu.indstate.edu/welsh/ua/s.htm
Blizzard	Severe weather condition characterised by low temperatures, winds of 51 km/hr or higher, and sufficient snow for visibility to be reduced to less than 167 m *source:* http://isu.indstate.edu/welsh/ua/b.htm
Cyclone	An atmospheric circulation that rotates counter-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere, that usually has a diameter of 2000 to 3000 kilometres *source:* http://isu.indstate.edu/welsh/ua/c.htm
Thunderstorm	A local storm produced by a cumulonimbus cloud, always with lightning and thunder, and usually accompanied by strong gusts of wind, heavy rain, and sometimes hail *source:* http://isu.indstate.edu/welsh/ua/t.htm
Tornado	A violently rotating column of air protruding from a cumulonimbus cloud and in contact with the ground; a condensation funnel does not need to reach to the ground for a tornado to be present *source:* http://isu.indstate.edu/welsh/ua/t.htm
Tropical Cyclone	The general term for a large low pressure system that originates over the tropical oceans; includes tropical depressions, tropical storms, and hurricanes *source:* http://isu.indstate.edu/welsh/ua/t.htm

Table A2 - Differences between Tornadoes and Tropical Cyclones
source: http://www.aoml.noaa.gov/hrd/tcfaq/tcfaqA.html#A1

CHARACTERISTICS	TORNADOES	TROPICAL CYCLONES
Diameter	Scale of 100s of meters	Scale of 100s of kilometres
No. of convective storms	1	Several to dozens
Genesis	Require substantial vertical shear of the horizontal winds (i.e. change of wind speed and/or direction with height). The winds of a tornado are the most violent winds that occur on the earth, reaching speeds of up to 480 km/hr.	Require very low values (less than 10 m/s [20 kt, 23 mph]) of tropospheric vertical shear.
Location	Produced in regions of large temperature gradient, and are primarily an over-land phenomena, as solar heating of the land surface usually contributes toward the development of the thunderstorm that spawns the vortex (though over-water tornadoes have occurred).	Generated in regions of near zero horizontal temperature gradient, and are purely an oceanic phenomena; they die out over-land due to a loss of a moisture source. **Note:** that tropical cyclones at landfall often provide the conditions necessary for tornado formation.
Duration	Minutes (not more than an hour)	Days

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