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Information technology — Data centre facilities and infrastructures —

Part 30:
Earthquake risk and impact analysis

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 39, *Sustainability, IT and data centres*.

A list of all parts in the ISO/IEC 22237 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

Parts 1, 3, 4 and 5 of the ISO/IEC 22237 series specify requirements and recommendations for the design of data centres to meet a given Availability Class. Parts 2 and 6 of the ISO/IEC 22237 series specify requirements and recommendations for the building construction and security systems for data centres.

Determination of the risk and scale of seismic activity should be included as part of the overall risk assessment approach found in ISO/IEC 22237-1. ISO/IEC TS 22237-2 requires a geographical risk analysis which includes seismic activity and relevant mitigation actions, but does not identify the specific actions to be applied. ISO/IEC TS 22237-6 addresses external environmental events but does not explicitly list earthquakes or seismic activity within that group of events (other than general vibration) or indicate the specific measures required.

Taking these points into consideration, this document provides requirements and recommendations for the type of risk assessment to be employed in the context of seismic activity and earthquakes in relation to data centres. It also describes design concepts that can be employed as mitigation actions within the construction, and other design elements, of data centres.

Information technology — Data centre facilities and infrastructures —

Part 30: Earthquake risk and impact analysis

1 Scope

This document specifies requirements and recommendations for the type of risk assessment to be employed concerning seismic activity and earthquakes in relation to data centres. In addition, it describes design concepts that can be employed as mitigation actions within the construction and other design elements of data centres.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
availability
ability to be in a state to perform as required

[SOURCE: IEC 60050-192:2015, 192-01-23, modified — Note 1 to entry and Note 2 to entry deleted.]

3.1.2
computer room space
area within the *data centre* (3.1.3) that accommodates the data processing, data storage and telecommunication equipment that provides the primary function of the data centre

[SOURCE: ISO/IEC 22237-1:2021, 3.1.6]

3.1.3
data centre
structure, or group of structures, dedicated to the centralized accommodation, interconnection and operation of information technology and network telecommunications (NT) equipment providing data storage, processing and transport services together with all the facilities and infrastructures for power distribution and environmental control together with the necessary levels of *resilience* (3.1.8) and security required to provide the desired service *availability* (3.1.1)

Note 1 to entry: A structure can consist of multiple buildings and/or spaces with specific functions to support the primary function.

Note 2 to entry: The boundaries of the structure or space considered the data centre which includes the *information and communication technology equipment* (3.1.4) and supporting environmental controls can be defined within a larger structure or building.

[SOURCE: ISO/IEC 30134-1:2016, 3.1.4]

3.1.4
information and communication technology equipment
equipment providing data storage, processing and transport services

Note 1 to entry: This represents the “critical load” of the *data centre* (3.1.3).

3.1.5
peak ground acceleration
maximum ground acceleration occurring during earthquake shaking at a location

Note 1 to entry: Peak ground acceleration (PGA) is equal to the amplitude of the largest absolute acceleration recorded on an accelerogram at a site during a particular earthquake.

Note 2 to entry: Earthquake shaking generally occurs in all directions. Therefore, PGA is often split into horizontal and vertical components. Horizontal PGAs are generally larger than those in the vertical direction, but this is not always true, especially close to large earthquakes.

Note 3 to entry: The design basis earthquake ground motion (DBEGM) is often defined in terms of PGA.

3.1.6
probable maximum loss
ratio (expressed as a percentage) of the *restoration cost* (3.1.9) to the *re-procurement cost* (3.1.7) taking into account the degree of earthquake risk, the stability of ground, the earthquake resistance of the building and the earthquake resistance of the facilities

3.1.7
re-procurement cost
total cost required to reconstruct the assets damaged at the time of evaluation

3.1.8
resilience
capacity to withstand failure in one or more of the information and communication technology (ICT) equipment or *data centre* (3.1.3) infrastructures

3.1.9
restoration cost
cost required to recover the damage caused by seismic activity (earthquake)

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

DBEGM	design basis earthquake ground motion
FL	liquefaction index
ICT	information and communication technology
IT	information technology
LPI	liquefaction potential index
NT	network telecommunications
PGA	peak ground acceleration

PL	probability of liquefaction
PML	probable maximum loss
PTFE	polytetrafluoroethylene
SIS	seismic intensity scale
SLA	service level agreement

4 ISO/IEC 22237-1 Availability Classes

ISO/IEC 22237-1 defines four classes of overall availability of the set of facilities and infrastructures of the data centre, described as Classes 1 to 4, which are intended to provide increasing levels of availability.

The desired Availability Class is supported by design solutions for:

a) power supply and distribution systems (ISO/IEC 22237-3),

b) environmental control systems (ISO/IEC 22237-4),

c) telecommunications cabling infrastructure (ISO/IEC TS 22237-5).

If the data centre is to be located in a region of seismic activity, then mitigation actions are necessary in order to maintain the desired Availability Class (but not further define it).

The intention of these actions is to provide the data centre of a desired Availability Class with aseismic performance.

5 Overview of risk associated with seismic activity

5.1 Direct risk of seismic motion

5.1.1 Short-period ground motion

Ground motion denotes the positional change of an area of ground relative to objects or other areas of ground nearby in both horizontal and vertical directions.

Short-period (high frequency) ground motion can cause the structural damage generally associated with earthquakes.

A number of mitigation techniques can be employed, including rack isolators within computer room spaces and the application of base isolation techniques for the structure accommodating the facilities and infrastructures of the data centre.

5.1.2 Long-period ground motion

Long-period (low frequency) ground motion is motion with a period typically between 1 and 5 seconds. This type of ground motion can occur at significant distances from an earthquake epicentre.

Long-period ground motion can cause the structural damage generally associated with earthquakes. Mitigation techniques should be employed to support the facilities of the data centre by using base isolation techniques.

In addition, long-period ground motion and can have unexpected consequences which are not directly constructional. For example, fuel storage tanks subject to long-period ground motion are at risk of fire due to “sloshing” of the fuel contained within them.

5.1.3 Ground liquefaction

Ground liquefaction resulting from ground motion results in a significant reduction in the load-bearing capacity of the ground. This can result in the uneven settlement (or unequal settlement) of buildings comprising the facilities of the data centre.

5.2 Indirect risk initiated by seismic motion

5.2.1 Fire and toxic or damaging effluent

Even if a data centre has employed mitigation measures and is unaffected structurally during an earthquake, the data centre can be affected by fire in the local areas. These fires can produce effluent which is toxic or damaging to the equipment within the data centre.

5.2.2 Explosion

Even if a data centre has employed mitigation measures and is unaffected structurally during an earthquake, the data centre can be affected by explosions of other facilities in the local area.

5.2.3 Flooding

Even if a data centre has employed mitigation measures and is unaffected structurally during an earthquake, the data centre can be affected by flooding from damaged water supplies or from surges in natural water sources.

5.2.4 Utilities

5.2.4.1 General

Even if a data centre has employed mitigation measures and is unaffected structurally during an earthquake, the data centre can be affected by failures of utility supply including electricity, gas, water and sewerage.

5.2.4.2 Electricity

For electrical power, data centres of Availability Class 2 and above feature design solutions to provide an additional supply to support the primary supply (see ISO/IEC 22237-3). Following an earthquake, the primary supply can be subject to multiple outrages and ongoing restrictions. Where the additional supply is fuel-based then the continued supply of the fuel is critical.

5.2.4.3 Gas

Following an earthquake, damage to gas supply piping infrastructure at or in the vicinity of the data centres (typically installed underground and subject to ground instability as described in 6.3), and also to the gas supply facilities, can result in disruption to supply.

In addition, even if damage has not occurred, if a seismograph installed at a supply facility detects a certain level of earthquake motion, the supply can be automatically shut down.

In both cases, the supply will not be provided until safety has been confirmed. The length of disruption can extend from days to weeks, depending on the scale of damage and repair actions found to be necessary.

5.2.4.4 Water

Following an earthquake, damage to water supply piping infrastructure at or in the vicinity of the data centres (typically installed underground and subject to ground instability as described in 6.3), and also to the supply facilities (for water intake, water purification and water distribution) can result in disruption to supply.

In addition, even if damage has not occurred, the primary power supply to the facilities can be disrupted. Where a data centre relies on the continual provision of water, the alternative provision of power to supply facilities should be assessed.

The length of disruption can extend from days to weeks, depending on the scale of damage and repair actions found to be necessary. Extreme situations have been known to extend this period to months.

5.2.4.5 Sewerage

Following an earthquake, the impact of damage to sewerage piping infrastructure and facilities serving the data centre should be considered to be similar to that of the water supply.

5.2.5 Access

Even if a data centre has employed mitigation measures and is unaffected structurally during an earthquake, the roads surrounding and leading to the data centre can be damaged and even destroyed.

This can restrict access for:

a) emergency services to address events (e.g. fires) in the local area which can increase associated for the operation of the data centre; and

b) the ongoing provision of consumables to the data centre.

5.2.6 Transport

Even if a data centre has employed mitigation measures and is unaffected structurally during an earthquake, the road and rail infrastructure surrounding and to the data centre can be damaged and even destroyed. In addition, local regulations can restrict the type of vehicles allowed to use that infrastructure to emergency and authorized vehicles.

This not only affects supply of consumables to the data centre but can restrict the availability of personnel to operate the data centre.

Even if access to the data centre is unaffected, the earthquake can reduce the availability of appropriate vehicles e.g. a lack of fuel tankers can limit the provision of fuel for additional power supplies.

5.2.7 Security systems

Measures intended to prevent unauthorized access and intrusion across the Protection Class boundaries of the data centre (see ISO/IEC TS 22237-6) can be damaged.

6 Seismic activity risk assessment

6.1 General

Determination of the risk and scale of seismic activity should be included as part of the overall risk assessment approach that assesses the risks and events that potentially impact the data centre. Further guidance in relation to the risk assessment approach can be found in ISO/IEC 22237-1.

Following the determination of the risk and scale of seismic activity, appropriate mitigation actions should be employed.

Subclause 6.2 addresses ground motion.

Subclause 6.3 address ground stability (liquefaction).