AUTORITÉ
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RÉPUBLIQUE FRANÇAISE

BASIC SAFETY RULE

Fundamental safety rule n°2001-01 concerning basic nuclear installations

Scope: Basic nuclear installations except for radioactive waste long-term repositories

Subject: Determination of the seismic risk for the safety of surface basic nuclear installations.

1. SUBJECT OF THE RULE

Regulatory practice in France requires that the safety-related functions of a surface basic nuclear installation, particularly – depending on its precise characteristics - safe shutdown, cooling and containment of radioactive products, must be guaranteed during and/or following plausible earthquakes that could affect the site of the installation in question. The purpose of this rule is to define an acceptable method for determining the seismic movements to be taken into account when designing the installation against the seismic risk.

In regions with slight deformation rates, such as metropolitan France, the strong earthquake return period is long and it is hard to link certain earthquakes to known faults. Furthermore, despite considerable progress in recent years, it is difficult, in the French seismotectonic context, to identify potentially seismogenic* faults and determine the characteristics of the earthquakes they could produce. Therefore, the approach proposed in this Fundamental Safety Rule aims to remedy this difficulty by taking account of all direct and indirect factors that could play a role in the appearance of earthquakes, as well as all known seismicity data.

Moreover, in the field of seismic motion calculations, the rarity of strong motion records in metropolitan France means that data obtained in other regions of the world has to be used.

2. DESCRIPTION OF THE RULE

To meet the objectives stated in 1, the basic approach explained below is deterministic, in that the reference motions are associated with reference earthquakes. The rule is first of all based on a definition of the characteristics of "Maximum Historically Probable Earthquakes" (*Séismes Maximaux Historiquement Vraisemblables* - SMHV) considered to be the most penalising earthquakes liable to occur over a period comparable to the historical period, or about 1000 years. Secondly, we define the "Safe Shutdown Earthquakes" (*Séismes Majorés de Sécurité* - SMS). The definition of the reference motion is for its part based on the use of a "seismic data library"*.

For certain sites, paleoseismic data may be included to complete the motions associated with the SMS. The principle of these studies is outlined in 2.3.5 and developed in appendix III.

For each site, these earthquakes are assessed according to the procedures defined in 2.2 and 2.3.

The corresponding studies must be carried out as early as possible. The safety cases for the basic nuclear installation must present the main data for characterising the SMHV, the SMS and the corresponding seismic motions.

2.1. Definition and principles for determining the characteristics of earthquakes representative of the seismicity of the site

The basic approach is to assume that earthquakes comparable to historically known earthquakes are liable to occur in the future, with an epicentre* position that is most penalising with regard to its effects (in terms of intensity*) on the site, while remaining compatible with the geological and seismological data.

The approach is therefore based on considering seismotectonic zones around the site on the one hand, and seismic data on the other, using a method to be specified in section 2.2. The investigation must be taken as far out geographically as necessary, to be sure that all the earthquakes that could have a significant effect on the definition of the SMHV have been included.

For the envisaged site, this operation allows definition of one or more Maximum Historically Probable Earthquakes which are the earthquake(s), resulting from the preceding approach, liable to produce the greatest effects on the site in terms of macroseismic intensity. On the site, we thus determine an intensity ISMHV. In order to take account of uncertainties inherent in the determination of the SMHV characteristics, a fixed safety margin is defined as follows. For each SMHV, we define a "Safe Shutdown Earthquake" (SMS), deduced from the SMHV by the following simple equation in terms of intensity on the site:

$$I\ SMS = ISMHV+1 \quad (1)$$

Except for the particular case dealt with in 2.3.5., the SMS are considered to be the most aggressive earthquakes to be used in assessing the seismic contingency to be included when sizing an installation.
We postulate that the SMS can be preceded or followed by earthquakes capable of reaching the SMHV level.

2.2. SMHV assessment procedure

This is based on identifying seismotectonic zones. These are volumes of the earth's crust with homogeneous seismogenic potential. We postulate that an earthquake which occurred at one point in a seismotectonic zone is capable of occurring at any point in it.

2.2.1. Determination of seismotectonic zones

A summary must be made of the most recent documents concerning geology, geophysics and seismicity. A detailed study taking account of the static and dynamic characteristics of the crust and the seismicity will also need to be presented. A method for determination of seismotectonic zones is presented in appendix I.

2.2.2. Seismicity study

Historical seismicity data are hindered by a lack of precision concerning both the accuracy of the facts and the assessment of macroseismic intensity levels.
The characteristics of earthquakes liable to be used in the definition of one or more SMHV must be established with the greatest possible precision, taking account of data from historical and instrumental seismotectonics and seismicity. Information collected in an updated macroseismic data base* (for example the SISFRANCE* base) should be used as a source of basic information. Additional data may be required and interpretation work is essential. The characteristics liable to be used in defining the SMHV are as follows :

- intensity at the epicentre,
- isoseismal curves*,
- -epicentre, hypocentre* and focal depth*,
- magnitude*,
- regional intensity attenuation laws*.

A method for determining these characteristics is presented in appendix II. The latest instrumental seismicity data must also be considered to complete the seismicity picture.

2.2.3. Determination of SMHV

Having determined the seismotectonic zones, the SMHV is then defined as being the historically known earthquake(s) which, if considererd at a particular location within the zone, would produce the highest intensities on the site, that is:
a) the earthquakes in the zone containing the site are considered as being able to occur on the site,
b) the earthquakes of other zones are considered as being able to occur at the point of the site nearest to

the zone to which they belong.

2.3. Calculation of seismic motion

Seismic motion* is defined by the response spectra* of the horizontal and vertical components of the motion on the surface of the site ground. This definition can be supplemented by other parameters mentioned in section 3.

2.3.1. Calculation of spectra corresponding to a given SMHV

The spectra calculation is based on the study of a number of records collected in a "seismic data library". Taking the values of the magnitude M and focal distance R* for the SMHV considered, the response spectra corresponding to the horizontal and vertical components of the motion are calculated according to a mean* attenuation law with the following form:

$\log_{10} PSA = aM + bR - \log_{10} R + c$ (2) where PSA is the value of the response spectrum (pseudo-acceleration) for a given frequency and damping.

With regard to the vertical component, it is acceptable to use the horizontal components response spectrum with application of a 2/3 coefficient for all the frequencies.

The correlation coefficients a, b and c, which depend on the frequency and damping rate considered, are evaluated for two categories of sites (see 2.3.4). These coefficients are valid for a distance and magnitude interval that depends on the records in the seismic data library and the seismological analysis (or a distance R of between 7 km and 100 km and a magnitude M of between 4.5 and 7.3). The spectra are calculated at least for the frequency range 0.25 - 33 Hz.

For focal distances of less than 7 km, the following conventional method can be adopted: the spectra calculation is made assuming that R is equal to this minimum distance, while increasing the magnitude M so that the earthquake produces the same effects on the site (ISMHV and ISMS are constant). Within the range of validity of the law (2), the acceleration at infinite frequency (equal to the maximum acceleration of the ground motion) is considered to be equal to the value of the response spectrum with acceleration at a frequency of 33 Hz.

The seismic data library, the method for determining correlation coefficients and their validity range are described in the IPSN/DPRE/SERGD/2000/0053 report produced under quality assurance rules.

2.3.2. Calculation of spectra corresponding to a given SMS

The SMS spectrum is calculated from equation (2), within its validity range, assuming that a one-degree increase in intensity between the SMHV and the SMS corresponds to an increase in magnitude conventionally set at 0.5.

2.3.3. Calculation of other ground motion parameters

The seismic motion definition in the form of a response spectrum can in particular be supplemented by the following data:

- duration of the strong phase,
- accelerograms,
- maximum ground speed,
- A/V*,
- CAV*,
- Arias intensity*.

These data must be compatible with the physical characteristics of the earthquake (SMHV or SMS) and the site conditions defined in section 2.3.4.

The database used to determine the coefficients in equation (2) may be used to calculate these various parameters.

2.3.4. Consideration of site effects

Site effects are generally due to amplification of the seismic motion created by a planar geometry layer of soil with lower mechanical strength located near the surface. Equation (2) can be used to calculate the spectra for two site conditions, based on the characteristic soil dynamics in accordance with RFS I.3.c:

- sites characterised by a mean shear wave velocity* in the first 30 metres of depth greater than 800 m/s,
- sites for which the mean shear wave velocity in the first 30 metres is between 300 m/s and 800 m/s.

When the soil underlying the installation has not been characterised, at least down to a depth of 30 m, or comprises significant lateral variations, the sizing spectrum will have to encompass the spectra calculated with the two site conditions.

In certain particular cases, the complex geometry of sedimentary layers (presence of sedimentary topography or a sedimentary basin) or their extreme thickness, can lead to amplification or lengthening of the duration of the seismic motion. These particular effects are not simply due to the surface properties of the soil (last 30 metres below the installation).

In these particular site effect cases, or if the mean shear wave velocity in the first 30 metres of depth is less than 300 m/s, specific studies will be required to take account of these particularities when estimating the seismic motion associated with the SMHV and SMS. In these situations, it may be useful to supplement the response spectrum calculated using law 2 with other seismic motion indicators specific to the site in question.

2.3.5. Consideration of active faults with surface fracture*

In the case of a site located in the immediate vicinity of an active fault with surface fracture, a study aimed at determining the seismic motion associated with the earthquakes that may have occurred on this fault, and which could have an effect on the site, will be carried out. Details on how these studies could be carried out are given in appendix III

2.4. Consideration of seismic motion

2.4.1. For the earthquake design of installations or parts of installations, the free field motion defined in 2.3 should be used as follows.

2.4.1.1 The installation must be designed to deal with seismic loadings greater than those induced by the motion associated with the Safe Shutdown Earthquakes (SMS). This conservative level is established according to parameters describing the soil motion associated with the SMS. With damping reduced by 5%, a comparison will be made between the spectra used to design the installation and the response spectra associated with the Safe Shutdown Earthquakes. It will be sufficient to check that the spectra used for the design of the installation encompass the response spectra associated with the Safe Shutdown Earthquakes. The data mentioned in point 2.3.3 are not used systematically, but only case by case depending on the type of site or structure concerned.

2.4.1.2 The spectra corresponding to earthquakes deduced from a study of active faults with surface fracture will be incorporated into the design of the installation on a case by case basis, depending on the return period* of these earthquakes, the degree of certainty attached to their characteristics and a comparison of the spectra obtained with the spectra

2.4.1.3 The spectrum adopted by the licensee for sizing its installation may not be less than a minimum fixed spectrum with acceleration at 0.1 g and infinite frequency. Depending on the site conditions, the acceleration values for this spectrum are defined by:

- Shear waves velocity less than 800 m/s
- Frequency 0.25 Hz 2.5 Hz 8 Hz 30 Hz 33 Hz
- Pseudo-acceleration 0.02 g 0.21 g 0.23 g 0.1 g 0.1 g

- Shear waves velocity higher than 800 m/s
- Frequency 0.35 Hz 3.5 Hz 9 Hz 30 Hz 33 Hz
- Pseudo-acceleration 0.02 g 0.21 g 0.23 g 0.1 g 0.1 g

2.4.2. During the installation construction or operation phase, new data or advances in the methods used may lead the administration to request a reassessment of the seismic motion corresponding to a given site.

APPENDIX I
METHOD FOR DELIMITING SEISMOTECTONIC ZONES

Seismotectonic zones are volumes of the earth's crust with homogenous seismogenic potential. The objective is to characterise each zone by its geometry and the seismicity occurring within it. A seismotectonic zone may consist of several separate volumes with the same structural and seismotectonic properties. A fault or set of faults may in this respect define a zone.
Characterisation of the zones takes account of all the geological, geophysical and seismic data available.

1. Data to be used

1.1. Static state

When defining the seismotectonic zones the following can for example be considered:
- the thickness of the crust;
- the thickness of the sedimentary covering;

- the lithological nature of the ground;
- the structure of the crust resulting from the main tectonic episodes. The geometry of the structures is essential for defining the zones. The direction of the paleo-stresses of these various tectonic episodes also contributes to identification of zones which have had the same tectonic history;
- geophysical data.

1.2. Dynamic state

Each seismotectonic zone must have homogeneous deformation (type and intensity of seismic and aseismic deformation). This is studied using seismicity, deformation and stress data.

1.2.1. Seismicity

Seismicity is an indicator of the current deformation. It is used in a number of respects for defining seismotectonic zones. Analysis of it contributes to understanding the deformation regime (type and intensity of seismic and aseismic deformation). It also highlights local characteristics. Particular attention should be paid to the following points:

- the location of epicentres;
- the intensity at the epicentre or the magnitude of the various earthquakes, their quantitative distribution according to these parameters;
- the depth of their hypocentres;
- the geometry of the areas of highest intensity during major earthquakes;
- the space/time distribution of instrumental earthquakes (mainly the aftershocks or strong earthquakes) or clusters of historical epicentres;
- the mechanisms at the earthquake hypocentres.

1.2.2. Deformations

All the indicators of neotectonic deformation*, whether direct indicators (fractures in recent ground, folds, volcanic events, etc.) or indirect ones (morphological anomalies) should be listed and studied. Faults with surface fracture should in particular be identified and the relevant data quantified whenever possible. In the case of displacement of morphological markers, they should be dated. For the most recent period, that is less than about a century ago, account should be taken of successive levelling comparisons, as well as conventional geodesy data (triangulation) and space-based geodesy (Global Positioning System). The elements presented above contribute to defining zones with a homogeneous

deformation regime, characterised by its type and intensity.
Type of deformation. Whenever possible, the type of potential deformation should be determined for each fault, based on recent deformation and stress direction data.
Deformation intensity. With the data currently available, the deformation intensity can only be defined qualitatively by taking account of deformation velocities, the intensity of the relief, etc. A seismicity study can also provide information about the seismic deformation rate.

1.2.3. Stresses

The state of the current stresses in the chosen sector is examined by considering:

- the in-situ stress measurements;
- the mechanisms at the earthquake hypocentres;
- the microtectonic measurements in recent ground and volcanic alignments.

2. Delimitation of seismotectonic zones

A summary of the elements presented above allows a definition of the seismotectonic zones consisting of volumes of the earth's crust with homogeneous seismogenic potential. We postulate that an earthquake which occurred at one point in a seismotectonic zone can occur at any point within it.
A seismotectonic zone can consist of a fault, or even a family of faults with the same geometric and dynamic characteristics and the same seismic potential. When a zone consists of one or more faults, its boundaries must take account of the dip of these structures.
For each zone, the static and dynamic characteristics must be detailed. Furthermore, for zones consisting of one or more accidents, the geometrical characteristics, the chronology of the various movements and the associated seismicity should be specified.

APPENDIX II

METHOD FOR DETERMINING THE CHARACTERISTICS OF EARTHQUAKES REPRESENTATIVE OF THE SEISMICITY OF THE SITE

The characteristics used when defining earthquakes representative of the seismicity of the site are:

- the coordinates of the epicentre;
- the intensity at the epicentre;
- the isoseismals;
- the hypocentre depth;
- the magnitude;
- the regional intensity attenuation laws.

As a general rule, the coordinates of the epicentre, the depth of the hypocentre and the magnitude are deduced from macro-seismic data. However, for recent earthquakes, these characteristics can be calculated from the available instrumental data. The values must be compared and their differences explained. If the justifications are insufficient to enable one of these values to be chosen, the most penalising value for the site will be selected.

1. Coordinates of the epicentre and epicentral intensity

The coordinates of the epicentre and the epicentral intensity are deduced from the near field distribution of the point observations of the intensities estimated in the different areas. The location of the epicentre generally corresponds to the barycentre of the area of highest intensity, but when this is poorly defined (for example if the epicentre is at sea), the approximate location of the epicentre can be calculated using appropriate methods (intensity attenuation law for example). The epicentral intensity does not necessarily correspond to the maximum intensity observed (site effect, epicentre at sea, mountainous region) and may be deduced from a distribution of the near field point intensities or the use of appropriate methods (intensity attenuation law for example).

2. Isoseismal curves

Isoseismal curves can be plotted if the number of point intensities with the same value is sufficient and their distribution is homogeneous enough. These curves, which smooth out local effects, offer a rapid overview of the effects (level and extension). When of recognised quality, the isoseismal curves can be used after the seismotectonic analysis to define the intensity on the site of the earthquakes representative of the site's seismicity.

3. Focal depth

When estimated over a sufficient number of points, the intensity can show a regular pattern of decrease as the distance from a source point increases, that can be explained by an extremely simple energy model (Sponheuer equation for example). This assumption is justified for medium to low magnitude earthquakes representative of the moderate seismicity of France. The distribution of intensities can then be used, after elimination of particular points (site effects and associated phenomena), to estimate the depth of the earthquake's hypocentre. The calculation must preferably be made using all the macro-seismic data, rather than the radii of the isoseismal curves, which are the result of an interpretation. The estimated depth is all the more precise the greater the number of point intensities and the more homogeneous their distribution, particularly in the area close to the epicentre. In the absence of sufficient macro-seismic data, the depth could be deduced from instrumental data or from well-documented historical earthquakes situated in the same seismotectonic domain, or via other methods. If significant differences appear and the justifications do not enable one or other value to be chosen, the most penalising value for the site will be selected.

4. Magnitude

The magnitude of historical earthquakes has to be determined from the available correlations best-suited to the French context, linking magnitude to intensity and to focal distance, established from sets of homogeneous macroseismic data. These correlations calibrated against earthquakes for which both instrumental magnitudes (M) and macroseismic intensities (I) are available, commonly take the form: $M = a I + b \log R + e$, in which R is the focal distance (km). One should avoid using such correlations established only on the value of the epicentral intensity. At the epicentre, the focal distance is the depth of the hypocentre.

5. Regional attenuation laws

Whenever possible, regional attenuation laws based on a model of decreasing intensity with increasing distance should be used (for example, Sponheuer equation). These laws can be used to define the intensity on the site of an earthquake, in the absence of isoseismal curves. The laws will be established on the basis of all macroseismic data concerning a sufficient number of earthquakes contained in the base used to assess the threat to the site, or of other data sets, provided that it can be proven that these laws are well suited to the regional context of the site.

APPENDIX III

CONSIDERATION OF ACTIVE FAULTS WITH SURFACE FRACTURE

The following three-step method can be used for the study aimed at determining seismic motions associated with earthquakes that may have occurred on the active fault with surface fracture.
The first step is to describe the observations enabling one to conclude that one or more surface fractures of co-seismic* origin have occurred, and to determine the age of these fractures and the unit slip value. The inclusion of paleo-seismicity indicators is backed up by the following elements:

§ direct observation of one or more surface fractures (photo, drawing, description of outcrop) or clear morphological evidence of slippage in dated and identified geological markers (river terraces, water courses, marker horizons, etc.). Each surface fracture must be linked to a fault whose dimensions (geometry, area, length) are compatible with the estimated magnitude of the paleoseismic event(s);
§ a study of the tectonic nature of the deformation. The other assumptions offering an explanation of the deformations observed must be examined (gravity processes, diapirism, halokinesis, argilokinesis, glacitectonics, glacial, karstic, processes linked to surface deformations in the periglacial environment, and so on);

§ an assessment of the age of the last level affected (whatever the dating method) and if possible the value of the return time between two or more events.

The second step is to assess the return time of the paleoseismic events from the mean velocity of the fault slip. This velocity is estimated using geological and geodetic data or the frequency and magnitude distribution of the earthquakes in the region. The paleoseismic indicators showing events separated by a return time less than or equal to several tens of thousands of years must be taken into account.

The third step is to determine the range of magnitudes associated with the surface fracture based on a study of the length, the segmentation and the seismogenic depth* of the fault. In the French context, these parameters are hard to determine and, if necessary, it is possible to refer to the published and commonly used empirical relations between the slip value and the magnitude.

The magnitude of paleoseismic events must be assessed using the moment magnitude one considers to be equal to the magnitude Ms between Mw=6.5 and Mw=7.5. The seismic motion associated with each of the scenarios concerning the magnitude of the paleoseismic event is calculated using equation (2) in section 2.3.1.

GLOSSARY

A/V: This parameter, expressed in s-1, where A and V designate the acceleration and maximum velocity of a signal respectively, give information about the frequency content of this signal.

CAV: CAV (Cumulative absolute velocity value) refers to the following quantity:
CAV: $|g(t)|$ dt
This is the integral, for the duration of the earthquake, of the absolute value of the acceleration g(t). It is expressed in m/s.

Coseismic: characteristic of the occurrence of an earthquake. A coseismic fracture is created by the instantaneous tectonic fracture of the fault which generates the earthquake. It is different from a fracture created by a phenomenon other than tectonics (collapse, landslip, etc.) or aseismic deformation (slow slip along a fault).

Focal distance: distance between the hypocentre of an earthquake and a given point.

Macroseismic data: information deduced from surface observation of the effects of earthquakes.

Strong phase duration: The duration of the strong phase of a seismological signal is generally defined by the time interval between the moment the signal has reached 5% of the Arias intensity and the time at which it has scanned 95% of it.

Epicentre: point on the surface of the ground vertically above the hypocentre of an earthquake.

Active fault with surface fracture: fault showing evidence of recurring motion near the surface within a period of several tens of thousands of years.

Hypocentre: point inside the Earth considered to be the origin of the energy dissipated by the earthquake.

Intensity: in a limited area on the surface of the ground, evaluation of the effects of an earthquake, on a statistical basis, with reference to the criteria of a descriptive scale.
In this rule, the MSK (Medvedev-Sponheuer-Karnik, 1964) macroseismic intensity is used to assess the intensity of the earthquakes contained in the SISFRANCE database (formerly SIRENE), while for recent earthquakes, the EMS 1998 (European Macroseismic Scale, version 1998) scale is used as an extension of the MSK scale, which is more suitable for modern constructions. These scales comprise twelve degrees and the intensity can be expressed in the form of degrees or half-degrees.

Arias intensity: the Arias intensity is defined by the following expression
$I = g2(t)dt$
This is the integral, for the duration of the earthquake, of the square of the acceleration value g(t). It is expressed in m/s
Isoseismal curve: curve encompassing points of the same intensity and separating two areas in which the intensities observed for the same earthquake are different.

Attenuation law: law describing the decrease of a parameter versus distance. In this rule, reference is made on the one hand to the attenuation of intensity versus focal distance, and on the other the attenuation of the spectral Y-axis of the response spectrum versus distance and magnitude.

Mean law: the values of the response spectrum obtained from records follow a log-normal distribution (the logarithms of these values are distributed normally). The two-step least-squares regression used to deduce the coefficients of the attenuation law (2) was established on the logarithm of the acceleration values. The mean value of the logarithm of the spectral accelerations is thus equal to the median value owing to this normal distribution. This means that the value given by law (2) represents a confidence interval of 50% and that the value predicted by law (2) plus its standard deviation represents a confidence interval of 84%.

Magnitude: value obtained by measuring the amplitude of the waves recorded by a seismograph; the magnitude gives an estimate of the energy dissipated at the hypocentre in the form of seismic waves. There are several definitions of the magnitude:

The Local Magnitude (Ml) is defined from the maximum amplitude of either P waves or S waves. The LDG uses the maximum amplitude of the S phase measured on the vertical component of the velocity (Plantet, 1978). For an epicentral distance D:
ML(LDG) = log(A/T) + B(D) + C

A: maximum displacement amplitude of S waves,
T: associated period,
B(D): mean attenuation coefficient,
C: station correction.

The magnitude of an earthquake is the mean of the values calculated by the stations located 100 to 1500 km from the epicentre.

The surface magnitude (Ms) is measured from the Rayleigh surface waves. A general definition of the surface magnitude Ms is as follows:

Ms = log10 (A/T) + s (D,h) + s(Ms)

A: ground displacement amplitude,
T: associated period,
s (D,h): empirical amplitude-distance calibration function,
s (Ms): corrective term enabling the site effects, the pathways and the hypocentre mechanisms to be taken into account (Wilmore, 1979).

The moment magnitude (Mw) is linked to the seismic moment Mo of the earthquake. Mo is simply expressed versus surface area S of the fault involved, the mean displacement (or dislocation) D on this fault and the rigidity m of the medium, by the equation Mo = m S D. The magnitude Mw is then linked to Mo by the expression:

Mw = 2/3log Mo – 6.0

For magnitudes of less than 7.5, the values found for Mw, Ms and Ml are virtually identical (Madariaga et Perrier, 1991).

Seismic motion: free field motion of a point on the surface of the ground, in other words in the absence of any installation.

Neotectonics: concerns the present-day deformation of the Earth's crust.

Return period: mean interval of time between two earthquakes, within a given magnitude range, occurring on the same fault or in a specific zone.

Seismogenic potential: capacity of a zone to produce earthquakes of given characteristics.

Focal depth: distance between the hypocentre and epicentre of an earthquake.

Seismogenic depth: maximum depth reached by coseismic fractures.

SISFRANCE: historical seismicity database (BRGM/EDF/IPSN) formerly known as SIRENE. This macroseismic database comprises information (dates, epicentre positions, point intensity values, etc.) on historical and contemporary earthquakes in France.

Seismic data library: set of accelerometer records obtained on the surface of the ground during earthquakes.

Response spectrum: curve corresponding to the maximum amplitude, versus frequency, of the response of simple oscillators for a given damping, when energised by the ground motion.

Mean shear wave velocity: means speed of propagation of shear waves, in the case of slight deformations.