USER'S MANUAL FOR PROGRAM CRISIS-99

February 1999

I. INPUT FILES

I. FILENAME.NAM

CRISIS99 reads the following two lines from a fixed-name file called FILENAME.NAM:

1. Name (including path) of the general data file (A200)
2. Name (including path) of the base name for output files (A200)

II. GENERAL DATA FILE

Format is free unless indicated otherwise.

1. General title of the run. 1 line

   TITGEN (A80)

2. Global parameters of the run. 1 line.

   NREG, NMOD, NT, NA

   NREG: Total number of regions (sources) in which the seismogenic area is divided.
   NMOD: Number of different attenuation models.
   NT: Number of spectral ordinates (or, in general, measures of intensity) for which seismic hazard is to be computed.
   NA: Number of levels of intensity for which seismic hazard will be computed.

3. Parameters for each spectral ordinate. NT lines. Free format

   T(I), AO(I), AU(I)

   T(I): Structural period of i-th spectral ordinate. It is used only for identification purposes, so in the cases in which structural period has no meaning, it can be just a sequential number.
   AO(I): Lower limit of intensity level for i-th spectral ordinate.
   AU(I): Upper limit of intensity level for i-th spectral ordinate.

   Exceedance rates for the i-th intensity will be computed at NA values, logarithmically spaced between AO(I) and AU(I)

4. More Global parameters

   RMAX, TR1, TR2, TR3, TR4, TR5

   RMAX: Parameter controlling the spatial integration process. Sources at distances greater then RMAX kilometers from a site will be ignored.

TR1,…,TR5: CRISIS-99 will generate a file containing intensity levels for fixed return periods TR1,…,TR5. See below for the description of this output file. Five values must be always given.

5. Parameters defining the basic grid of points in which hazard is to be computed. 1 line

   LOI, LAI, DLO, DLA, NLO, NLA

   LOI, LAI: Longitude and latitude, respectively, of the origin of the grid.
   DLO, DLA: Longitude and latitude increments
   NLO, NLA: Number of lines of the grid in the longitude and latitude directions, respectively.

   Results will be given for points (LO(I),LA(I)), where

   $$LO(I) = LOI + (J-I)*DLO \text{ , } J=1, NLO$$
   $$LA(I) = LAI + (I-1)*DLA, I=1, NLA$$

6. Number of polygons to be used to reduce the initial rectangular grid. 1 line.

   NPOLGRID

   Introducing one or more boundary polygons can reduce the initial rectangular grid of points. If polygons are given (NPOLGRID>0) the computation of hazard will be performed only for those points of the grid, which are inside one of the polygons. If NPOLGRID=0 computations will be made for all points in the rectangular grid. NPOLGRID<=10.

   If NPOLGRID>0 then the following lines must be given for each polygon:

7. Definition of the k-th boundary polygon.

   NVERGRID (K)
   LONG (K, 1), LAT (K, 1)
   …
   LONG (K, 1), LAT (K, 1)
   } NVERGRID(K) lines

   NVERGIRD(K): Number of vertex of polygon k. NVERGRID(K)<=30.
   LONG (K, I), LAT (K,I), I=1,…,NVERGRID(K): Coordinates of the polygon's vertex. The polygon must be described counter clockwise.

8. Files of attenuation tables. NMOD lines

   MODELO (I) (A20)

   MODELO (I): Name of the file containing the i-th attenuation table (including path). The format of attenuation tables is explained below.

9. Data defining seismicity in each region. NREG blocks.

   TITULO (N) (A80)
   IC(N), IE(N), IMO(N)
   NV(N)
   LONG(1),LAT(1),PROF(I)
   …
   LONG(NV), LAT(NV), PROF(NV)
   } NV lines
   Poisson model: (IC(N)=1)
   LAMBDA0(N), EB(N), CB(N), EMU(N), SMU(N), MMAX(N),M0(N)

Characteristic model: (IC(N)=2)
EMT(N), T00(N), D(N), F(N), SMT(N), M0(N), MU(N)

TITULO(N): Identification name for source N
IC(N): Flag defining the type of occurrence model assumed for N-th source. IC(N)=1 for Poisson model, IC(N)=2 for characteristic-earthquake model.
IE(N): Defines type of source. IE(N)=0 for area source, IE(N)=1 for line source and IE(N)=2 for point source.
IMO(N): Number of the attenuation model that will be used with this source. Must be between 1 and NMOD.
NV(N): Number of vertex defining source N.
LONG(I), LAT(I), PROF(I), I=1,…,NV(N): Coordinates of vertex I of source N. LONG(I) and LAT(I) are geographical coordinates of point i, whereas PROF(I) is the depth of the point, in km, which must be positive.

Sources can be of three types: areas (polygons), polylines or points. Polylines and points can be given in any order. In general, in the case of an area source, CRISIS99 will divide the polygon into triangles. It first checks if triangulation can be made in the XY plane. Numbering of the vertex of the polygon must be done counter-clockwise in this plane when looked from above the surface of the Earth. If there are vertical planes, CRISIS99 will try to triangulate the area in the XZ plane, so numbering of vertex must be done counterclockwise in this plane. Finally, CRISIS99 will try to triangulate in the YZ plane. There are some bizarre source geometries that cannot be well resolved by CRISIS-99, for instance, an L-shaped vertical plane. In these cases, an error will be reported.

Poisson model:
LAMBDA0(N): Exceedance rate of magnitude M0(N). The units are earthquakes/year.
EB(N), CB(N): Expectation and coefficient of variation, respectively, of the "b-value" for the source, given in terms of the natural logarithm.
EMU(N), SMU(N): Expected value and standard deviation, respectively, of the maximum magnitude for the source.
MMAX(N): Maximum observed magnitude in this source.
M0(N): Threshold magnitude for source N. The catalog of earthquakes is assumed to be complete for M>M0. Earthquakes with M<M0 are absolutely ignored.

Characteristic model:
EMT(N): Median value of the times between characteristic earthquakes with M>M0. This is the inverse of the exceedance rate for M>M0.
T00(N): Time elapsed since the last occurrence of a characteristic earthquake.
D(N), F(N): Parameters defining the expected magnitude as a function of time, as in the slip-predictable model. It is assumed that

E(M|t)=max(M0(N),D(N)+F(N)*LN(t))

Of course, if F(N) is set to zero, then D(N) becomes the expected time-independent magnitude of the characteristic earthquake.
SMT(N): Standard deviation of the magnitude of the characteristic earthquake. It is assumed independent of time.
M0(N): Minimum possible magnitude of a characteristic earthquake. Earthquakes with M<M0 are absolutely ignored
MU(N): Maximum magnitude of the characteristic earthquake to be used in the integration process.

10. Name of the map file. 1 line

File name (including path) containing the base map to be used in post-processing with CRISIS99 for windows. This name does not have any influence in the hazard computations. However, CRISIS99 expects a line here.

11. Name of the file of cities. 1 line

    File name (including path) containing the coordinates of cities, to be used in post-processing with CRISIS99 for windows. This name does not have any influence in the hazard computations. However, CRISIS99 expects a line here.

III. ATTENUATION TABLES

NMOD attenuation tables must be given each one in a different file. The tables give to CRISIS-99 the relations between magnitude, focal distance and median intensities. CRISIS-99 expects the following parameters in the i-th attenuation file, I=1,…,NMOD:

1. Parameters defining the magnitude limits. 1 line

   MINF(I), MSUP(I), NMAG(I)

   MINF(I): Lower limit of magnitude given in the table.
   MINF(I): Upper limit of magnitude given in the table.
   NMAG(I): Number of magnitudes for which intensity is given.

   CRISIS-99 assumes than intensities are given for magnitudes M(K), where M(K)=MINF(I)+(K-1)*DMAG, where DMAG=(MSUP(I)-MINF(I))/(NMAG(I)-1).

2. Parameters defining the distance limits. 1 line

   RINF(I): Lower limit of distance given in the table.
   RINF(I): Upper limit of distance given in the table.
   NRAD(I): Number of distances for which intensity is given.

   CRISIS-99 assumes than intensities are given for distances R(K), where log(R(K))=log(RINF(I))+(K-1)*DLRAD, where DLRAD=(log(RSUP(I))-log(RINF(I)))/(NRAD(I)-1). That is, distances are supposed to be logarithmically spaced.

3. For each of the NT different intensity measures, the following block of lines:

   T(I,J), SLA(I,J), AMAX(I,J)
   SA(I,1,1,1), SA(I,1,1,2),…,SA(I,J,K,L),….,SA(I,NT,NMAG(I),NRAD(I)

   T(I,J): Structural period of j-th spectral ordinate. It is used only for identification purposes, so in the cases in which structural period has no meaning, it can be just a sequential number.
   SLA(I,J): Standard deviation of the natural logarithm of the j-th measure of intensity in the i-th model.
   AMAX(I,J): Maximum possible value of the j-th intensity in model I. The integration process will be truncated, regarding as impossible (zero probability) values larger than AMAX(I,J). If AMAX(I,J) is set to zero, then integration with respect to possible values of intensity will be performed from 0 to ∞.
   SA(I,J,K,M): Median value of the intensity in model I, for the J-th spectral ordinate, the K-th magnitude and the L-th distance.

   For each attenuation model, given in a separate file, CRISIS-99 reads the above mentioned parameters in the following form:

```
D0 J=1,NT
  READ(8,*) T(I,J),SLA(I,J),AMAX(I,J)
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```
  DO K=1,NMAG(I)
    READ(8,*) (SA(I,J,K,L),L=1,NRAD(I))
  ENDDO
ENDDO
```

II. OUTPUT FILES

CRISIS98 generates several output files, whose names begin with the base name requested at the beginning of the run in file FILENAME.NAM. The output files are:

1. Main results file. This file with - .res - extension contains a printout of the name of the run, the values assigned to the variables, characteristics of the attenuation models, geometrical and seismicity description of the sources, the data defining the computation grid, etc. It also gives the final results, that is, exceedance rates for each site and type of intensity. It also gives a brief summary of the computations for each site, indicating which sources are of interest to the site and which sources were skipped.

2. Graphics file. The principal graphics file with - .gra - extension contains a brief identification header, and the exceedance rates for the type and levels of intensity requested. This file can be used as input file to plot intensity versus exceedance rate curves. CRISIS99 generates also a binary file with the exceedance rates for each structural period, so CRISI99 will generate NT binary files. These binary files will be used only in the Windows System version of CRISIS99 to make hazard maps. The names of these files are base_name.b1, base_name.b2,…, base_name.bNT.

3. Map file. This file with - .map - extension contains intensity levels for fixed return periods (TR1…TR5) for each type of intensity and site. It also gives the coordinates of each site. This file can be used to generate contour or 3d maps of intensity levels associated to constant exceedance rates.