DGSNR - CEPN

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PROPOSAL FOR A RADIATION PROTECTION EVENT SCALE

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AIMS OF A RATING SCALE FOR THE RADIOLOGICAL INCIDENTS AND ACCIDENTS (1)

- There is a need for the regulatory body to have a simple tool for communicating with the public about radiological incidents and accidents and putting into perspective their relative severity.
- In terms of radiological protection -for the individuals the severity is a function of the individual risks (the probabilities of developing health effects) -for the society it takes care also of other aspects

AIMS OF A RATING SCALE FOR THE RADIOLOGICAL INCIDENTS AND ACCIDENTS (2)

- To be credible, that tool has to rely on the international consensus on the exposure risks relationships for both deterministic and stochastic effects;
- To be simple and fast to be used for the scoring, it must provide the experts with available up to date charts, software …

AIMS OF A RATING SCALE FOR THE RADIOLOGICAL INCIDENTS AND ACCIDENTS (3)

- To be comprehensive for the communication with the media and the public, it must use qualitative words of the usual language (accident, incident, serious, major…);

AIMS OF A RATING SCALE FOR THE RADIOLOGICAL INCIDENTS AND ACCIDENTS (4)

- It must differentiate the events dealing with the public and the workers;
- It has to take into account the number of exposed individuals;
- It must be able to take care of the potential events;
- It must point out the events displaying a lack of radiological protection culture or violations to radiological protection regulations;

TARGETED EVENTS

- Most exposure situations to natural irradiation are excluded;
- “Normal” occupational or medical exposure are excluded;
- The scale may be used for communicating on all events adding exposure to “normal” or “under control” exposures in the industrial and medical areas.

INES and RADIOLOGICAL PROTECTION

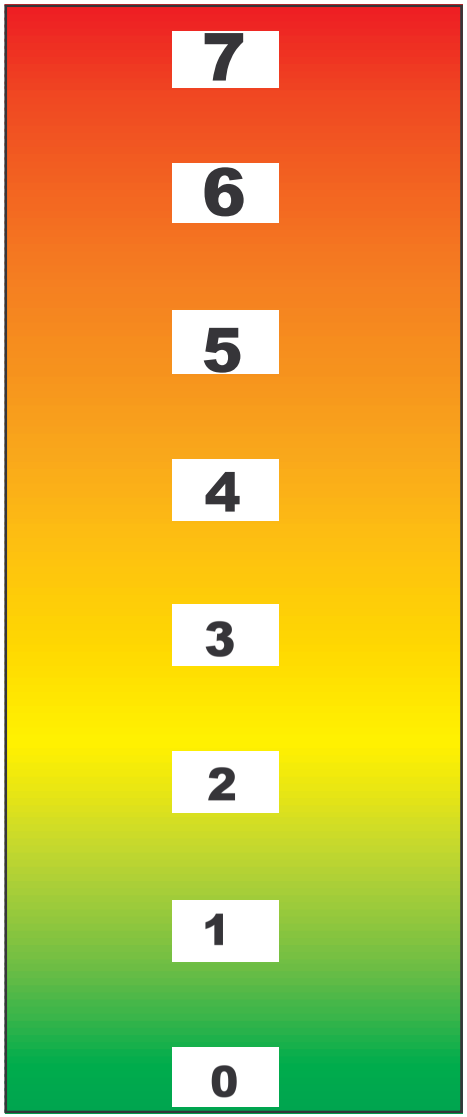
- Examples of inconsistencies when using INES for radiological events:
  - Same grading for a few mSv to members of the public in case of releases and for 5 Gy in case of transport accident;
  - Same grading for a few mSv to members of the public and lethal exposure of a worker.
  - Same grading for a worker dose “between 20 mSv and one Gy
- Need to have a more adapted tool, … but the regulatory body request is to have a tool totally compatible with INES:
  - Same number of severity levels
  - Same wordings and comments
  - Level 2 for exceeding the annual dose limit

EVENT CONCERNING BOTH
nuclear safety and radiological protection

- Any such event would be scored on both INES and the RPES scales

- Communication should be done using only the higher scoring

RADIATION PROTECTION EVENT SCALE



ACCIDENTS

INCIDENTS

Description of the event

Major Accident level 7

Serious Accident level 6

Accident level 5

Accident level 4

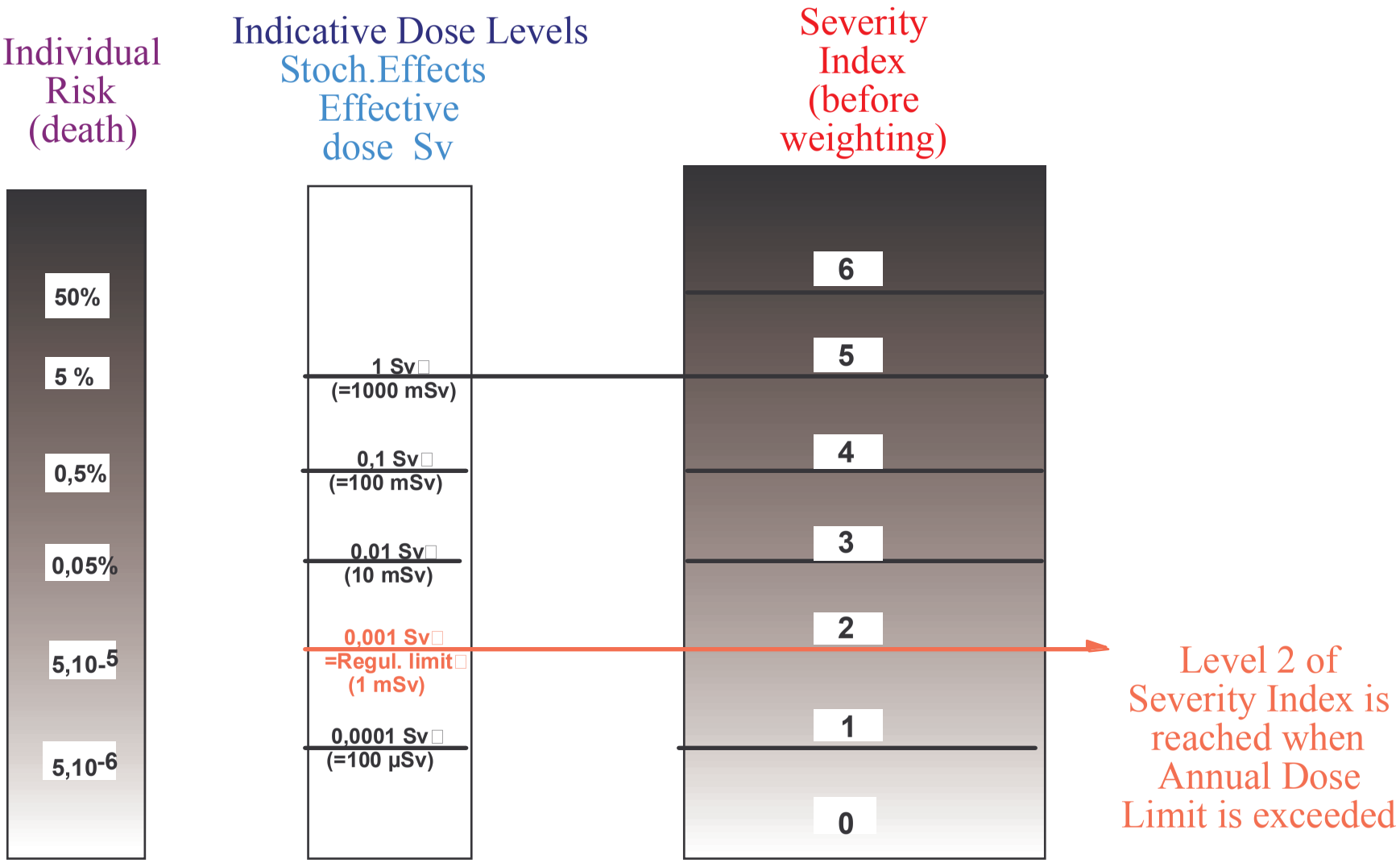
Serious Incident level 3

Incident level 2

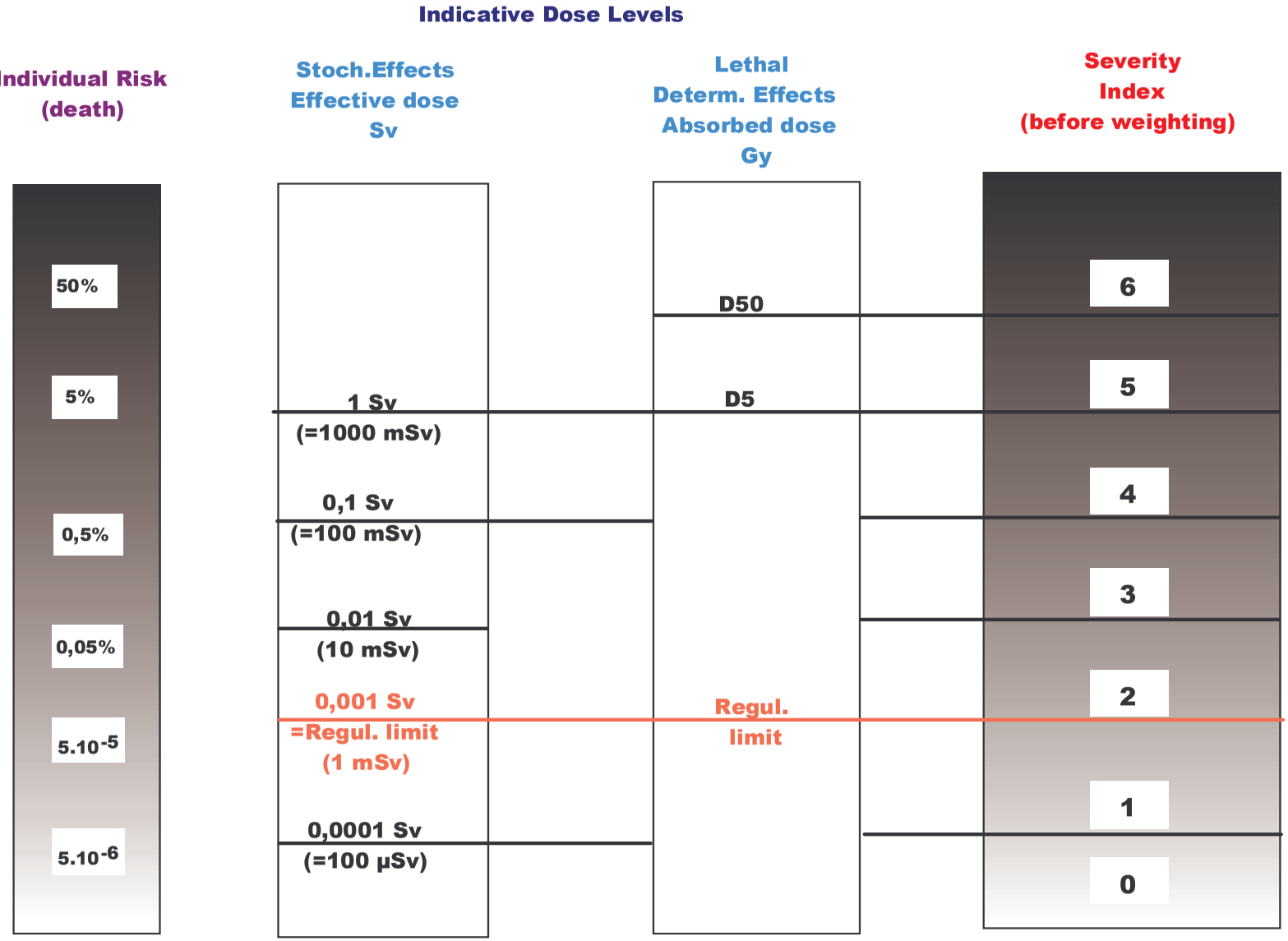
Anomaly level 1

Deviation (level 0)

RATING OF EVENTS FOR THE MEMBERS OF THE PUBLIC (1)
Stochastic Effects



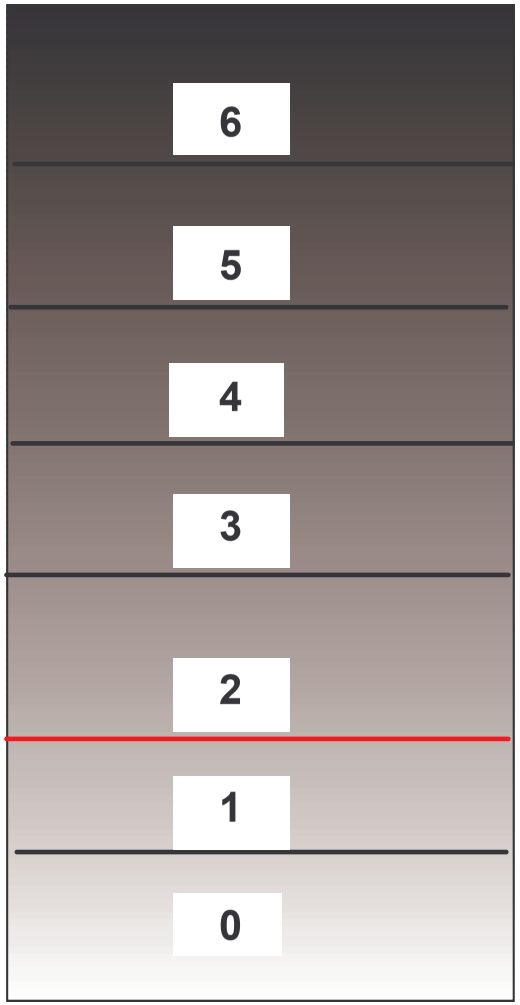
RATING OF EVENTS FOR THE MEMBERS OF THE PUBLIC (2)
Deterministic Effects (Lethal)



RATING OF EVENTS FOR THE MEMBERS OF THE PUBLIC (3)

Deterministic Effects (not Lethal)

Severity Index (before weighting)



Weighting factor

Severity of Deterministic Effec

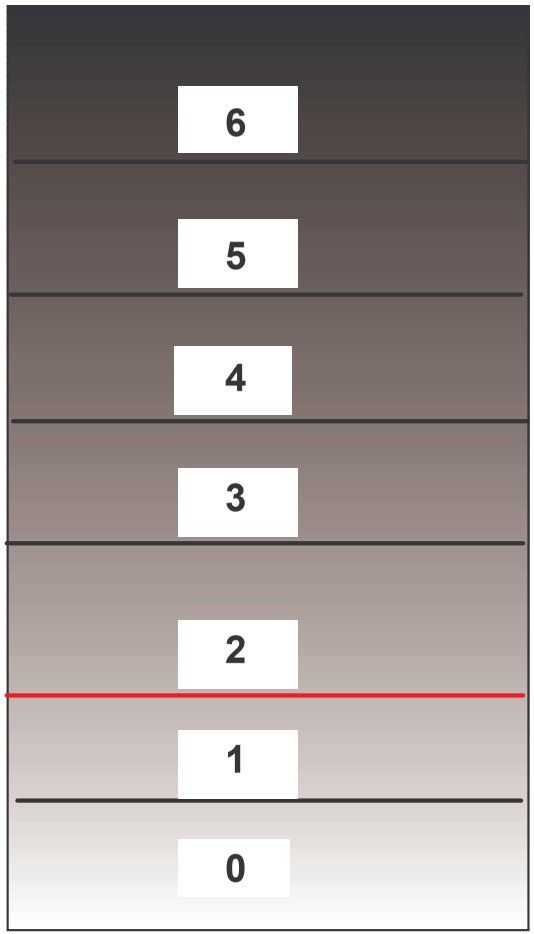
Not Lethal (disabling or not)

Not Lethal but disabling (-1)

Not Lethal and not disabling (-2)

RATING OF EVENTS FOR THE MEMBERS OF THE PUBLIC (4)
Several Individuals Exposed

Severity Index (before weighting)

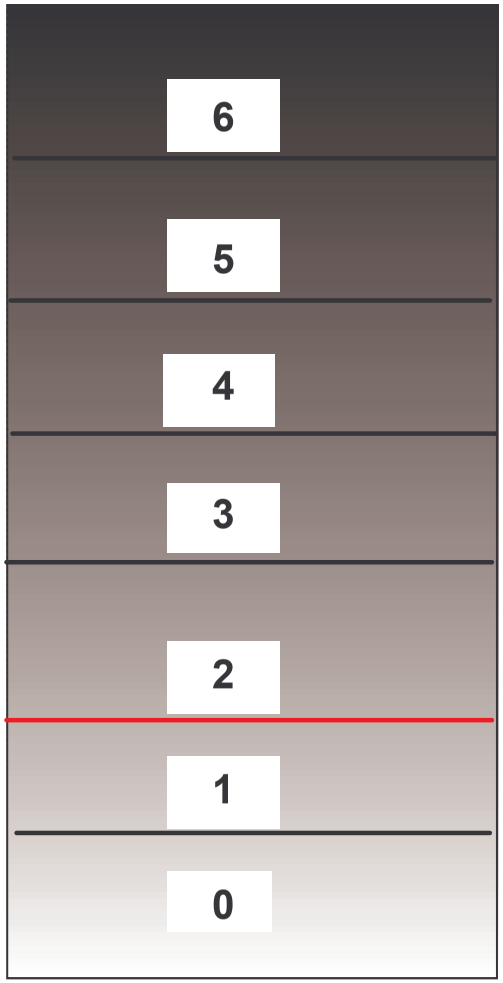


Weighting factor
Number of Exposed Individuals

+10 persons (+1)
+10 persons (+1) +100 persons (+2)

RATING OF EVENTS FOR THE MEMBERS OF THE PUBLIC(5)

Severity Index (before weighting)



Weighting factor Others

Potential Event

–

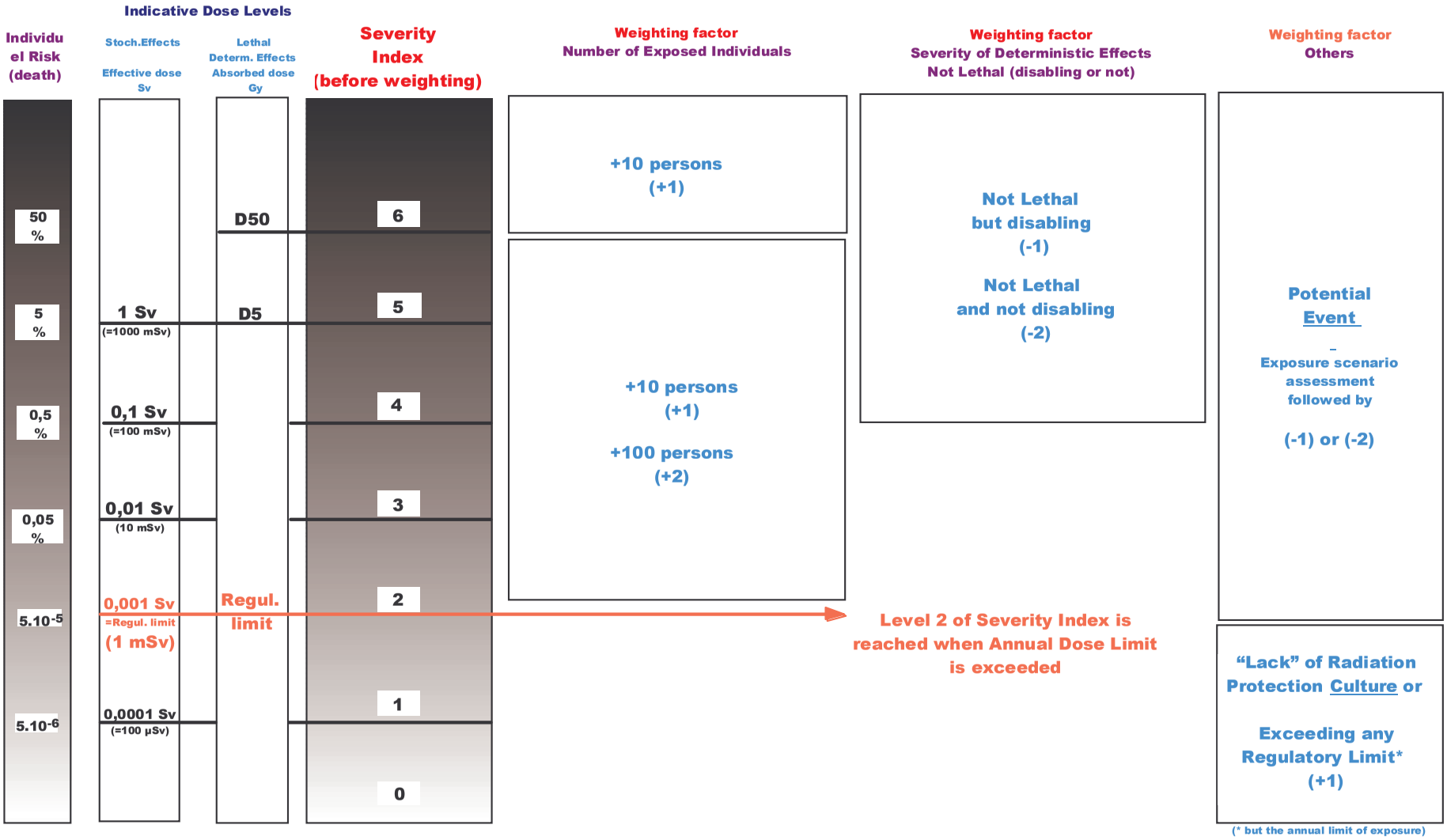
Exposure scenario assessment followed by

(-1) or (-2)

"Lack" of Radiation Protection Cultureor Exceeding any Regulatory Limit* (+1)

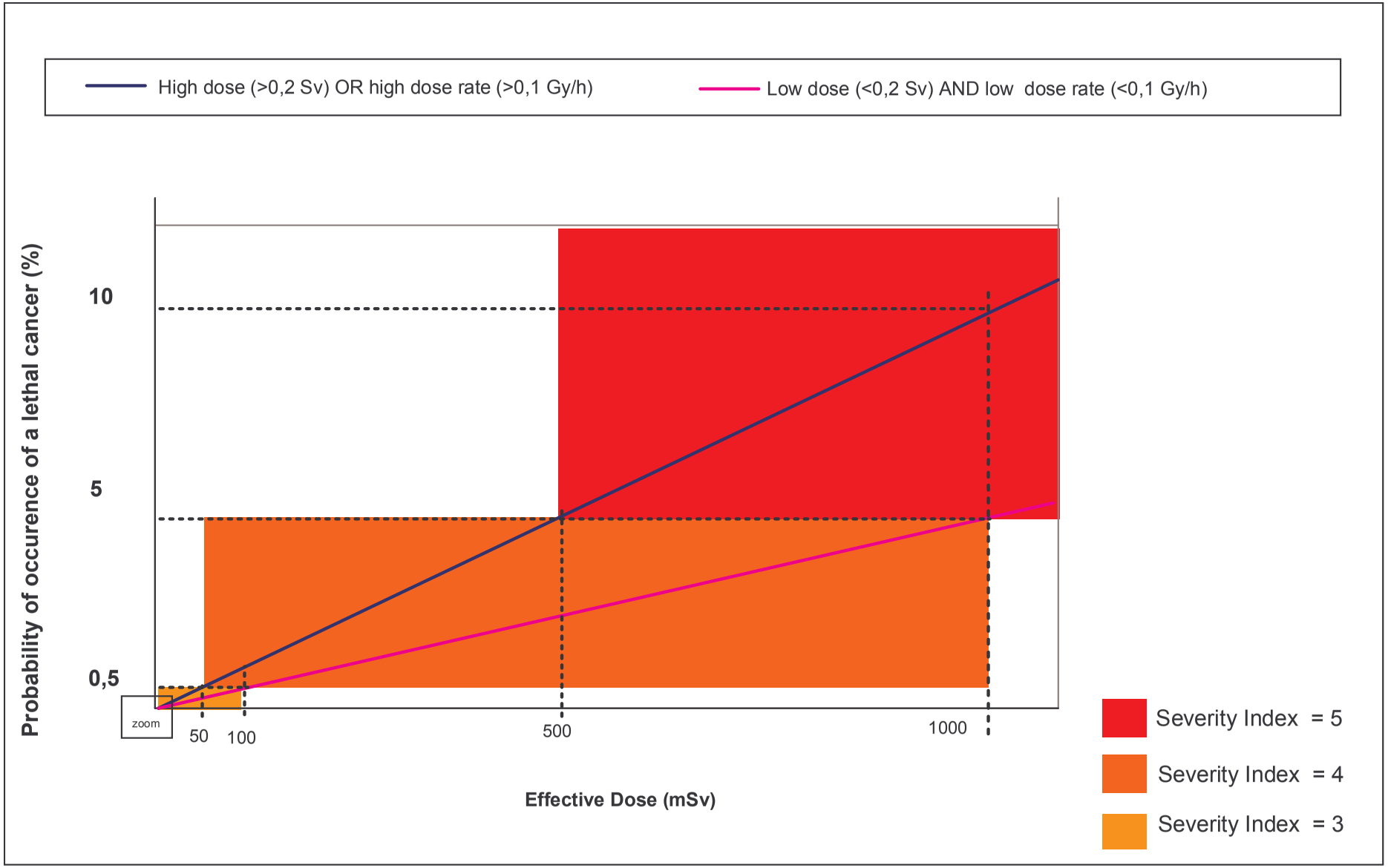
(* but the annual limit of exposure)

RATING OF EVENTS FOR THE MEMBERS OF THE PUBLIC* (6)

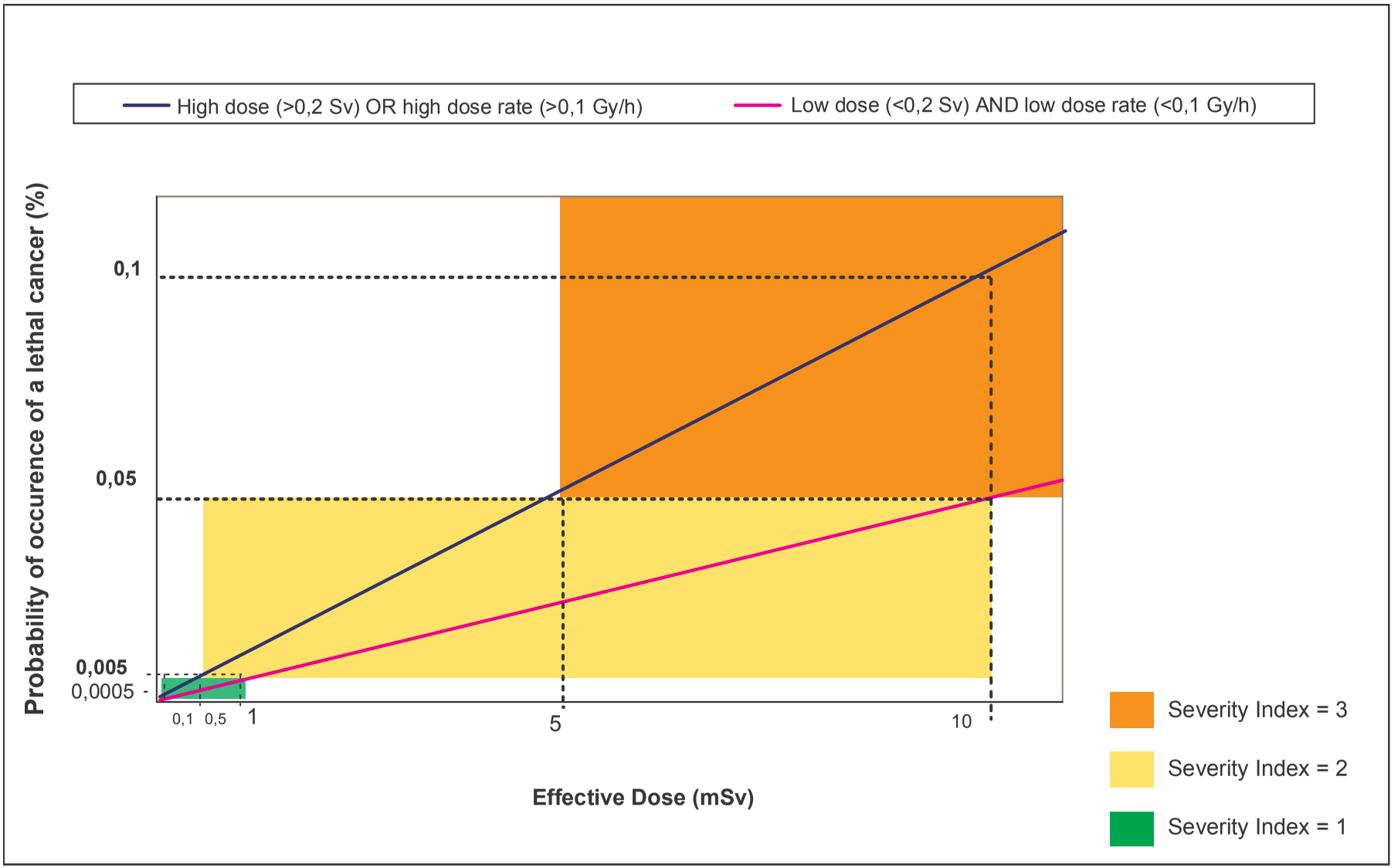


(*) In most cases, the Severity Index corresponding to a worker may be estimated using that synoptic and subtracting 1 to the resulting Severity Index Level

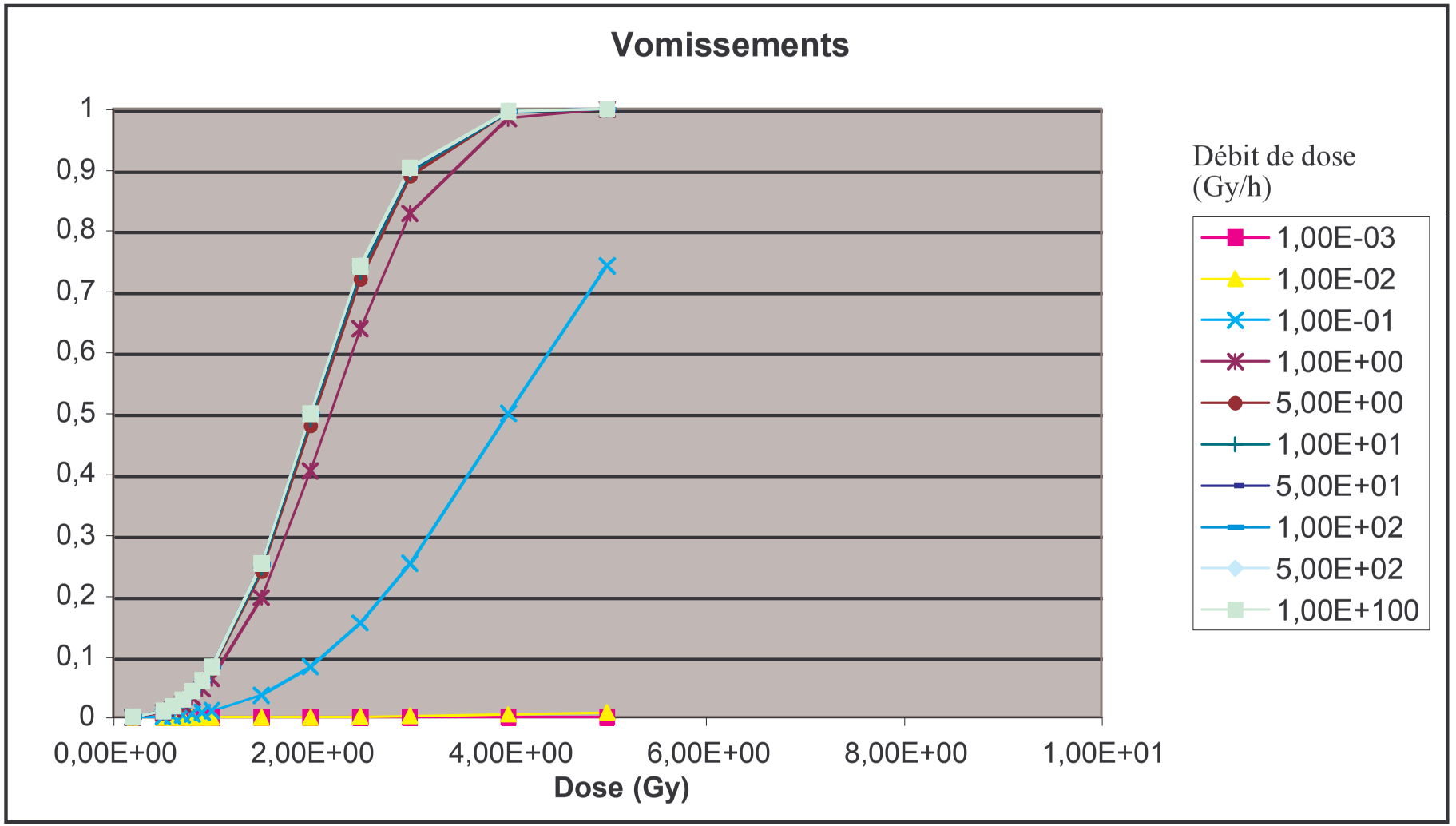
SEVERITY INDEX LEVEL OF THE SCALE
Lethal Cancer as a Function of Dose and Dose Rate



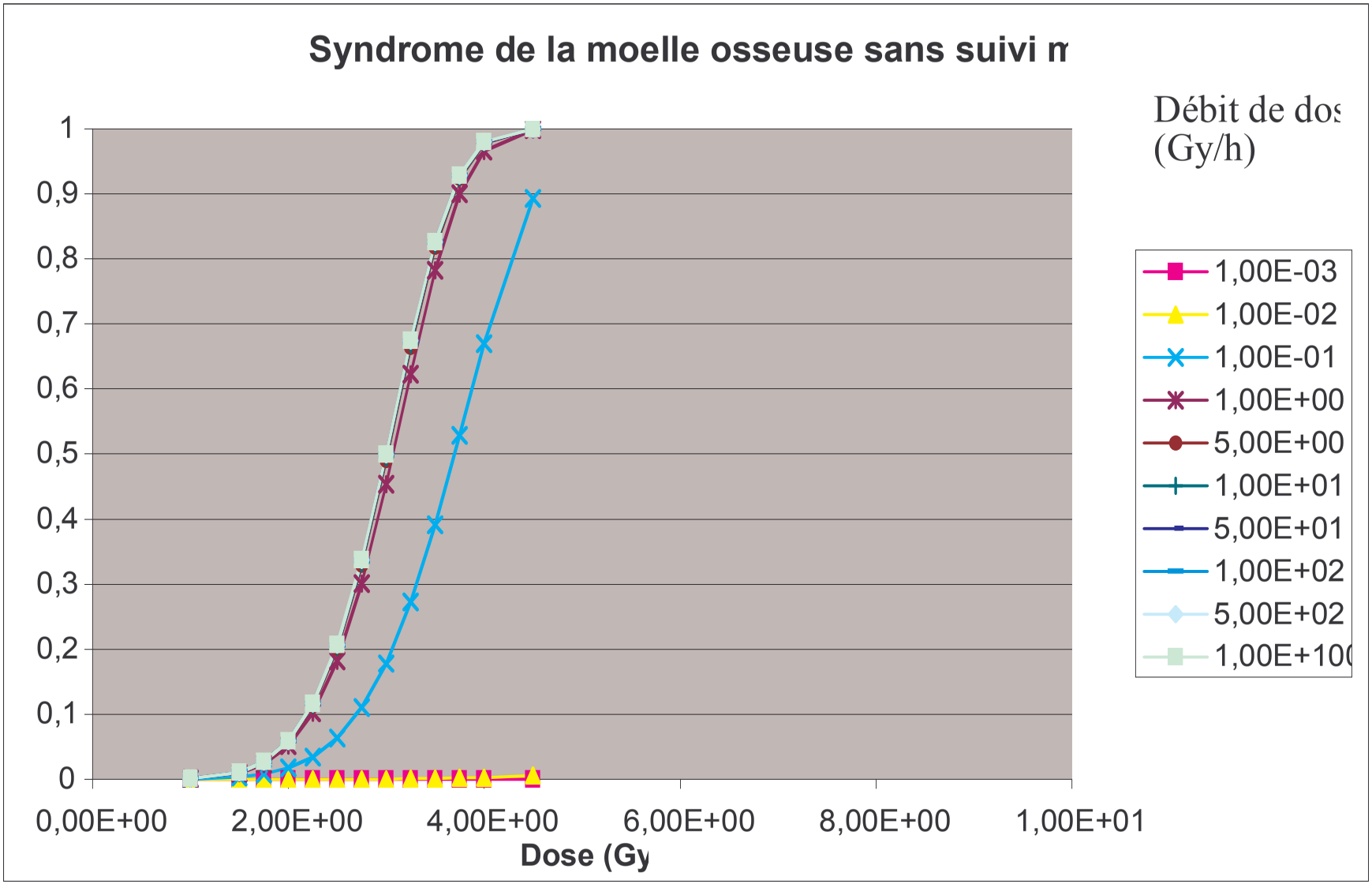
SEVERITY INDEX LEVEL OF THE SCALE
Lethal Cancer as a Function of Dose and Dose Rate
Zoom Doses < 10 mSv



Vomiting


Vomissements
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
0,00E+00
2,00E+00
4,00E+00
6,00E+00
8,00E+00
1,00E+01
Dose (Gy)
Débit de dose (Gy/h)
1,00E-03
1,00E-02
1,00E-01
1,00E+00
5,00E+00
1,00E+01
5,00E+01
1,00E+02
5,00E+02
1,00E+100

Bone Marrow Syndrom without medical follow up



- **Vomiting**

Dose (Gy) / Débit de dose (Gy	2,00E-01	5,00E-01	6,00E-01	7,00E-01	8,00E-01	9,00E-01	1,00E+00	1,50E+00	2,00E+00	2,50E+00	3,00E+00	4,00E+00	5,00E-
1,00E-03	6,73E-10	1,05E-08	1,82E-08	2,88E-08	4,31E-08	6,13E-08	8,41E-08	2,84E-07	6,73E-07	1,31E-06	2,27E-06	5,38E-06	1,05E-
1,00E-02	5,21E-07	8,14E-06	1,41E-05	2,23E-05	3,33E-05	4,75E-05	6,51E-05	2,20E-04	5,21E-04	1,02E-03	1,76E-03	4,16E-03	8,10E-
1,00E-01	8,66E-05	1,35E-03	2,34E-03	3,71E-03	5,53E-03	7,86E-03	1,08E-02	3,59E-02	8,30E-02	1,56E-01	2,54E-01	5,00E-01	7,42E-
1,00E+00	5,21E-04	8,10E-03	1,40E-02	2,21E-02	3,28E-02	4,63E-02	6,30E-02	1,97E-01	4,06E-01	6,38E-01	8,28E-01	9,84E-01	1,00E-
5,00E+00	6,53E-04	1,02E-02	1,75E-02	2,76E-02	4,09E-02	5,78E-02	7,84E-02	2,41E-01	4,80E-01	7,21E-01	8,90E-01	9,95E-01	1,00E-
1,00E+01	6,73E-04	1,05E-02	1,80E-02	2,84E-02	4,21E-02	5,95E-02	8,07E-02	2,47E-01	4,90E-01	7,31E-01	8,97E-01	9,95E-01	1,00E-
5,00E+01	6,89E-04	1,07E-02	1,84E-02	2,91E-02	4,31E-02	6,09E-02	8,25E-02	2,52E-01	4,98E-01	7,40E-01	9,02E-01	9,96E-01	1,00E-
1,00E+02	6,91E-04	1,07E-02	1,85E-02	2,92E-02	4,33E-02	6,10E-02	8,28E-02	2,53E-01	4,99E-01	7,41E-01	9,03E-01	9,96E-01	1,00E-
5,00E+02	6,92E-04	1,08E-02	1,85E-02	2,93E-02	4,34E-02	6,12E-02	8,29E-02	2,53E-01	5,00E-01	7,42E-01	9,03E-01	9,96E-01	1,00E-
1,00E+100	6,93E-04	1,08E-02	1,85E-02	2,93E-02	4,34E-02	6,12E-02	8,30E-02	2,54E-01	5,00E-01	7,42E-01	9,04E-01	9,96E-01	1,00E-

>D1
>D5
>D50

- **Bone Marrow Syndrom without medical follow up**

Dose (Gy) / Débit de dose (Gy	1,00E+00	1,50E+00	1,75E+00	2,00E+00	2,25E+00	2,50E+00	2,75E+00	3,00E+00	3,25E+00	3,50E+00	3,75E+00	4,00E+00	4,50E+
1,00E-03	4,58E-12	5,22E-11	1,32E-10	2,93E-10	5,94E-10	1,12E-09	1,98E-09	3,34E-09	5,40E-09	8,42E-09	1,27E-08	1,88E-08	3,80E-
1,00E-02	6,93E-07	7,90E-06	1,99E-05	4,44E-05	8,99E-05	1,69E-04	3,00E-04	5,05E-04	8,16E-04	1,27E-03	1,93E-03	2,84E-03	5,74E-
1,00E-01	2,70E-04	3,07E-03	7,73E-03	1,71E-02	3,44E-02	6,38E-02	1,10E-01	1,79E-01	2,73E-01	3,91E-01	5,28E-01	6,69E-01	8,94E-
1,00E+00	8,28E-04	9,39E-03	2,35E-02	5,16E-02	1,02E-01	1,83E-01	3,01E-01	4,53E-01	6,23E-01	7,82E-01	9,00E-01	9,66E-01	9,99E-
5,00E+00	9,24E-04	1,05E-02	2,62E-02	5,75E-02	1,13E-01	2,02E-01	3,30E-01	4,90E-01	6,64E-01	8,17E-01	9,24E-01	9,77E-01	1,00E+
1,00E+01	9,37E-04	1,06E-02	2,66E-02	5,82E-02	1,15E-01	2,05E-01	3,33E-01	4,95E-01	6,69E-01	8,22E-01	9,26E-01	9,79E-01	1,00E+
5,00E+01	9,48E-04	1,07E-02	2,69E-02	5,89E-02	1,16E-01	2,07E-01	3,36E-01	4,99E-01	6,73E-01	8,25E-01	9,28E-01	9,79E-01	1,00E+
1,00E+02	9,49E-04	1,08E-02	2,69E-02	5,90E-02	1,16E-01	2,07E-01	3,37E-01	5,00E-01	6,73E-01	8,25E-01	9,29E-01	9,80E-01	1,00E+
5,00E+02	9,50E-04	1,08E-02	2,69E-02	5,90E-02	1,16E-01	2,07E-01	3,37E-01	5,00E-01	6,74E-01	8,26E-01	9,29E-01	9,80E-01	1,00E+
1,00E+100	9,50E-04	1,08E-02	2,69E-02	5,90E-02	1,16E-01	2,07E-01	3,37E-01	5,00E-01	6,74E-01	8,26E-01	9,29E-01	9,80E-01	1,00E+

>D1
>D5
>D50

Example 1
TRICASTIN NPP

- March 99: during a refueling outage an HP technician entered without autorisation into a red zone. He staid there about 3 minutes nearby very active instruments. When going out, he suddenly noticed that his EPD indicated 340mSv
- Later on, his film badge has confirmed about 300 mSv

Example 1
TRICASTIN NPP

- Severity index before weigthing = 4
- Category of individuals = worker = - 1
- Nbr of people less than ten = no modification

- Classification on the RPES:

  serious incident level 3

  – It has been qualified in 1999 as INES level 2

Example 2
FEDEX

- 2002,01 France: during a transport of radioactive material between Sweden and USA, the monitoring of the doserate at the arrival showed an abnormal result : about 4 mSv/h at 25 meters. It appeared then that the plugs of 2 tubes with Iridium 192 pils in were not in place.
- The doses of 2 Roissy airport workers (not radiation trained nor classified) has been estimated around 15 mSv
- One month later complementary study results has reached about 100 mSv for one worker

Example 2
FEDEX

- First classification
- Severity index before weigthing = 3
- Category of individuals = public (not classified worker) = no modification
- Nbr of people less than ten = no modification
- Classification on the RPES:

serious incident level 3

  - It has been qualified in 1999 as INES level 3 by the Swedish regulatory body

Example 2
FEDEX

- new classification after dose reevalaution
- Severity index = 4

- Classification on the RPES:

  accident level 4

  – It has been qualified in 1999 as INES level 3 by the Swedish regulatory body

Example 3
Radiotherapy in POLAND

- 2001, Poland; after a cut off of electricity, a linear accelerator started again to be used for treatments without recalibration of the parameters.
- After complains from patients, the medical physicist has found dose rates 10 to 20 times higher than expected.
- During the following months five patients showed very important necrosis. At least two were nearby dying.
- LD > 50

Example 3
Radiotherapy in POLAND

- Severity index before weighing = 6
- Category of individuals = patient = public (?)
- No modifcation
- Nbr of individuals less than 10 ; no modification
- Classifation:

Serious accident level 6