Acceptable, tolerable, non-tolerable

Risks at the workplace

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BASF SE

GUS/TD – Hazardous Material Management
Different Exposure Situations

General Population:

Exposure duration, in total: 75 a
Annual Exposure: 52 w
Weekly Exposure: 7 d
Daily Exposure: 24 h
Exposure group: everybody including hypersensitive persons

Workplace situation:

Exposure: 40 a
Annual Exposure: 44 w
Weekly Exposure: 5 d
Daily Exposure: 8 h
Exposure group: healthy worker
Starting point of our Discussion

Report of the Federal Environmental Agencies in 1992:

- Risk from the 7 most important environmental carcinogens, in total:

<table>
<thead>
<tr>
<th>Urban population</th>
<th>Rural population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 : 1,000/Pt</td>
<td>1 : 5,000/Pt</td>
</tr>
</tbody>
</table>

The risks for the urban population was assessed as being to high.

**Goal:** adaptation to situation of the rural population

**Intermediate step:**

Urban population : 1 : 2,500/Pt
## Risk from X-ray examination

<table>
<thead>
<tr>
<th>Kind of examination</th>
<th>Risiko</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand</td>
<td>1 : 10 Millionen</td>
</tr>
<tr>
<td>Elbow, knee</td>
<td>1 : 1 Million</td>
</tr>
<tr>
<td><strong>Lung, cervical spine, skull</strong></td>
<td><strong>1 : 100,000</strong></td>
</tr>
<tr>
<td>Thoracic spine, hip, mammography</td>
<td>1 : 40,000</td>
</tr>
<tr>
<td>Lumbar spine, abdomen, CT- head</td>
<td>1 : 10,000</td>
</tr>
<tr>
<td>Stomach and small intestine (radiography), CT-spine</td>
<td>1 : 2,000</td>
</tr>
<tr>
<td>Large intestine and artery (radiography), CT-thorax</td>
<td>1 : 1,000</td>
</tr>
</tbody>
</table>

Additional mortality risk by one time X-ray examination
Source: Prof. Jung, Uni Hamburg
Radiation Safety Regulation

Accepted maximum annual radiation dose for employees:

⇒ 20 mS/a

Accepted maximum lifetime radiation dose for employers:

⇒ 400 mS

⇒ additional risk cancer: 2 : 100/Wt

Natural Radiation Exposure

⇒ radiation dose: 1 mS/a

additional risk cancer: 4 : 1,000/Pt
## Lethal risks in different branches of economy

<table>
<thead>
<tr>
<th>Branch</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forestry</td>
<td>2.5 : 1,000 /Wt</td>
</tr>
<tr>
<td>Agriculture</td>
<td>3 : 1,000 /Wt</td>
</tr>
<tr>
<td>Construction</td>
<td>2 : 1,000 /Wt</td>
</tr>
<tr>
<td>Mining</td>
<td>3 : 1,000 /Wt</td>
</tr>
<tr>
<td>Retail</td>
<td>4 : 10,000 /Wt</td>
</tr>
</tbody>
</table>
Common substances risks of every day life

Arsenic in drinking water (10 µg/l)  \[5 : 10,000/Pt\]

Dioxin in food (2 pg Teq/kg)  \[3 : 10,000/Pt\]

Diesel engine emissions (5 ng BaP/m³)  \[2 : 10,000/Pt\]

Cadmium in environmental dust  \[2 : 100,000/Pt\]
Different kind of Carcinogens

A Carcinogen Cat. 1A, 1B or 2 can be quite different!

- **Category 1A, 1B**
- **Category 2B**
- **Category 4**
- **Category 5**

- **genotoxic carcinogens**
  - have usually **no threshold**

- **non-genotoxic Carcinogens**
  - have a **threshold**
Accepted risks in different countries, e.g. NL (DECOS), USA (EPA)

1 : 1,000,000 Pt

Calculated for the workplace situations, based on the same exposure dose:

4 : 100,000 Wt
Risk Thresholds in Germany

Tolerable Risk: 4 : 1,000 Wt

Tolerable Risk:
Threshold, above which employees should not be exposed

Acceptable Risk (intermediate, until 2018: 4 : 10,000 Wt)
from 2019: 4 : 100,000 Wt

Acceptable risk:
Risk at the workplace without any additional safety measures required by the agencies
Safety measures concept

Division into 3 risk areas:

**High risk:** above tolerable limit

**Medium risk:** between acceptable and tolerable limit

**Low risk:** below acceptable limit
Priorisation of the different measure options in dependence of the risk

- Background concentration
- Acceptable risk
- Tolerable risk

Increased necessity of risk reduction measures

Importance of socio-economic criteria

Basic measures

Area of safety measures

Risk
Consideration: state of technology

Procedure is needed, if state of the technology is

⇒ below tolerable concentration

or even

⇒ below acceptable concentration

General principle:

⇒ prohibition of degradation

⇒ former German TRK-values are not allowed to exceed
Comprehensive concept

Acceptable and tolerable concentration:
⇒ defined as TWA (time-weighted-average) for 8 h shift

Peak exposure:
⇒ Short time exposure limits (STEL) are established additionally, if needed

Different assessment duration:
⇒ For particles without acute (to chronic) health effects:
  ⇒ assessment duration > shift are in discussion
Comprehensive concept

Consideration of background concentration (ubiquity):  
⇒ procedure, if background concentration is above acceptable concentration  
⇒ nitrosamines

Analytical limitations:  
⇒ procedure, if detection limit is above acceptable concentration and can not be reached with reasonable effort  
⇒ fibres, nitrosamines

Endogenous carcinogen:  
⇒ Consideration of endogenous produced carcinogens  
⇒ ethylenoxide
Risks at the workplace

Assessment of risks at the workplaces
- a task for **real** experts -

*Thank you very much for your attention!*