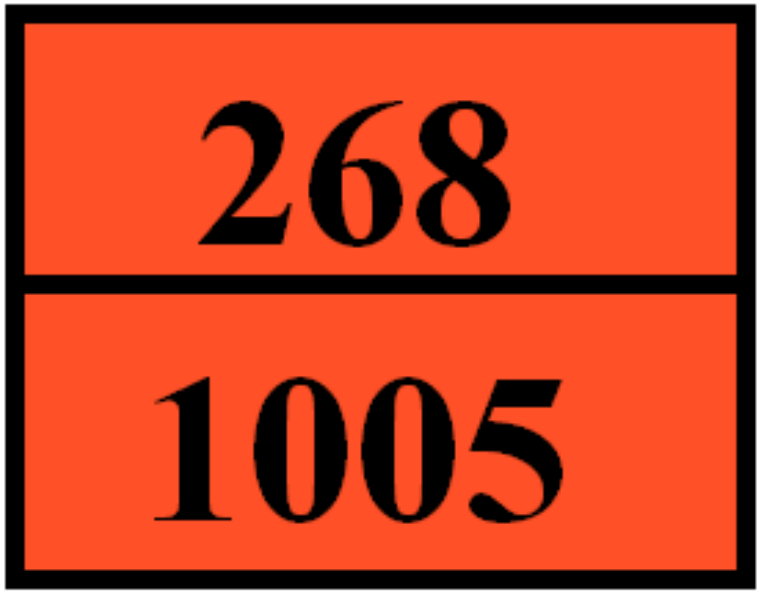
# Decision Support

*Hazard Identification Number*

- The number on top explains the dangers with the substance. The same number twice enhances the danger.
- The number at the bottom is an ID of the substance.




1005 is the ID of ammonia.

2 Gas

3 Flammable liquid

4 Flammable solid substance

5 Oxidizing

6 Risk of poisoning

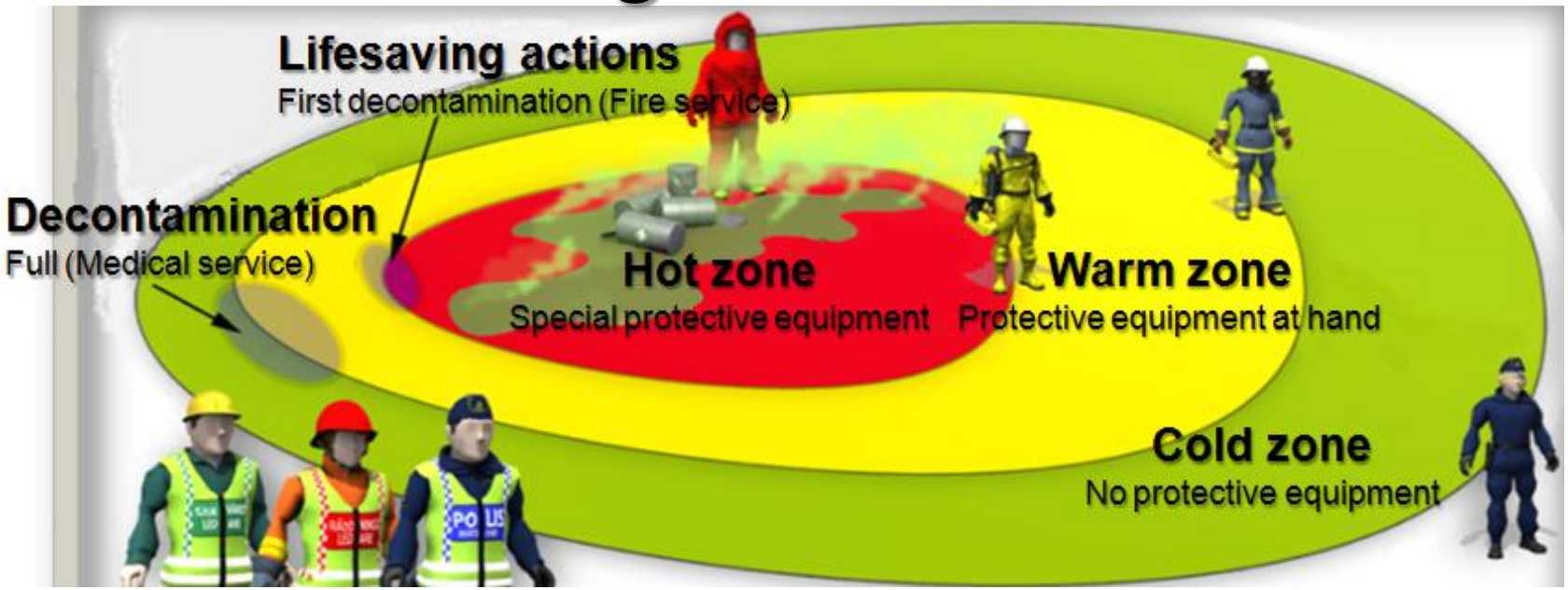
7 Risk of radioactivity

8 Risk of corrosive damages

9 Risk of spontaneous, rapid reaction.

X Reacts dangerously with water

# Life saving decontamination




1. **Evacuate the victim**

Considerations

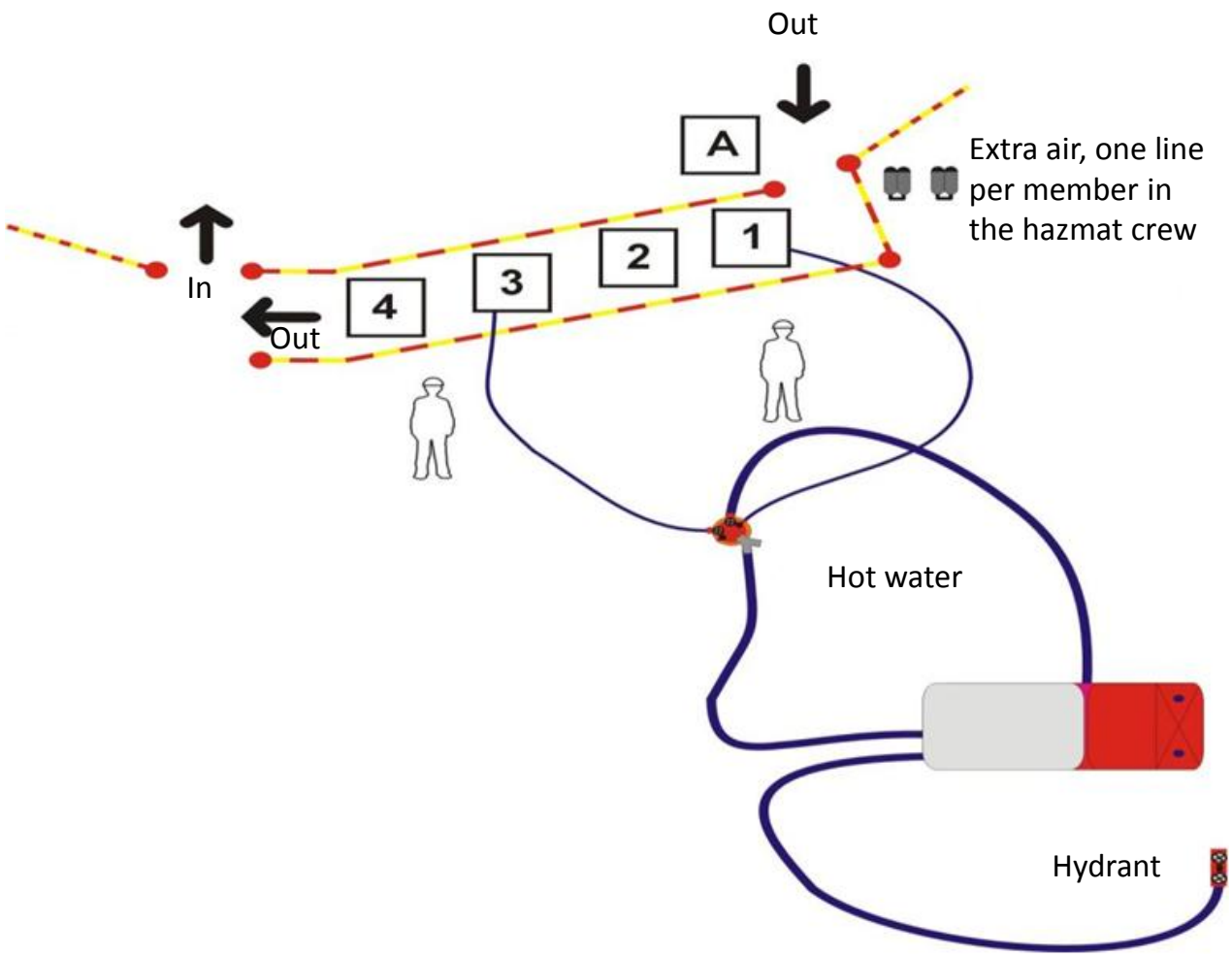
- Surroundings
- Wind direction
- Base point
- Ground angle
- Wells, drains

# Decontamination of rescue personnel

**Consider:**

- Disposal of contaminated water.
- Hazmat crew should be able to decontaminate themselves.
- Extra air for breathing apparatus at hand.

# Organisation




A. Drop of point; equipment, cold covers etc.

1. First with water decontamination; dirt, saw dust etc.

2. Second with soap decontamination, possibly with detergents.

3. Rinsing

4. Check

# Example of a decontamination route

# Life saving decontamination

**9. Physical and Chemical Properties**

| PARAMETER | VALUE | UNITS |
|---|---|---|
| Physical state (gas, liquid, solid) | : Gas | |
| Vapor pressure at 70°F | : 94 | psia |
| Vapor density at 60°F (Air = 1) | : 0.62 | |
| Evaporation point | : Not Available | |
| Boiling point | : -28 | °F |
| | : -33.3 | °C |
| Freezing point | : 107.9 | °F |
| | : -77.7 | °C |
| pH | : Not Available | |
| Specific gravity | : Not Available | |
| Oil/water partition coefficient | : Not Available | |
| Solubility (H20) | : Very soluble | |
| Odor threshold | : Not Available | |
| Odor and appearance | : A colorless gas with a pungent odor. | |

**Hot water:**

Fire truck

Tank truck

Water heaters

**4. Some substances could be rinsed of.**

**Check if the substance is soluble in water.**

- Hot water +25-30°C.
- 30 minutes could be necessary.
- Minimum 20 liters/minute.
- Protect from wind and low temperatures, use blankets.

# Damage reduction

- Damming
- Sealing
- Collecting
- Recondensation
- Washing down and steering
- Chemical methods
- Hindering of free fall

# Damming

**Damming**

- Reduce further spreading.
- Resistance of the equipment towards the chemicals.
- Density
- Solubility

# Sealing

**Sealing**

- Reduce or stop further spreading.
- Source strength >1 bar could be difficult.
- Characteristics of the chemicals – toxic, flammable, risk of explosion, corrosive etc.

# Sealing

**Equipment:** Wedges, load binders, plates, sealing cushions, drainable cushions, outer pipe sealers, inner pipe sealers, hoses, spatulas, hydraulic tools,  drain sealer sacks, hand held tools.


# Sealing

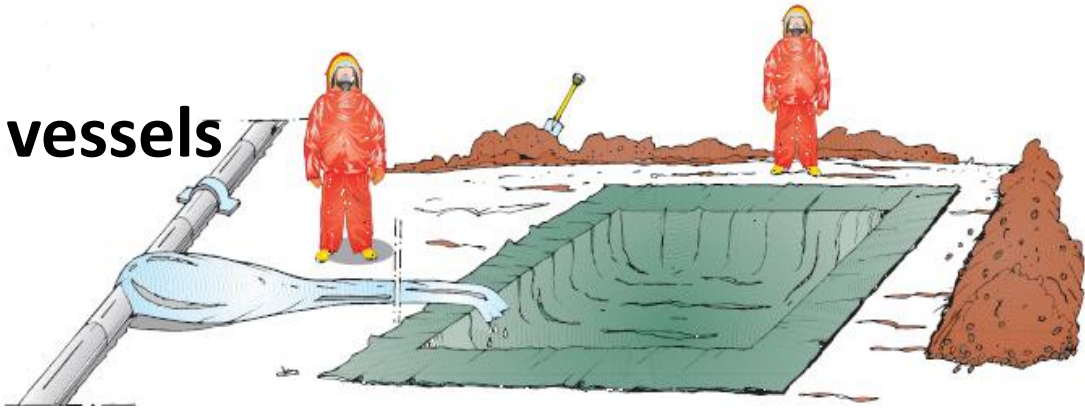
**Hydraulic pipe press**

- Clamping bars
- Hydraulic forced piston
  - + Extra clamping bars
  - + Pump

# Collecting

**Equipment – collection vessels**

- Wide resistance
- Easy to transport
- Easy to “build”
- Durable
- Easy to empty
- Easy to clean



# Recondensation

**Recondensation**

- Condensed or liquefied gases
- Great dangers, cold
- Large danger zones
- Reduced spread
  – smaller danger zone
- Non-flammable
- Gas or liquid phase

# Recondensation

**Equipment:** Funnel, tarpaulins, rope, magnets, load binders, collection vessels.

# Washing down and steering

**Washing down and steering**

- Dilute the gas cloud – smaller danger zone
- Solubility
- A lot of water
- Life saving actions
- Additives – chalk, sodium thiosulfate

# Washing down and steering

**Equipment:** Nozzles, hoses, water cannons.

# *Damage reduction*

**Difficult!**

**Best of several bad possibilities.**

**Safety first.**

# As good as it gets!

# Class 2 Gases

## Classification


### Toxic gases

- Ammonia $NH_3$
- Chlorine $Cl_2$
- Sulfur dioxide $SO_2$
- Nitrate dioxide $NO_2$
- Hydrochloric $HCl$

# Class 2

## Toxic gases


***Accidents with toxic gases creates a risk of:***

***Intoxication***

***Frostbite***

***Corrosive damages***

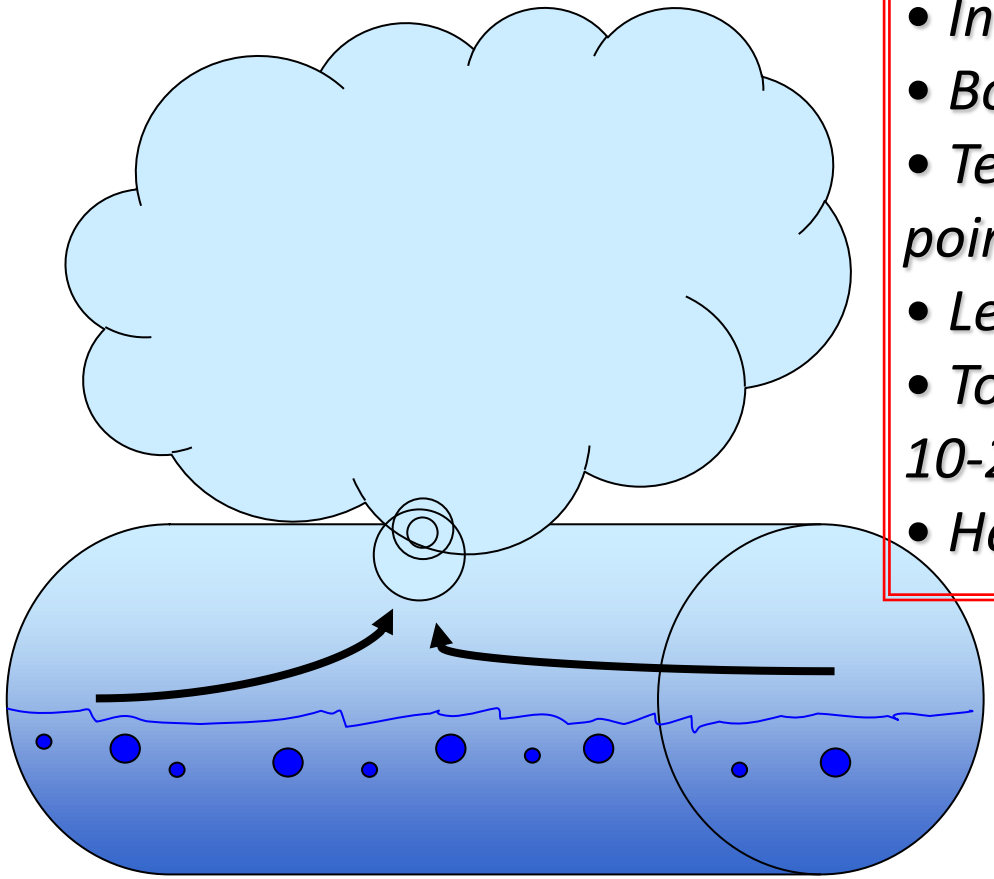
# Class 2 Gases

## Dispersal liquid/gas

*1 liter liquid gives*
*1000 l ammonia*
*450 l chlorine*
*450 l sulfur dioxide*
*250 l propane*

# Class 2 Gases

## *Vapour leakage*

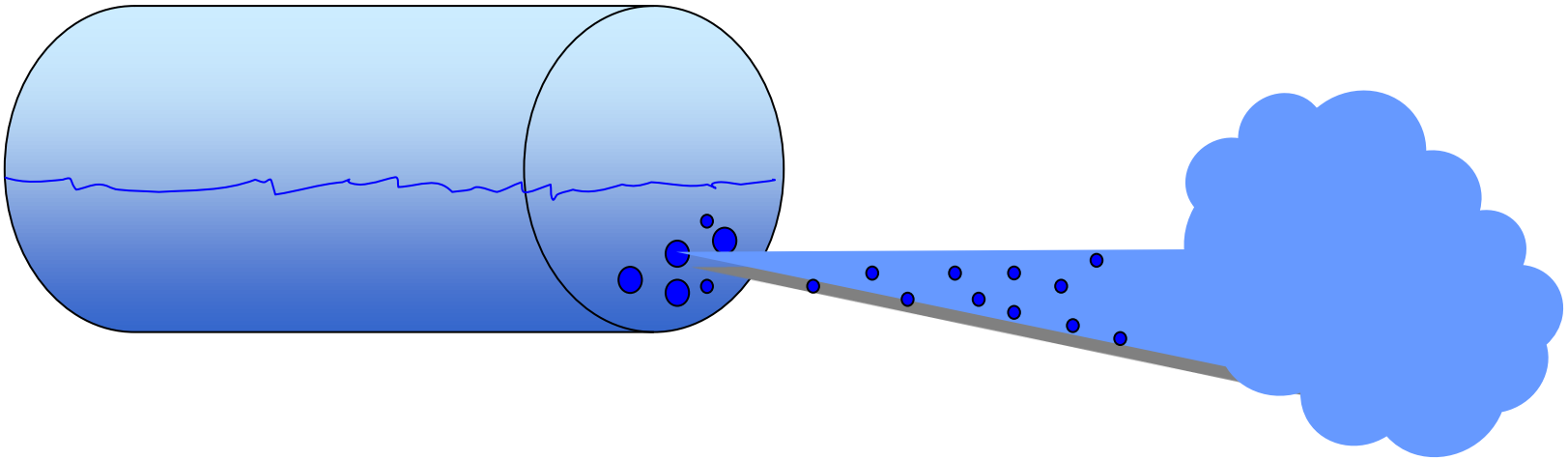


- *Initially intensive course.*
- *Boiling consumes energy.*
- *Temperature goes towards boiling point.*
- *Leakage reaches pivot point.*
- *Total amount lost about 10-20%.*
- *Heard but not seen*

# Class 2 Gases

## *Leakage in liquid phase*

- *Ammonia leaves in liquid form.*
- *Jet beam of gas/aerosol.*
- *Continues until the liquid surface reaches the leakage point.*
- *Pressure is constant.*
- *Escape velocity up to 100 m/s.*

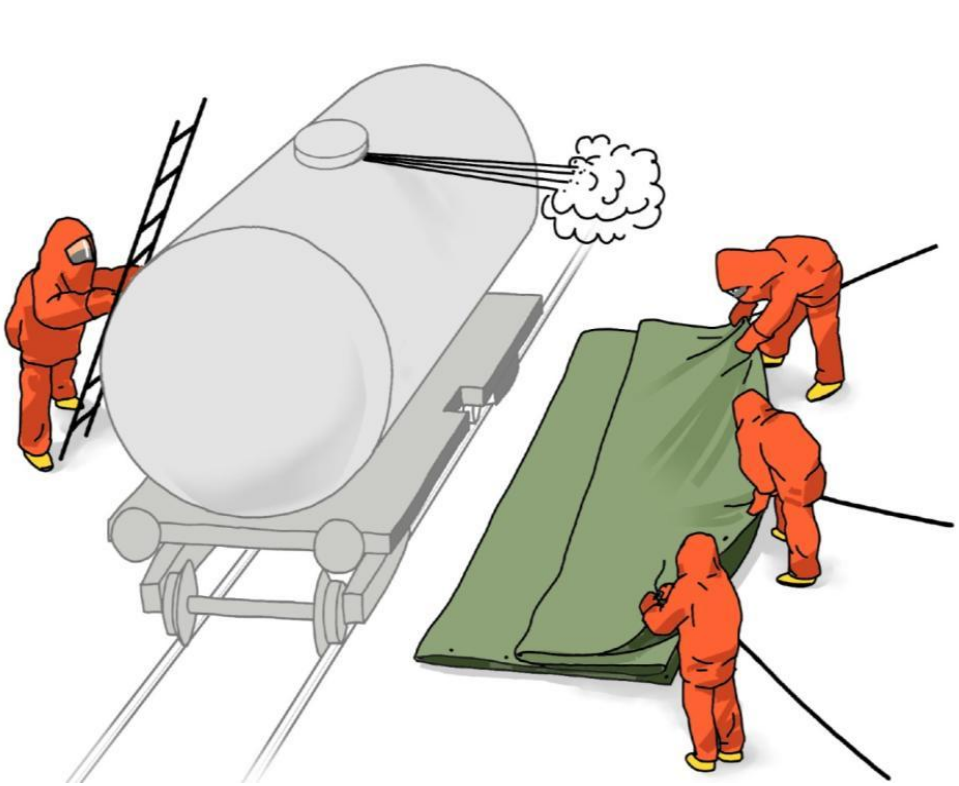



# Protection

**Full cover chemical suit and breathing apparatus (enhanced with cold cover if there is a risk of direct contact with liquefied gases).**

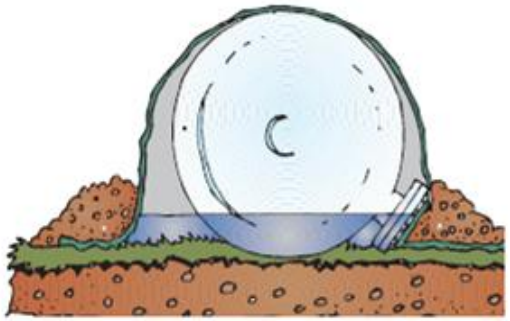
# Class 2 Gases

## Recondensation



# Class 2 Gases

## *Recondensation*



# *Actions at the scene of accident*


- Identify hazards and determine size of danger zone.
- Determine level of protection.
- Perform life saving actions.
- Evacuate and cordon off the danger zone.
- Perform recondensation.
- Wash the gas down if it is soluble in water (more than 10% solubility).
- Close valves and taps if possible.
- Isolate from the ground and cover the liquid to prevent vapourization of recondensated cold liquid.
- Turn the canister to shift the leakage from liquid form to gas phase form.
- Close the breach.
- Confirm size of the danger zone through measuring and indicating.
- Do not put water on canisters since that will give heat and increase vapourization and leakage speed.

# Consider the hazards

Shockwave

Lack of oxygen

Frostbite

Corrosive damages

Shrapnel

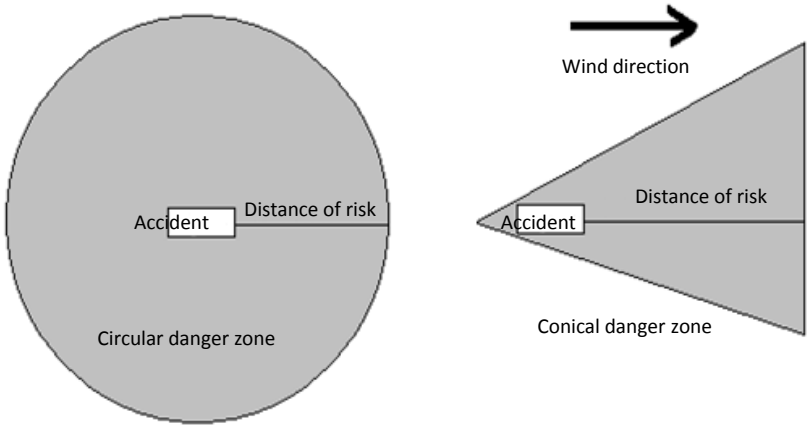
Ionizing radiation

Infection

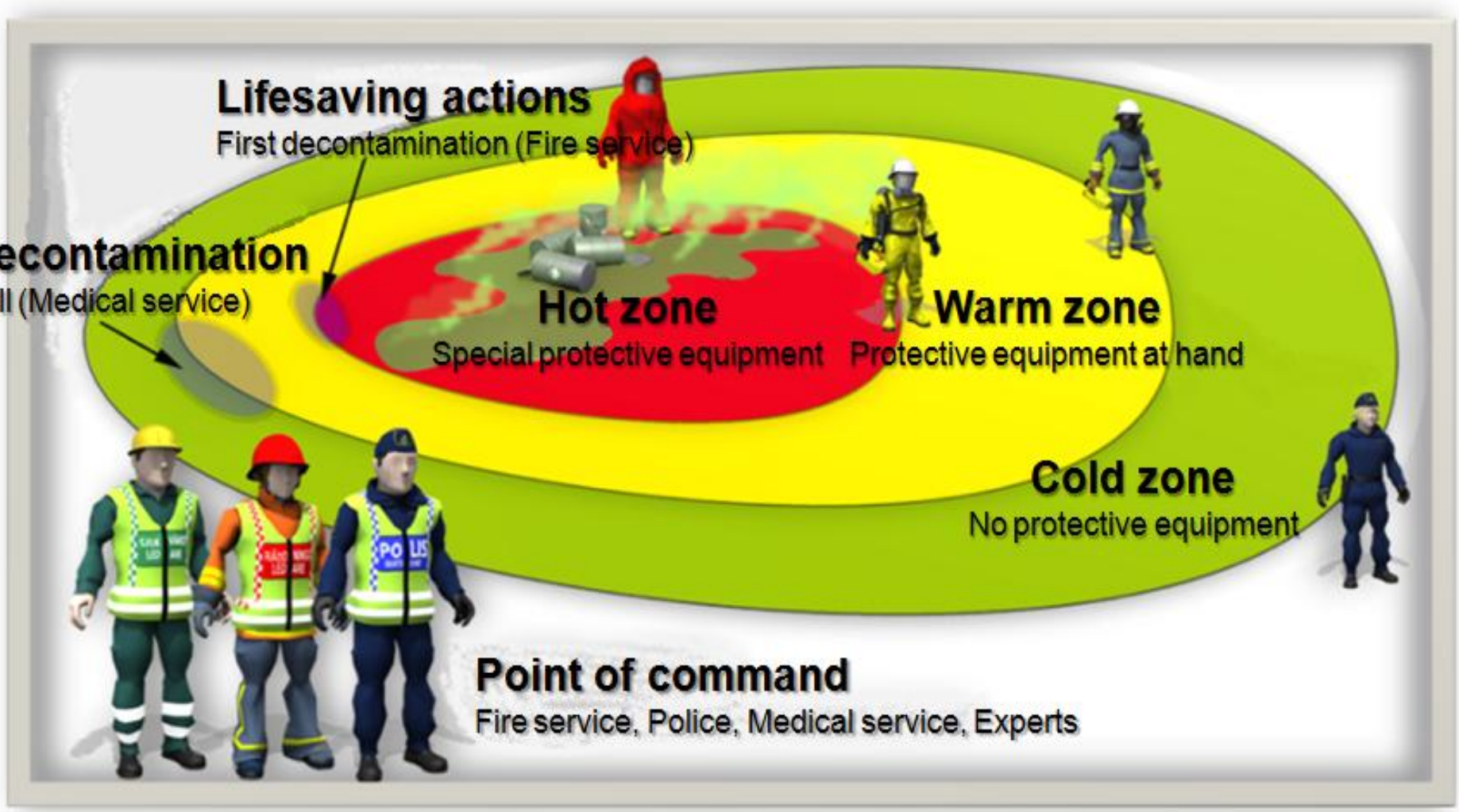
Intoxication

Heat radiation

# Determine danger zone and level of protection




# Different fields of the danger zone



# Level of protection

1. Fire protection clothing and breathing apparatus.

2. Fire protection clothing and breathing apparatus enhanced with splash cover.

3. Full cover chemical suit. (Non-encapsulating and encapsulating).

Full cover chemical suit enhanced with cold cover.

# Level of protection

**1. Fire protection clothing and breathing apparatus.**

- Life saving actions.
- Danger of fire or explosion.

- Outer garment.
- Helmet.
- Fire protection hood.
- Under garment (wool, cotton).
- Fire gloves.
- Boots (non-static).

# Level of protection

**2. Fire protection clothing and breathing apparatus enhanced with splash cover.**

- Enhanced risk of getting splashed.
- One use only or dual use.
- Easy to put on.
- Should not obstruct vision.
- Should not obstruct work to much.
- Possibility to read manometer and to reach reserve air switch.
- Check chemical resistance.

# Level of protection

**3. Full cover chemical suit, non-encapsulating.**


- Gas- and liquid sealed.
- Over pressurized 2-30 liters/min.
- Connection for rescue air hose and rescue mask.
- Possibility to read manometer and to reach reserve air switch.
- Check chemical resistance.
- Undergarment should be worn underneath.

- Not suitable if there is a risk of fire or explosion.
- Extra gloves – hands are a weak spot; low temperatures, tears.

# Level of protection

**3. Full cover chemical suit, encapsulating.**

- Gas- and liquid sealed.
- Over pressurized 2-30 liters/min.
- Connection for rescue air hose and rescue mask.
- Possibility to read manometer and to reach reserve air switch.
- Check chemical resistance.
- Full fire protection clothing to be worn underneath.
- Extra gloves – hands are a weak spot; low temperatures, tears.

# Level of protection

**Full cover chemical suit enhanced with cold cover.**

- Liquefied gases.
- Extremely low temperatures.