Development of Hazard Ratings

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Introduction

- **Our purpose is to develop consistent hazard ratings for both pure chemicals and chemical products (mixtures).**

- **Other rating systems such as HMIS and GHS will be contrasted.**

The Need for Hazard Ratings

- **Method of communicating the hazards present in a product and/or location through standardized labeling**
  - **Relative health risk for an acute exposure only!**
  - **Does not necessarily correlate with PELs, TLVs, BEIs, TEELs, ERPGs, or AEGLs!**
- **Utilized as part of the screening criteria for EPHAs**
  - **DOE O 151.1C**

Various Methods / Schemes in Use

- **NFPA 704** – ***Standard system for the Identification of the Hazards of Materials for Emergency Response***
- **HMIS** – ***Hazardous Materials Information System***
- **GHS** – ***The Globally Harmonized System (GHS) for Hazard Classification and Labelling of Chemicals (UN)***
- **CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act (Superfund): implemented by the U.S. Environmental Protection Agency (EPA).**
- **Mfr. Specific**

Purpose of Each Method

- **NFPA 704 – Relative Hazard Level in A Fire / Emergency Situation.**
- **HMIS – Relative Hazard Level for Someone Using the Product.**
- **GHS – Relative Hazard Level for Someone Using the Product.**
- **CERCLA - Relative Hazard Level for Someone Using the Product & Biodegradability.**
- **Mfr. Specific - Relative Hazard Level for Someone Using the Product.**

NFPA 704

- ***"Standard System for the Identification of the Hazards of Materials for Emergency Response"*** **is used as the basis.**

- **Provides a numeric value "0" (minimal hazard) to "4" (extreme hazard) for:**
  - **Health (toxicological and / or physical)**
  - **Fire**
  - **Instability (formerly reactivity)**
  - **Special**
    - **Water reactivity**
    - **Oxidizer**
    - **Simple Asphyxiant**
    - **Combination of above**

  - **We recommend expanding the scope of the special hazard block to include explosive, reproductive toxin, carcinogen, developmental toxin, and polymerizes.**

NFPA & HMIS

- **Well defined, moderately well understood, widely used.**
- **Number scale indicates the degree of relative hazard**
- **Ranges:**
  - **“0” (minimal hazard) to “4” (extreme hazard).**

- **Health Rating Compatibility:**
  - **Pre 2001 – may differ significantly**
  - **Post 2001 – similar criteria for toxicology, treat physical hazards differently**

Current NFPA / HMIS Compatibility

- The NFPA 4, 3, and 2 health hazard rankings for oral, dermal, and inhalation toxicity are based primarily on UN criteria.
- The 1 and 0 health hazard rankings for oral, inhalation toxicity, and all the “skin/eye contact” rankings are based primarily on HMIS criteria.
- NFPA does not distinguish between toxicological and physical hazards, HMIS does.
- HMIS has a chronic component, NFPA does not.
- NFPA looks at products of combustion and interactions with extinguishing products, HMIS does not.

GHS

- Fairly wide acceptance, adopted by EU.
- Number scale indicates the degree of relative hazard
- Ranges:
  - “5” (minimal hazard) to “1” (extreme hazard).
- Very prescriptive
- Philosophy similar to HMIS

CERCLA

- Similar to NFPA 704
- Scale 0 to 3
- NFPA 3 & 4 = CERCLA 3
- Rating for “Persistence”

Glimpse of Reality

Sodium Hydroxide (Solid) (LD 50 – 4090 mg/kg)

Method	Health	Fire	Instability	Reactivity / Special
• NFPA	3	0	1	- (Water / Special)
• HMIS	3*	0	N/A	0 (Phy Haz)
• GHS	2	0	N/A	0 (Reactivity)
• Mfr.	3,4	0	N/A	3 (Reactivity)
• CERCLA	3	0	N/A	0 (Reactivity)

- * HMIS Has an "*" For Chronic Issues
- * HMIS III Gives an Acute & Chronic Health Rating

SARA Title III

- **SARA Title III categories are determined:**
  - **Acute (immediate) (toxicological and / or physical)**
  - **Chronic (delayed)**
    - **Carcinogen**
    - **Reproductive**
    - **Developmental**
  - **Fire**
    - **Flammable / combustible**
    - **Oxidizer**
    - **Pyrophoric**
  - **Pressure**
    - **Gas - including aerosols and liquefied gases**
    - **Explosive**
  - **Reactivity**
    - **Unstable Reactive**
    - **Organic Peroxide**
    - **Water Reactive (Heat and / or Flammable Gas Production)**

Target Organs

- **Target organ orientated systemic toxicity**
  - **Liver**
  - **Kidney**
  - **Nervous system (CNS, Brain)**
  - **Blood system (blood, spleen, bone marrow)**
  - **Heart (heart, circulatory system)**
  - **Reproductive system**
  - **Skin**
  - **Eye**
  - **Lung (lung, respiratory tract, mucous membrane)**

Health Hazards Evaluated

- **Both physical and toxicological**

- **Acute toxicity**
  - **LC / LD-50**
  - **skin irritation / corrosion / burns**
  - **eye irritation / corrosion / burns**
  - **respiratory sensitization / corrosion / burns**
  - **skin sensitization**
  - **target organs**

Health Hazards Evaluated

- **Both physical and toxicological**

- **Chronic toxicity**
  - **mutagenicity**
  - **cancer**
  - **tumorigenic**
  - **teratogenicity**
  - **reproductive toxicity**
  - **developmental toxin**
  - **neurotoxicity**
  - **target organs**

Physical Hazards Evaluated

- flammable liquids / solids / gases
- aerosols
- pyrophoric liquids / solids
- self-heating substances
- water reactivity, (heat and/or flammable gases produced)
- oxidizing liquids / solids / gases
- organic peroxides
- self-reactive substances
- explosive substances (liquid or solid) and explosive articles

Personnel Requirements

- Technically competent and experienced in the interpretation of hazard criteria.

- High degree of professional judgment is involved.

Assignment of Ratings

- Ratings are based on a knowledge of the inherent hazards of the material.
- Ratings must reflect changes in behavior to be expected when exposed to fire or fire control materials.
- All possible routes of entry must be considered.

Assignment of Ratings: Continued

- **Mixtures of chemicals:**
  - **Actual data on the mixture itself for health, flammability, instability, and special categories.**
  - **Estimated based on the cumulative properties of the individual components.**
    - **Accounting for:**
      - **Dilution**
      - **Negation (cancel out)**
      - **Potentiation (enhance or increase the effect)**
      - **Synergism (enhance or increase the effect)**

Health Hazard Rating Criteria

NFPA 704	Gas/Vapor		Dust/Mist			
Degree of Hazard	Inhalation LC50 (ppm-v)	Saturated Vapor Concentration X (LC50 in ppm-v)	Inhalation LC5(mg/L)	Oral LD50 (mg/kg)	Dermal LD50 (mg/kg)	
4	0 to 1,000	10 to >10	0.00 to 0.5	0.00 to 5	0.0 to 40	
3	1,001 to 3,000	1 to <10	0.51 to 2	5.01 to 50	40.1 to 200	Corrosive, irreversible eye injury pH <=2 or >=11.5 Frostbite, irreversible < -65 C. compressed Gases or liquefied gases
2	3,001 to 5,000	0.2 to <1	2.01 to 10	50.1 to 500	201 to 1,000	Severe irritation, reversible eye injury Sensitizers Lacrimators Frostbite from compressed liquefied Gases -30 to -65 C.
1	5,001 to 10,000	0 to <0.2	10.1 to 200	501 to 2,000	1,001 to 2,000	Slight to moderate eye irritation Mild irritation is borderline 0/1
0	>10,000	0 to <0.2	>200	>2,000	>2,000	Essentially nonirritating

ppm = (mg/m3 X 24.45) / MW

SVC = (Vapor Pressure (mmHg) X 106)/760

UN Health Rating Criteria

- **Inhalation Hazard Using UN Criteria.**
  - **The UN criteria for inhalation toxicity are based on the LC50 and saturated vapor concentration of the material.**
- **Oral and Dermal toxicity, and Corrosivity Using UN Criteria.**
  - **Based on those criteria, the UN assigns materials to categories called Packing Groups:**
    - **Packing Group I materials - severe hazard in transport,**
    - **Packing Group II materials - serious hazard,**
    - **Packing Group III materials - low hazard.**

UN Health Rating Criteria Continued

UN inhalation toxicity criteria;

Exposure Route	Cat-1	Cat-2	Cat-3	Cat-4
Gases (ppmV)	100	500	2500	5000
Vapours (mg/l)	0.5	2.0	10	20
Dusts & Mists (mg/l)	0.05	0.5	1.0	5

Note: The UN "Globally Harmonized System" (GHS) ratings numbers are the opposite of the NFPA system.

UN Health Rating Criteria Continued

UN Packing Group	NFPA Health Hazard Rating
I	4
II	3
III	2

Fire Hazard Rating Criteria

NFPA Flammability Class	NFPA Fire Rating	Flash Point		Boiling Point	
		°F	°C	°F	°C
Flammable Liquids					
IA	4	<73	<22.8	<100	<37.8
IB	3	<73	<22.8	>=100	>=37.8
IC	3	>=73 & < 100	>=22.8 & <37.8	-	-
Combustible Liquids					
II	2	>=100 &<140	>=37.8 & < 60	-	-
IIIA	2	>=140 & <200	>=60 & <93	-	-
IIIB	1	>=200	>=93	-	-

Aerosol Level Rating Criteria

Heat of Combustion Range	Aerosol Level	Flammability Rating
0 to 8,600 Btu/lb. (20 kJ/g)	1	2
8,600 Btu/lb. (20 kJ/g) to 13,000 Btu/lb. (30 kJ/g)	2	3
Greater than:13,000 Btu/lb. (30 kJ/g)	3	4

$$?Hcomb = \sum_{n=1}^{n} (((kj/m) / (g/m)) \times (\text{wt. fraction in product}))$$

- Material is packaged in a pressurized aerosol (spray) can
- Based on the heat of combustion of the composite material contained per NFPA 30B.
- The NFPA Flammable/Combustible liquid classification does not apply to aerosols and should not be assigned.
- Note that there is no level “0”, all aerosols are, at a minimum, rated “1”.
- This does not apply to pump spray bottles, they are treated as liquids.

Instability

- **Rating** — **Instantaneous Power Density at 250°C**
  - **4** — **1000 W/mL or greater**
  - **3** — **At or above 100 W/mL and below 1000 W/mL**
  - **2** — **At or above 10 W/mL and below 100 W/mL**
  - **1** — **At or above 0.01 W/mL and below 10 W/mL**
  - **0** — **Below 0.01 W/mL**

Instability

- **4 Materials that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures.**
- **3 Materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures.**
- **2 Materials that exhibit adiabatic exotherm initiation temperatures below 200°C or materials that polymerize vigorously with evolution of heat**
- **1 Materials that exhibit adiabatic exotherm initiation temperatures between 200°C and 500°C or materials that might polymerize when heated**
- **0 Materials that do not exhibit an exotherm at temperatures less than or equal to 500°C (932°F) when tested by differential scanning calorimetry.**

Oxidizer

- **Oxidizer**
  - **ranked according to the classification system presented in NFPA 430 This numerical class can be included in the special hazards quadrant of the NFPA 704 placard. For example, since ammonium permanganate is a Class 4 oxidizer (per NFPA 430), the special hazards quadrant would be marked OX 4 to better define the hazard.**

- **The adding of the quantification of the oxidation helps to better define the hazard.**
  - **For example:**
    - **manganese dioxide (NFPA 430, Class 1)**
    - **ammonium permanganate (NFPA 430, Class 4)**

would both be listed under the current system as OX in the NFPA 704 system, with no information on the degree of hazard.

Simple Asphyxiant

- **SA is added to the special hazards quadrant**
  - **New requirement in the 2007 edition of NFPA 704**
  - **Standing recommendation by CGA for years**

- **Examples:**
  - **Argon**
  - **Nitrogen**
  - **Carbon Dioxide**

Water Reactivity

- No longer a part of the instability (formerly reactivity) rating
- Indicated by placing a \ in the Special (white) diamond
- Rating ranges from 0 to 3 (4 not used)
- The numeric rating may be included if known
  - Only for a 2 or 3 rating are marked with the \ symbol
  - Ratings of 0 or 1 do not get the \ symbol

Water Reactivity Hazard Degree Zero

- Indicates the chemical is essentially non-reactive with water, therefore the symbol is not used.
  - Using the Two Drop Mixing Calorimeter (Hofelich 1994) or equivalent technique, the heat of reaction is less than 30 calories per gram of total mixture (cal/g),
    - using a 1:1 wt/wt ratio of chemical to water.
- Gas is not generated, although the evaporation rate of a volatile liquid chemical can be increased during water application.
- The heat of reaction can also be capable of generating sufficient water vapor pressure to damage some closed containers.
- An example of a water reactivity rating of zero is diethanolamine with a -6.5 cal/g Two Drop Mixing Calorimeter Test result, with no gas release.

Water Reactivity Hazard Degree One

- The heat of reaction is too small to preclude the use of water during emergency response therefore the symbol is not used.
  - Since water is an acceptable agent for dilution of spills and for fire control, chemicals with this rating are not assigned the symbol.
    - 30 calories per gram of total mixture (cal/g), but less than 100 cal/g, using a 1:1 wt/wt ratio of chemical to water.

- The heat of reaction may be capable of causing the water to boil at atmospheric pressure.

- The “1” rating should be used if any gas is generated via reaction with water, even if the heat of reaction is below 30 cal/g.

Degree One Example

- 50 percent sodium hydroxide.
  - The exothermic heat of solution measured using the Two Drop Mixing Calorimeter is -35.3 cal/g with no gas release, therefore a 1 rating is assigned.

- It should be noted that the heat of solution of a solid material such as sodium hydroxide is not constant, but decreases as the solid goes into solution.

- The first water that is added to sodium hydroxide could in fact boil, even though the Two Drop Calorimeter indicates a heat release of much less than 100 cal/g.

- Where large quantities of such solids are wetted by small quantities of water, the hazard might be better represented by a water reactivity rating of 2.

Water Reactivity Hazard Degree Two

- Indicates that the reaction with water is rapid and should be used only where it can be applied in flooding quantities
  - (which can be impractical for large piles of solids).
  - Using the Two Drop Mixing Calorimeter test, the heat of reaction is greater than or equal to 100 cal/g, but less than 600 cal/g using a 1:1 wt/wt ratio of chemical to water.

- The heat of reaction is likely to boil the water at 1:1 wt/wt ratios and may be sufficient to boil both the water and vaporize the chemical

- Other than carbon dioxide or steam (or other non-hazardous gases), if flammable or toxic gases are generated in hazardous quantities via reaction with water, the rating determined on the basis of heat of reaction should be increased by 1.

Degree Two Example

- **Calcium carbide.**
  - **Although the dry solid does not burn, a nonviolent but vigorous exothermic reaction with water produces calcium hydroxide plus flammable acetylene gas.**

- **Dichlorosilane.**
  - **In contact with water, exothermic hydrolysis is accompanied by evaporation of the volatile liquid phase.**
  - **Toxic dichlorosilane plus hydrogen chloride gases are released and spontaneous ignition of the dichlorosilane can occur.**

Water Reactivity Hazard Degree Three

- **Materials that react explosively with water without requiring heat or confinement**
  - **(This qualitative description is most applicable when assigning water reactivity ratings to solids since the heat of mixing is determined by physical characteristics and the degree to which the material has dissolved).**

- **Materials whose heat of mixing is greater or equal to 600 cal/g.**
  - **The 3 rating is not increased to a 4 rating if gas is generated, since “explosive reaction” already implies gas generation.**

Degree Three Example

- **triethyl aluminum**
  - **The heat release using the Two Drop Mixing Calorimeter test is -1008 cal/g with release of gas.**

Polymerizes (POL)

- **Materials that polymerize vigorously with evolution of heat should also be rated at least 2 for instability.**

Additional info

- **In some instances a manufacturer may state that a product is water reactive and/or polymerizes upon contact with water.**
  - **These reactions need to be examined to determine the amount of energy released and the types of gases or liquids released.**
  - **For example, acetic anhydride clearly reacts with water to produce acetic acid but does not meet any of the NFPA 704 criteria requiring the \ symbol.**
  - **There are cases where the energy release is low but a toxic/flammable gas is produced. Those cases may require the \ symbol**

Above and Beyond

- **Explosive (EXP)**
- **Reproductive Toxin (R)**
- **Carcinogen (C)**
- **Developmental Hazard (D)**
- **Polymerizes (POL)**

Explosive (EXP)

- **Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures.**

- **Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation.**

- **Materials rated a 3 or 4 for instability**

Reproductive Toxin (R)

- **Any chemical which affects the reproductive system and may produce chromosomal damage (mutation) and/or adverse effects on the fetus (teratogenesis).**

- **For the purposes of this methodology, any chemical with a *mutagenic* or *teratogenic* quotation in the Registry of Toxic Effects of Chemical Substances (RTECS) is considered a reproductive hazard.**

Carcinogen (C)

- **A substance or agent capable of causing or producing cancer in mammals, including humans. A chemical is considered to be a carcinogen if:**
  - **It has been evaluated by the International Agency for Research on Cancer (IARC) and found to be a carcinogen or potential carcinogen; or**
  - **It is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or**
  - **It is regulated by OSHA as a carcinogen; or**
  - **It is listed by the American Conference of Governmental Industrial Hygienists (ACGIH) as an A1 or A2 human carcinogen.**

Developmental Hazard (D)

- **Interferes with the normal growth and development of children.**
  - **RTECS and other peer reviewed references**

Biological Model

- **Health issues**
  - **acute toxicology**
  - **acute physical hazard**
- **Routes of entry**
  - **inhalation, dermal, and oral**
- **Biological model, NFPA 704 and other codes based on the use of**
  - **LC50-Albino Rat weighting 200 to 300 grams**
  - **LD50 oral-Albino Rat weighting 200 to 300 grams**
  - **LD50 dermal-Albino Rabbit weighting 2 to 3 kilograms**

- **The problem with this is that the available toxicological data frequently is not for one of the above combinations.**

Typical Data

- **Routes of entry cited (not all inclusive)**
  - Dermal
  - Inhalation
  - Intraperitoneal
  - Intravenous
  - Oral
  - Subcutaneous

- **Biological Models cited (not all inclusive)**
  - Cat
  - Dog
  - Foul (Chicken, Duck, Wild Bird)
  - Guinea pig
  - Hamster
  - Human (Man, Woman, Child)
  - Mammal
  - Mouse
  - Raccoon
  - Rat
  - Rodent

Methodology

- **Start By Prioritizing routes of entry based on material state**
  - **Inhalation, Dermal, Oral**
  - **Material state {G, L, S (powder)}**
- **Review Mfr's MSDS for Ratings and/or data**
  - **NFPA, HMIS, etc.**
  - **Toxicological Data {LC50, LD50, etc.}**
  - **Inhalation rating Using DOT or UN Criteria**
  - **Dermal and Oral Hazard Considerations Using UN Criteria**

Methodology Cont.

- Compare against existing ratings
- Generate rating based on available data
- Mixtures
  - Synergistic and/or anti-synergistic behaviors

Rating Pure Chemicals

- **Review the MSDS for:**
  - **Toxicological data – confirm using RTECS and/or another source**
  - **Physical hazards such as corrosive**
  - **Health rating - (NFPA or HMIS)***
  - **Review other manufacturers' MSDS existing ratings**
  - **Other health info such as State/DOT/UN**

*** Note: Some manufacturers like J.T. Baker and Kodak have their own ratings system, which may not use the same criteria and therefore cannot be used**

Rating Mixtures

- **All of the same issues as pure chemicals with additional issues**
- In the absence of data on the specific mixture:
  - Use the most conservative rating (numerically highest) for each component of the mixture for health and instability
  - With adjustment for professional judgment

More on Mixtures

- **Evaluate the potential interactions between the various components**
  - **Is there a synergistic effect:**
    - **The damage caused by the combined effect of n-hexane and methyl ethyl ketone on the nervous system is far greater than the sum of either of these substances acting alone**
  - **Is there a potentiation effect:**
    - **A dilute acid or base solution that would not be considered corrosive because of pH, but would become corrosive with the addition of a small amount of a 'harmless' (rating of 0) surfactant.**

Absence of Directly Verifiable Data

- **Manufacturer supplies an Estimated Value**
  - **Check Other Mfrs, Use Most Conservative**
- **Extrapolating Between Species**
  - **Risky, no real trends**
- **Extrapolating Between Similar Inorganic Chemicals**
  - **Risky but possible with a good knowledge of chemistry and toxicology**
- **Extrapolating Between Similar Organic Chemicals**
  - **Don't! Rare exception (some poly-alcohols, fats, waxes)**

Comparison of Acute Toxicities

Chemical	Animal	LD_{50} (oral)	Animal	LD_{50} (oral)
Acrylic Acid	Rat	33.5 mg/kg	Mouse	2400 mg/kg
Methylene Bromide	Rat	108 mg/kg	Rabbit	1,000 mg/kg
Theobromine	Rat	1265 mg/kg	Cat	200 mg/kg

LD50 (oral) values of Chemicals Containing Specific Functional Group

Chemical 1	LD_{50}	Chemical 2	LD_{50}
Formic Acid	1100 mg/kg	Acetic Acid	3300 mg/kg
Methylamine	100 mg/kg	Ethylamine	400 mg/kg
Methyl iodide	76 mg/kg	Ethyl Iodide	330 mg/kg
Acetonitrile	2460 mg/kg	Propionitrile	39 mg/kg
Phenol	317 mg/kg	1,2-Benzenediol	260 mg/kg
1,2-Ethanediamine	1200 mg/kg	Ethylamine	400 mg/kg

Other Potential Sources

- **TLVs, PELs, or TEELs**
  - **No, not necessarily based on toxicology**
- **Use of AEGLs and ERPGs**
  - **Yes, based on pier reviewed tox data but limited number of them**
- **Use of Similar Physical Characteristics**
  - **Limited, but possible {example – short chain amines}**

Rate Your Rating

- Is it real or estimated
- Is it a health hazard, physical hazard, or both
- Is it a viable route of entry
- Is it solely on the inherent properties or also products of combustion

Summary

- MSDS is the first source of information
- Use preferred model if possible
- Verify data when possible (lit search)
- If extrapolating use extreme care
- Flag estimated values (Rate the Rating)
- Independent review

Publications - CSTC Project

- ***Determining Acute Health Hazard Ratings in the Absence of Applicable Toxicological Data*, Fred Simmons, David Quigley, Dave Freshwater, Helena Whyte, Lydia Boada-Clista, JC Laul, Journal of Occupational & Environmental Hygiene, in press.**

Tox References

- *Registry of Toxic Effects of Chemical Substances (RTECS):*
- **http://www.cdc.gov/niosh/rtecs/default.html**
- *The Agency for Toxic Substances and Disease Registry (ATSDR);*
- **http://www.atsdr.cdc.gov/toxpro2.html**
- *The International Agency for Research on Cancer (IARC);*
- **http://monographs.iarc.fr/**
- *National Toxicology Program (NTP);*
- **http://ntp.niehs.nih.gov/**
- *National Institute of Occupational Safety and Health (NIOSH);*
- **http://www.cdc.gov/niosh/homepage.html**
- *Toxicology Data Network (TOXNET);*
- **http://toxnet.nlm.nih.gov/**
- *The Risk Assessment Information System (RAIS);*
- **http://rais.ornl.gov/tox/metadata.shtml**
- *American Conference of Governmental Industrial Hygienists (ACGIH);*
- **http://www.acgih.org/home.htm**
- *Comparative Toxicogenomics Database (CTD):*
- **http://ctd.mdibl.org/**

Data Mining

- **Quantitative Structure Activity Relationship (QSAR) Methodologies and Computer Programs**
  - **Developed initially for drug research**
  - **Have been successfully used to predict LD50**
  - **Statistical method – risk of false positive**

Requesting the *SRS Chemical Products Hazard Ratings*

- DOE personnel
  - Submit an email to the following requesting the document:
  - jean.campbell@srnl.doe.gov
  - (803-725-3852)

- Other Federal Agency Personnel
- DOE Subcontractors
  - Submit an email to jean.campbell@srnl.doe.gov
    - » (803-725-3852)
  - with the following information:
    - Name of the Company
    - Name of the Requestor (title, department, email address, phone)
    - Federal Contract Number
    - Mailing Address

Requesting the *SRS Chemical Products Hazard Ratings*

- Private Companies
- Other Agencies (City, County, State Governments)

  - These requestors will be required to work out licensing arrangements.
  - Please contact Licensing Specialist:

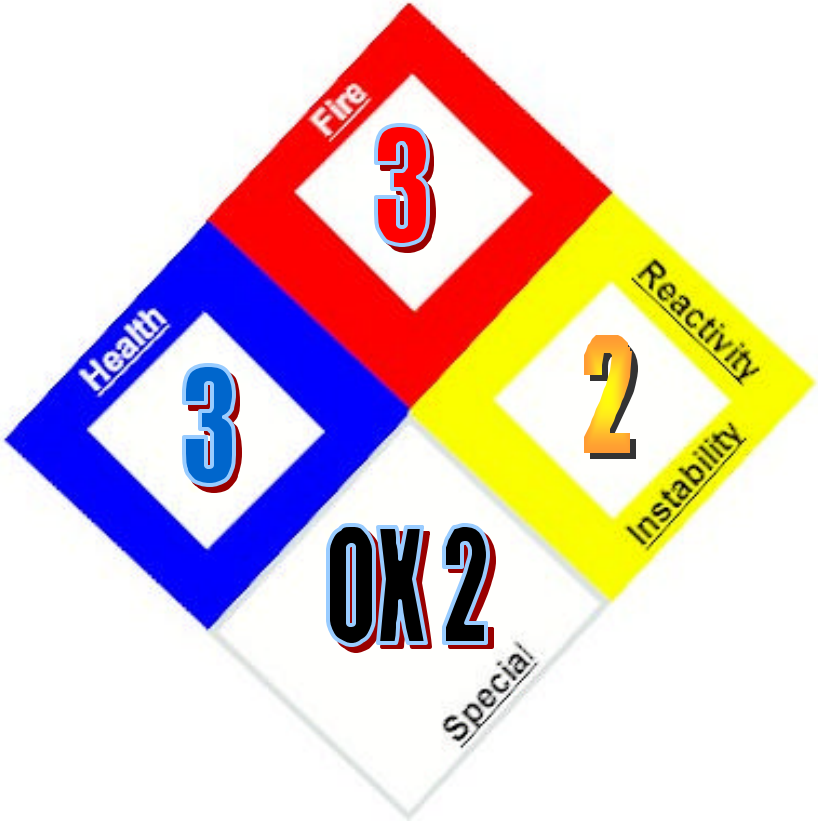
- Eric Frickey at 803-725-0406.
- eric.frickey@srnl.doe.gov
- 803-725-0406

Questions


SPONTANEOUSLY
COMBUSTIBLE
4


ORGANIC PEROXIDE


FLAMMABLE SOLID
4


Fire
3
Health
3
Reactivity
2
Instability
OX
Special