1.3

Research Project on Risk Assessment of Mildly Flammable Refrigerants

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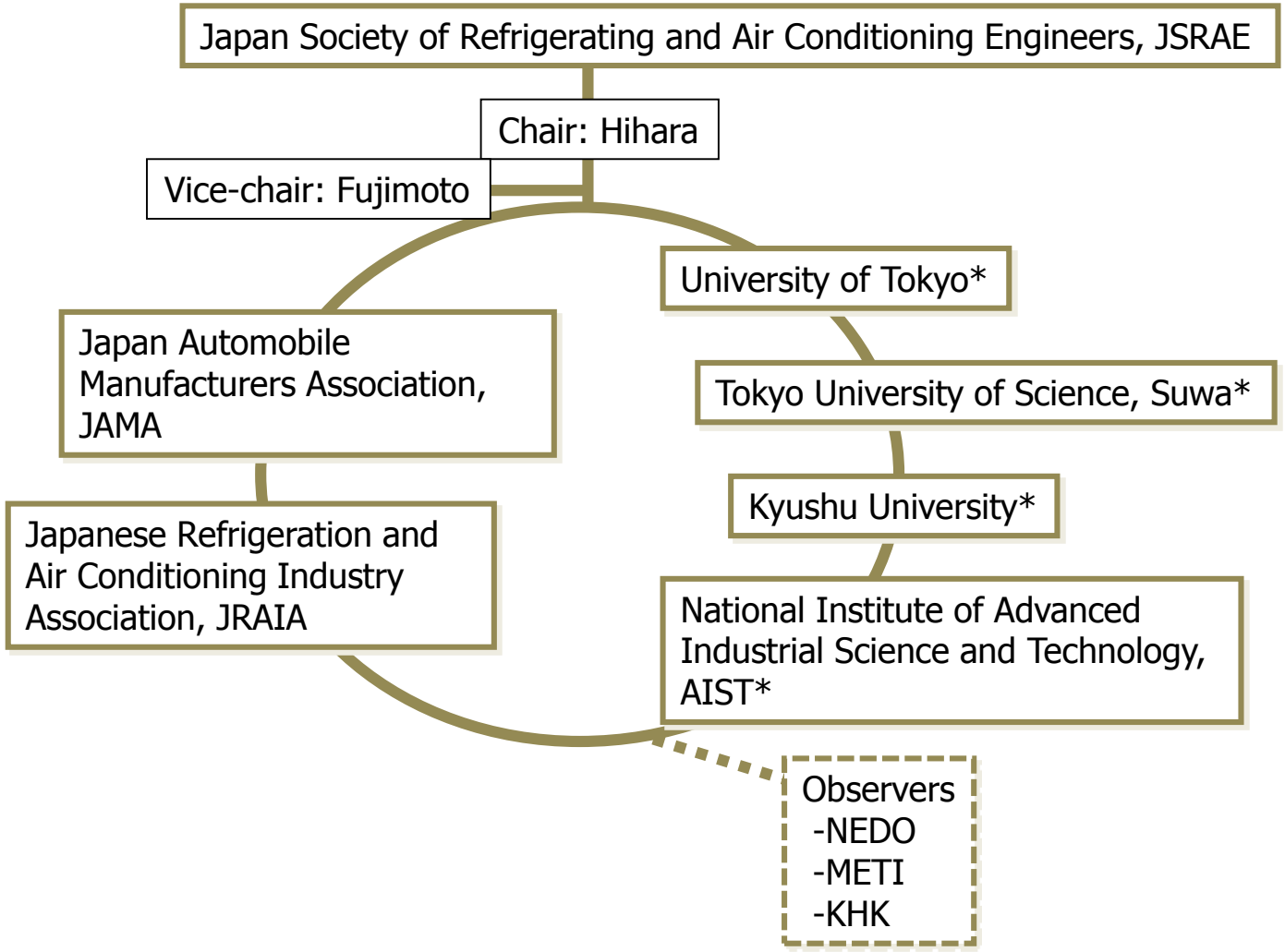
Trade-off between GWP and flammability

- To reduce the emission of greenhouse gases including HFCs from refrigerating and air conditioning equipment, changing refrigerants from HFCs to lower-GWP refrigerants is one of the key considerations.
- R1234yf, R32, and R290 have much lower GWP values than R410A. R410A is nonflammable whereas R1234yf, R32, and R290 are flammable. Because the burning velocities of R1234yf, R1234ze, and R32 are lower than 10 cm/s, the flammability levels of R1234yf, R1234ze, and R32 are very weak and they are categorized under the A2L class of the ASHRAE.

Refrigerant	R410A	R32	R1234yf	R1234ze	R717	R290
Boiling temperature, ^{o}C	-51.4	-51.7	-29.4	-18.9	-33.3	-42.1
Critical temperature, ^{o}C	71.3	78.1	94.7	109.4	132.4	96.7
GWP (100 years)	2088	675	4	6	<1	<3
Burning velocity (cm/s)	-	6.7	1.5	1.2	7.2	46
LFL [vol %]@23^{o}C, 50%RH	-	14.4	6.2	6.5	16.7	2.1
UFL [vol %]@35^{o}C, 0%RH	-	29.3	12.0	n.f.	30.4	9.81
Minimum ignition energy (mJ)	-	29	780	n.a.	45	0.35
Flammability	1	2L	2L	2L	2L	3

Organization of the research committee



* Member of the NEDO project

Research content of members

1. National Institute of Advanced Industrial Science and Technology, AIST
   a. Effect of temperature and humidity on combustion limit
   b. Minimum ignition energy
   c. Production of HF at thermal decomposition
   d. Safety analysis at combustion

2. Tokyo University of Science, Suwa
   a. Production of HF at fire
   b. Safety analysis at service

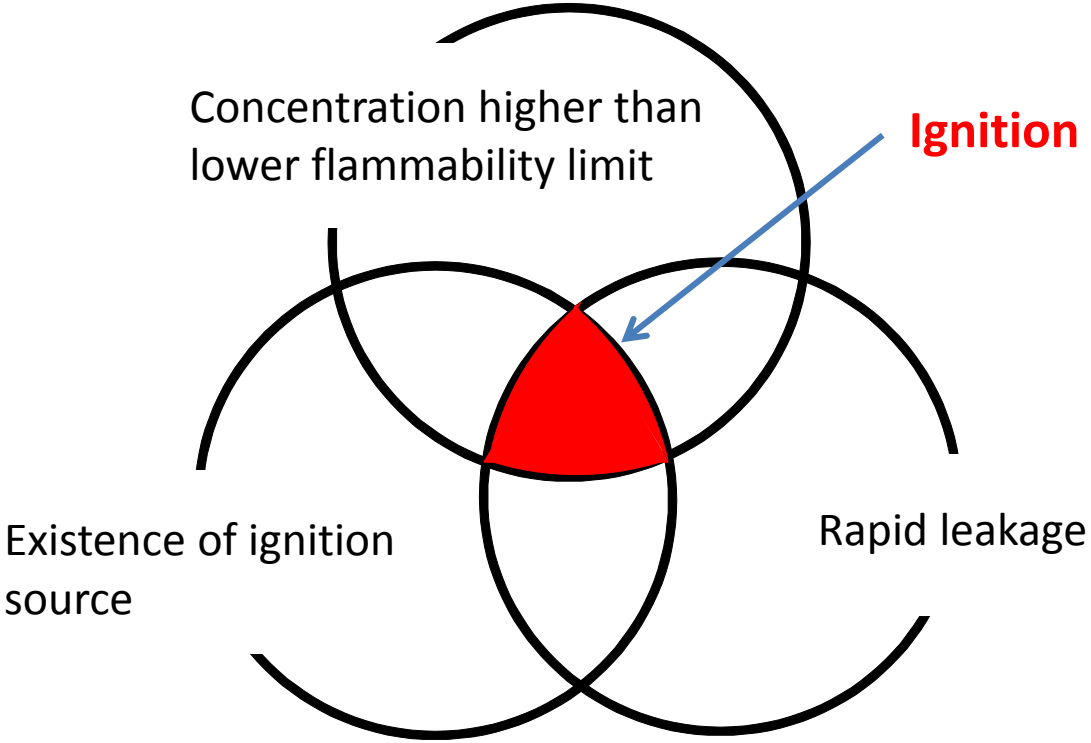
3. University of Tokyo
   a. Leakage analysis
   b. Production of HF at thermal decomposition

4. The Japanese Refrigeration and Air-conditioning Industry Association, JRAIA
   a. Risk assessment of mini-split, VRF and chiller

5. Japan Automobile Manufacturers Association, JAMA
   a. Risk assessment of MAC at repair shop

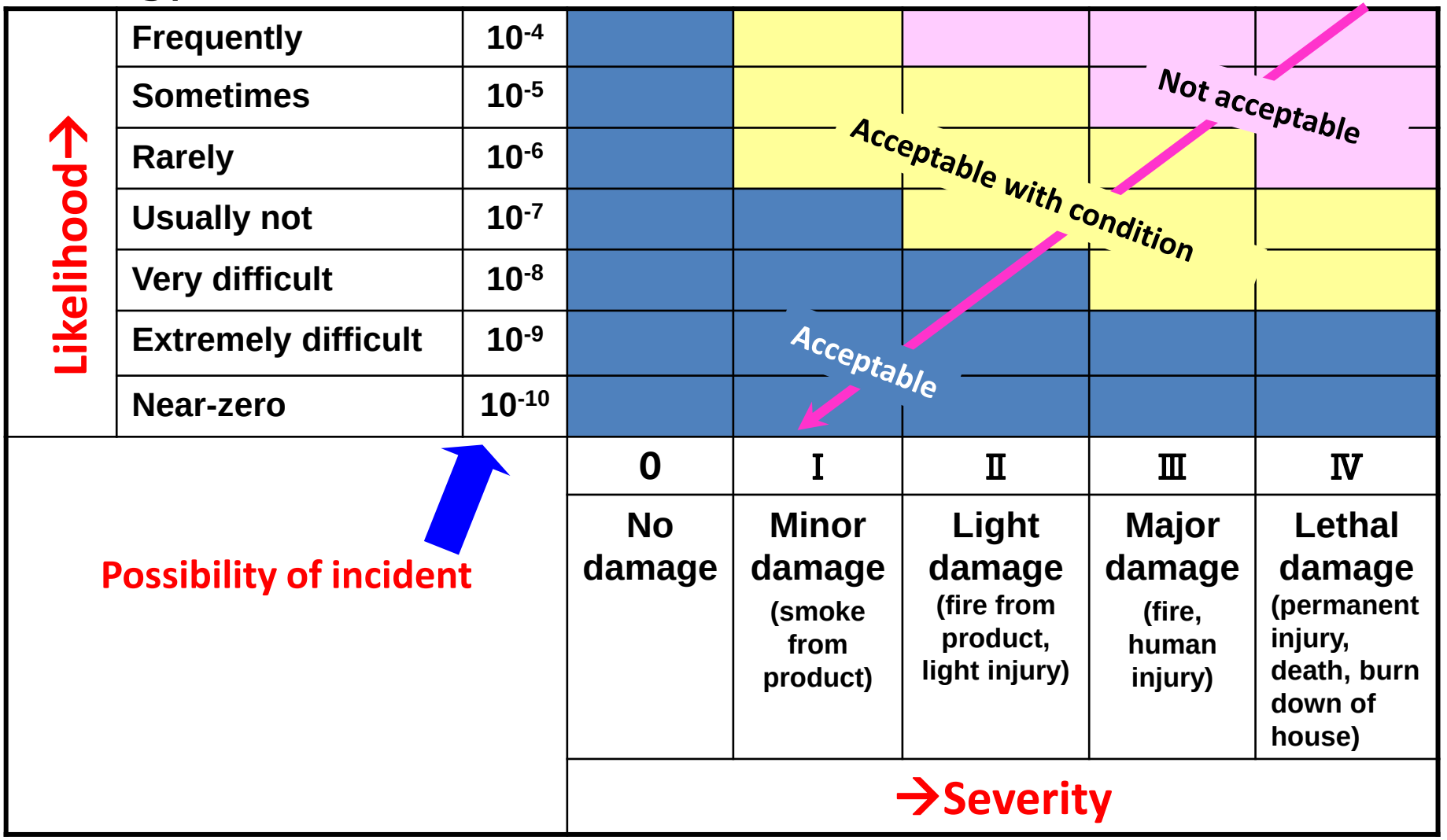
Methodology of Risk Assessment

[Probability]＝[Rapid Leakage] X [High Concentration] X [Ignition Source]



Risk Map (ISO Guide 51)

Strategy for Risk Evaluation



The 2014 Progress Report is available from the JSRAE website as follows:
http://www.jsrae.or.jp/jsrae/committee/binensei/risk_e.html