

2.1

Basic procedure of Risk Assessment in JRAIA

(on behalf of following three presentations)

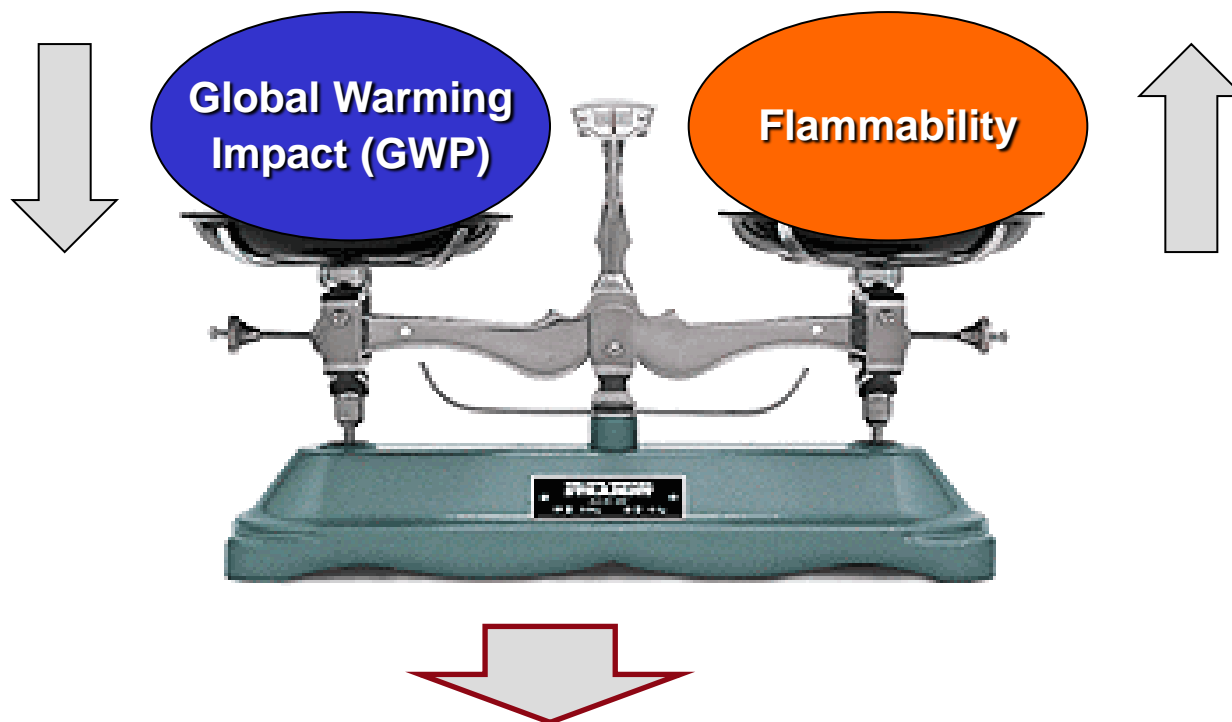
August 19, 2015

Risk evaluating committee co-chair in JARAE

Safety investigating working-group chair in JRAIA

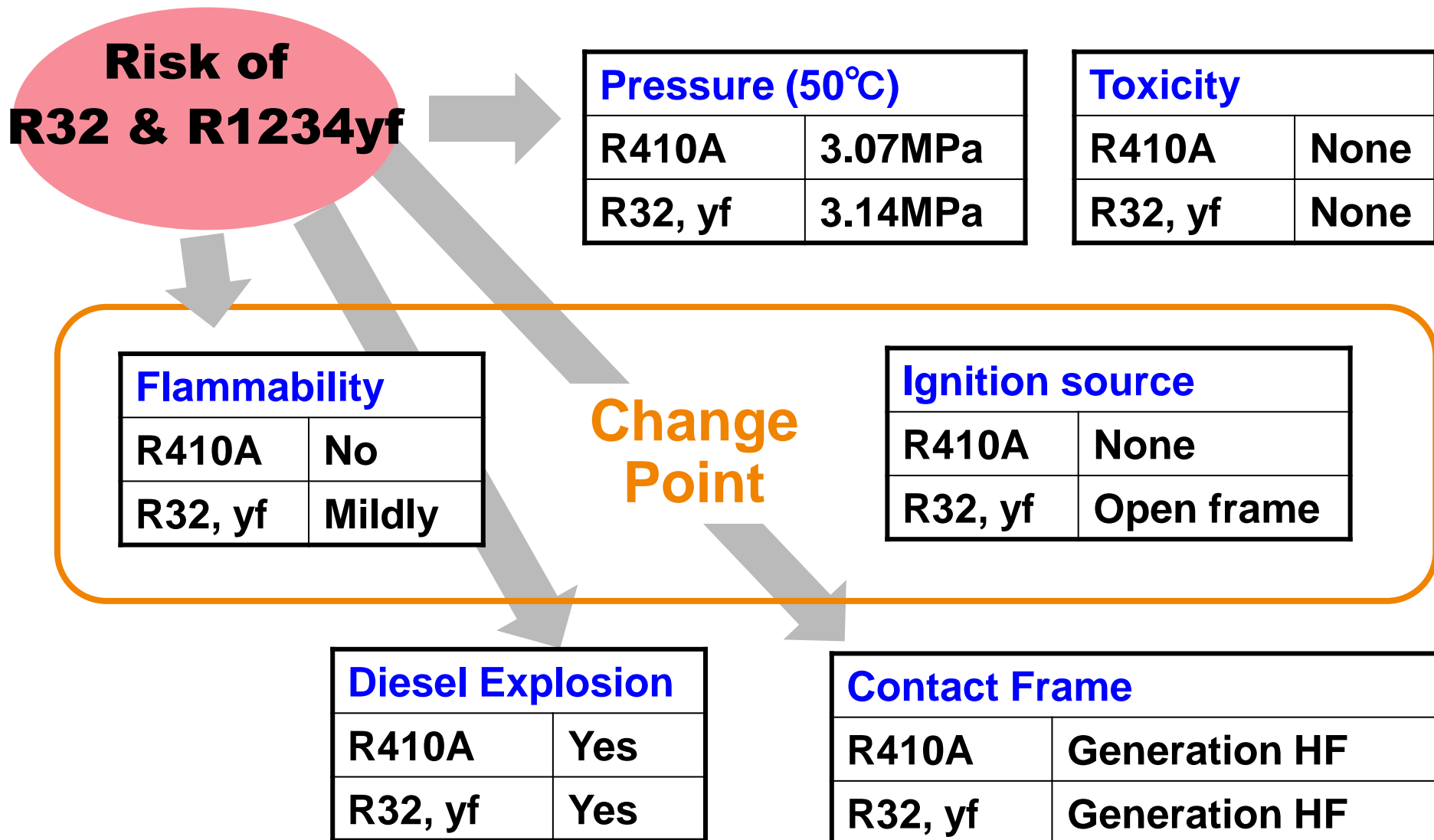
Satoru Fujimoto (Daikin Industries, Ltd)

Trade-off between GWP and flammability

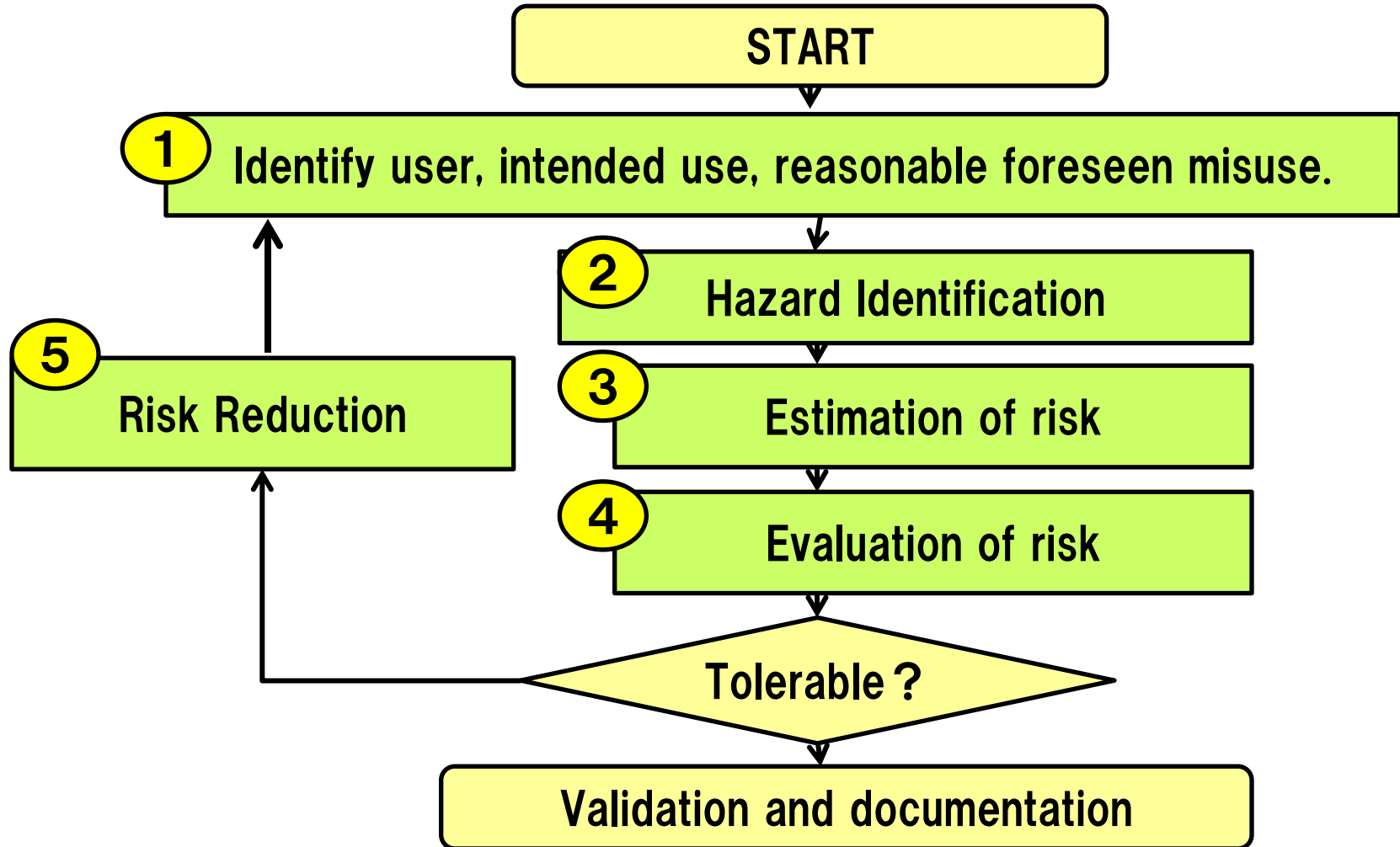


**To measure global warming,
we should use mildly flammable refrigerant**

Risk of R32 and R1234yf

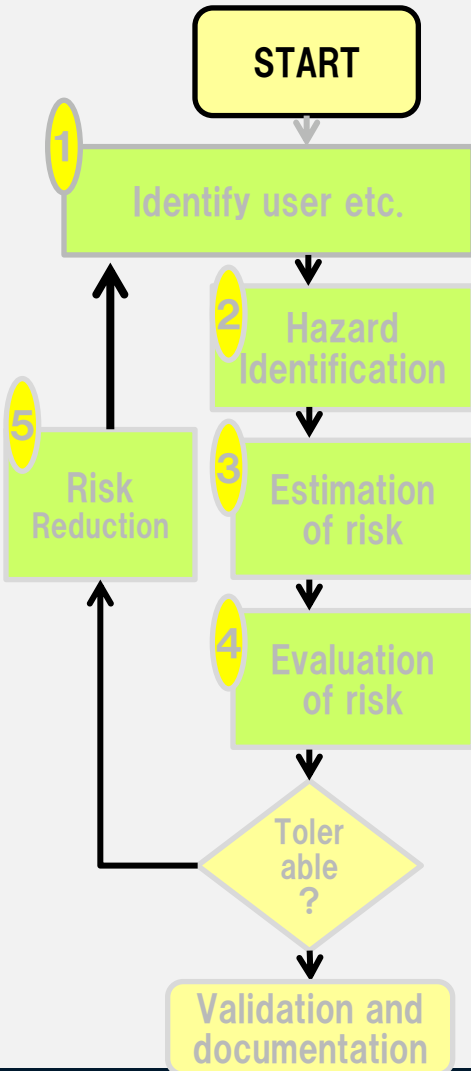


JRAIA has been conducting the risk assessment since 2011 in accordance with ISO/IEC guide 51.

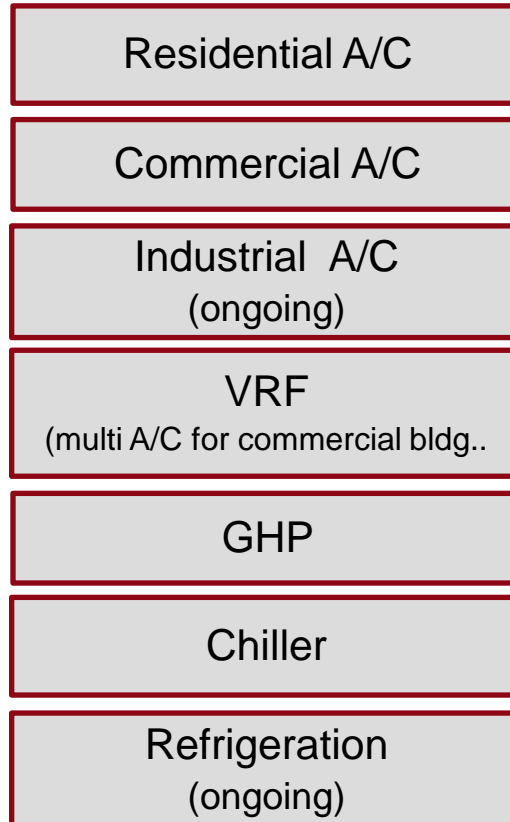


Start : Select products and life cycle stage

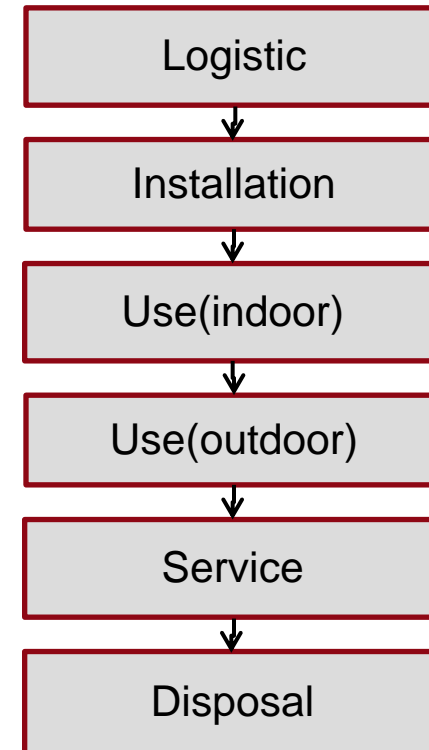
JRAIA organized safety evaluation WG and some sub-WG for each products



Identified Product/System



Identified Life stages



Guide 51 said;

◆ Safety means ;

Freedom from risk which is not tolerable.

◆ Tolerable risk is;

Accepted in a given context based on the current values of society.

Examples of the current values in Japan

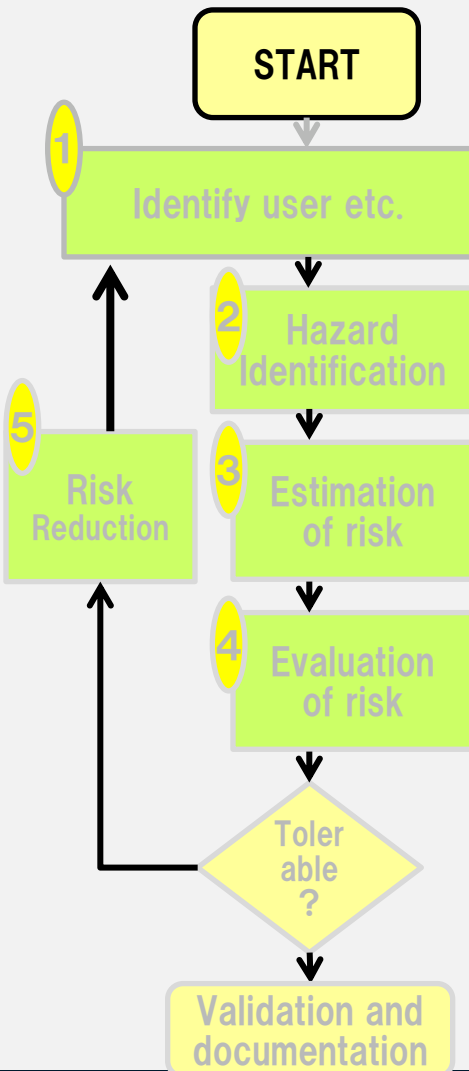
1. Chemical factory : 10^{-5} [accidents/(year*site)]

2. Car : 10^{-7} [accidents/(year*unit)]

3. Home appliance : 10^{-8} [accidents/(year*unit)]

for one million units in the market

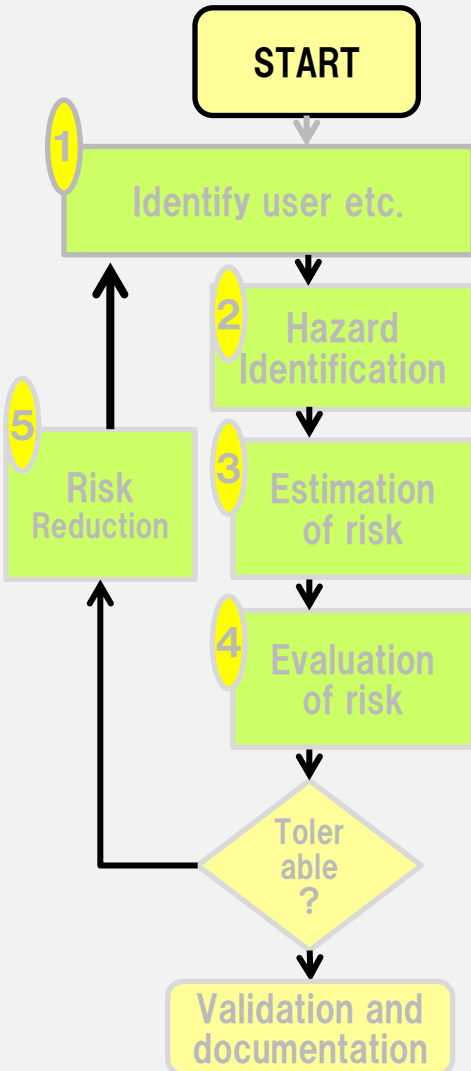
JRAIA decided the accident less than once per century would be tolerable for use.



Start : Identify the tolerable risk

Tolerable values are dependent on the number of units in the market for each products

The tolerance values were increased because they are handled by trained professionals except when used by customers

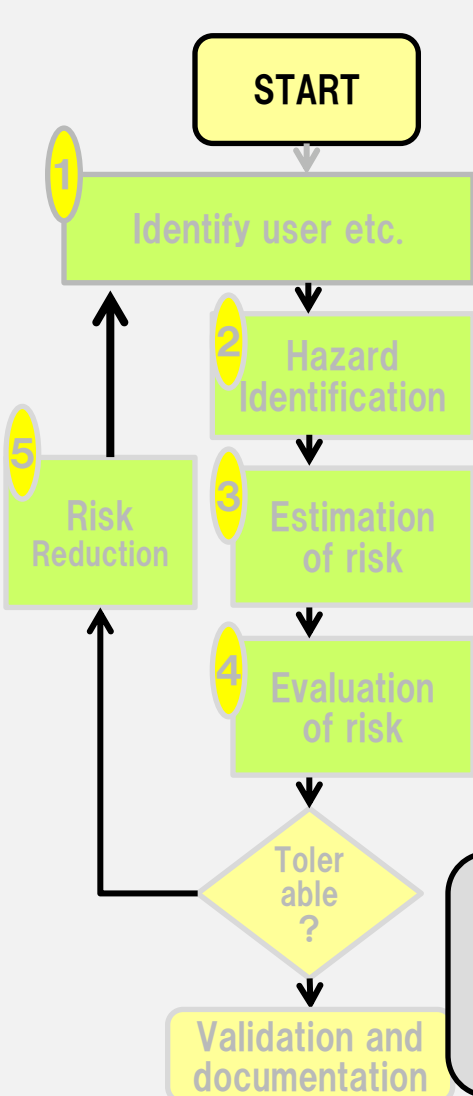


Product/ System	No. of units in market	Tolerable value when used	Tolerable value except when used
Residential A/C	10 ⁸ units	1.0 * 10 ⁻¹⁰	1.0*10 ⁻⁹
Commercial A/C	7.8* 10 ⁶ units	1.3 * 10 ⁻⁹	1.3 * 10 ⁻⁸
VRF	10 ⁷ units	1.0 * 10 ⁻⁹	1.0 * 10 ⁻⁸
Chiller	1.34*10 ⁵ units	7.5 * 10 ⁻⁷	7.5 * 10 ⁻⁷

The tolerance value was increased by 10 times when used for industries

Start : Identify the tolerable risk

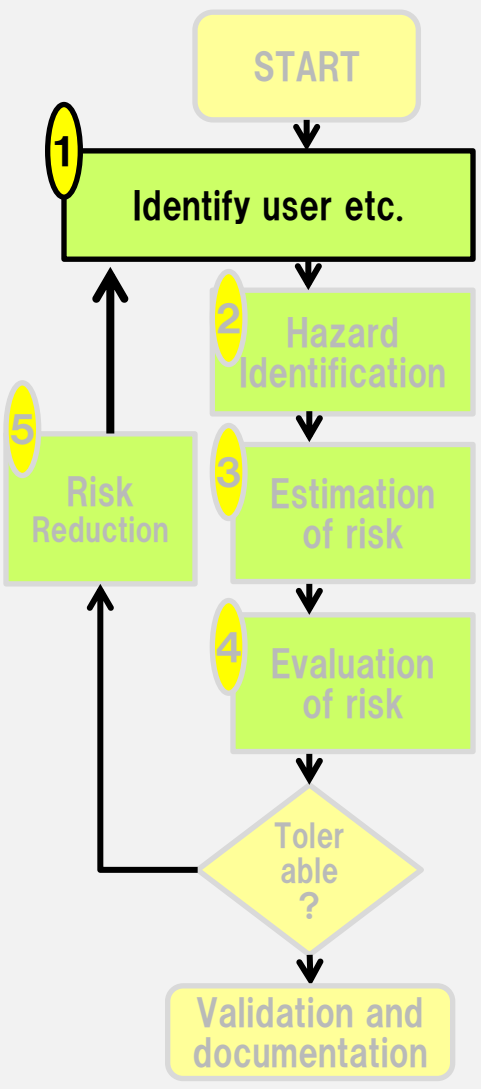
Risk is a function of severity and probability



Probability of occurrence	Usually	$10^{-5} \sim$	Acceptable	No Acceptable				
	Frequently	$10^{-6} \sim$		Acceptable with Condition				
	Sometime	$10^{-7} \sim$						
	Rare	$10^{-8} \sim$						
	Usually not	$10^{-9} \sim$						
	Near Zero	$\sim 10^{-10}$						
[Event/(unit*year)] Residential A/C case			No	Minor	Light	Major	Lethal	
			Severity of Harm					

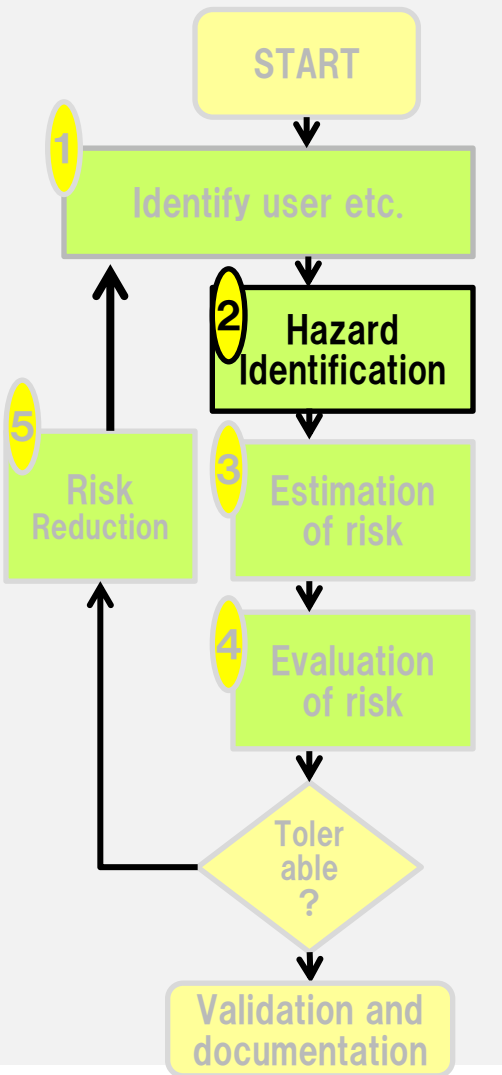
JRAIA supposes at present
A Ignition would always cause lethal damage
 since we could not classify severity of harm.

Identify user, intended use and reasonable foreseen misuse (including severe case)



System for each user	Normal case	Severe case	misuse case
Residential A/C		Floor standing type Multi type etc.	Mischarge etc.
Commercial A/C (including industry use; ongoing)		Floor standing type Karaoke room etc. Semi-under ground	Mischarge etc.
VRF(including GHP)		Floor standing type Karaoke room etc. Semi-under ground	Mischarge No ventilation etc.
Chiller		Small machine room	No ventilation etc.
Refrigeration (ongoing)		Walk-in type Back yard etc.	Mischarge etc.

Ignition triggered by flammable refrigerant can only occur when all 3 conditions are met.



1. Rapid gas Leakage occur

and

2. Leaked gas Assess Flammability

and

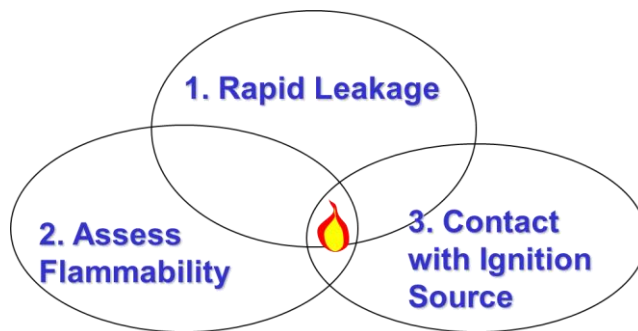
3. Contact with Ignition Source

Probability given from the market data

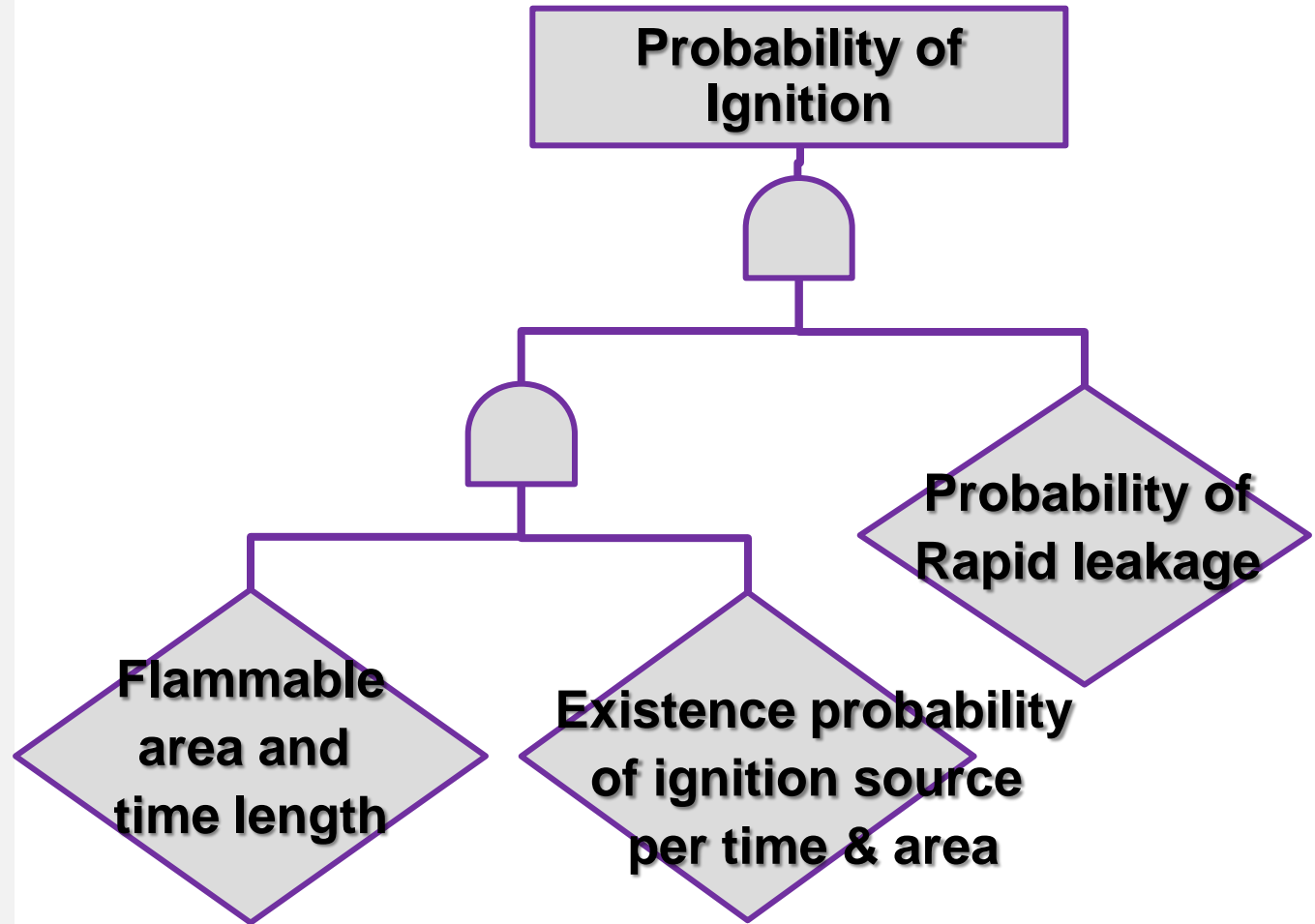
Time length & volume of flammable area from simulation.
(Tokyo Univ. and JRAIA)

Existence probability of ignition source by researches.
(AIST, TUSS and JRAIA)

NEDO project



Develop FTA and calculate probability of ignition



If not tolerable , reduce the risk until it is tolerable

Risk measures taken during design as responsibility of manufacture

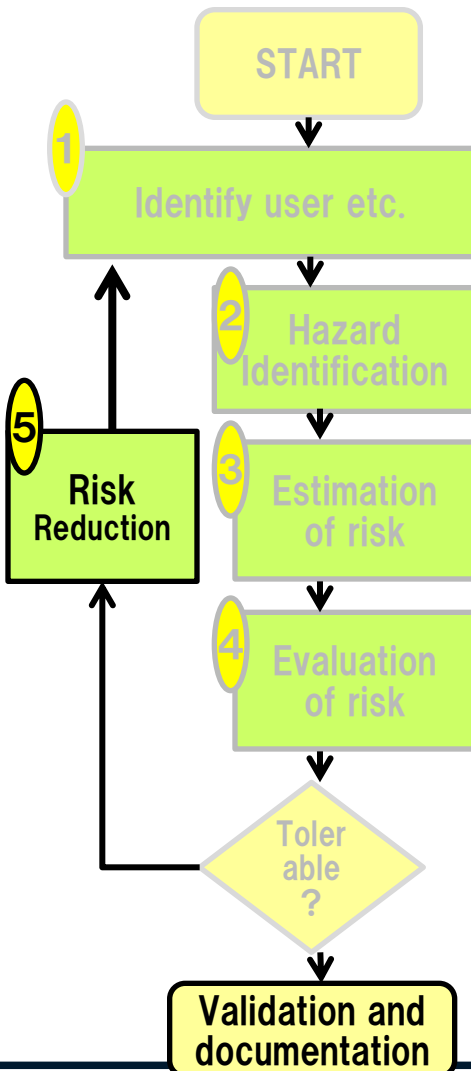
Step1: Inherently safe design

Step2: Guards and protective devices

Step3: Information for use such as ;
warning, instruction, training etc.

If risk remains after design, the other
measures for use should be taken.

Additional protective , Training, Organization,
Personal protective equipment etc.



**JRAIA is drawing up the guideline
or manuals for safety use**

**Thank you very much
for your attention!**