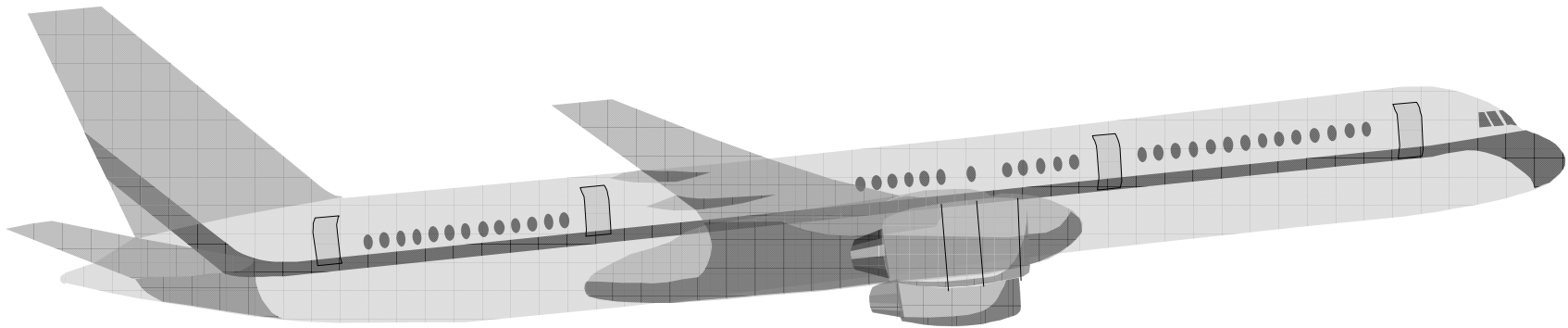


PCAIRE

A solution for aircrew radiation dose monitoring



**Dr. Francois Lemay, COO
PCAIRE Inc.**

January 2009



Obsolete units of distance

- Inch – length of a thumb
- Foot – length of a foot
- Cubit – length of a forearm
- Yard – used to sell fabric
- Fathom – nautical term for depth
- Rod – used for surveys
- Furlong – throw of a javelin
- Mile – distances on land between towns
- Nautical Mile – distances on sea
- League – distance on roads (different in France and England, and period of history)

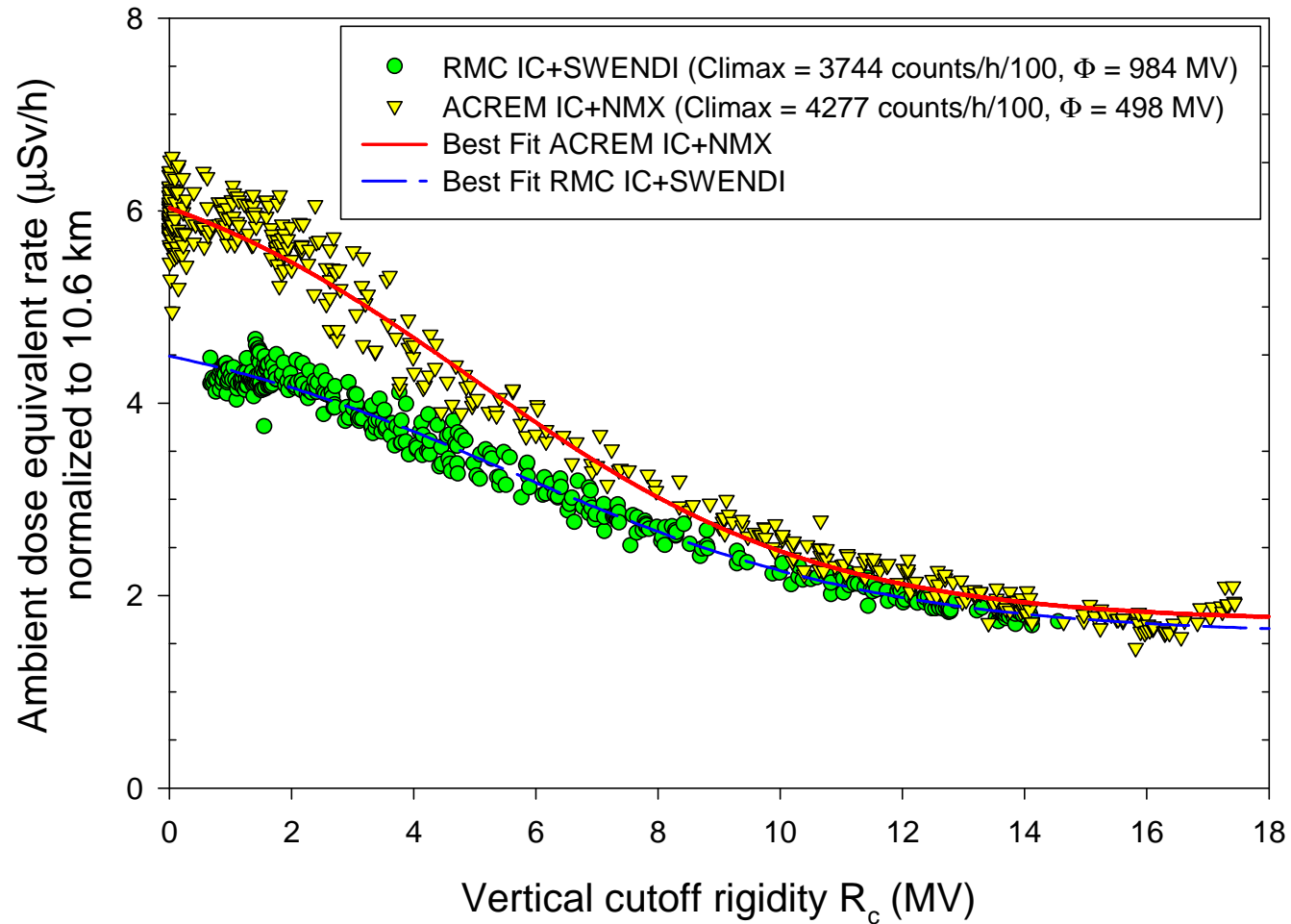
Definition of dosimetry

- What are we trying to measure?
 - Goal is to evaluate the risk from exposure to radiation
- Why so many quantities?
 - Effective dose E
 - Ambient dose equivalent H^*

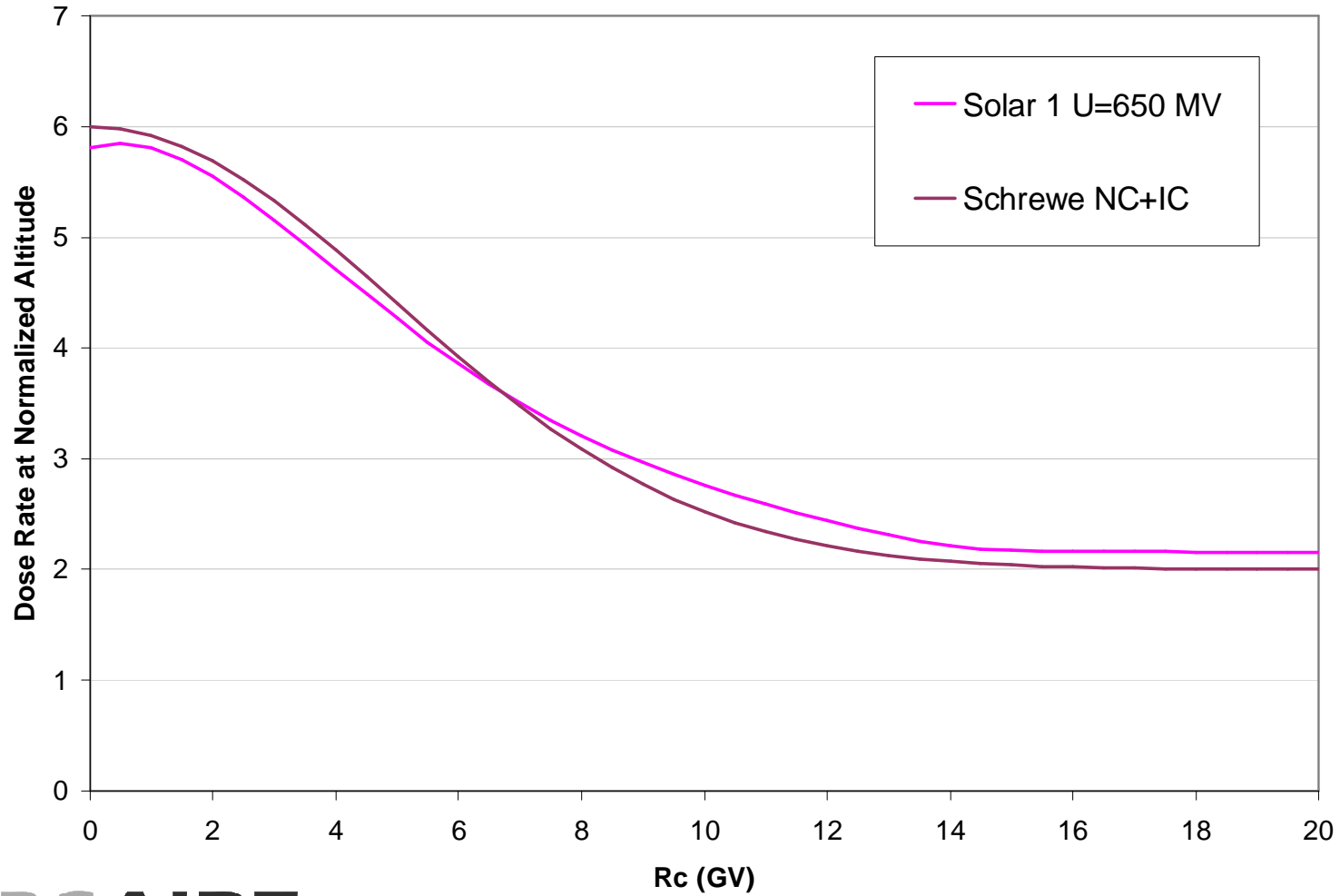
In-flight measurements at RMC



Ambient dose equivalent



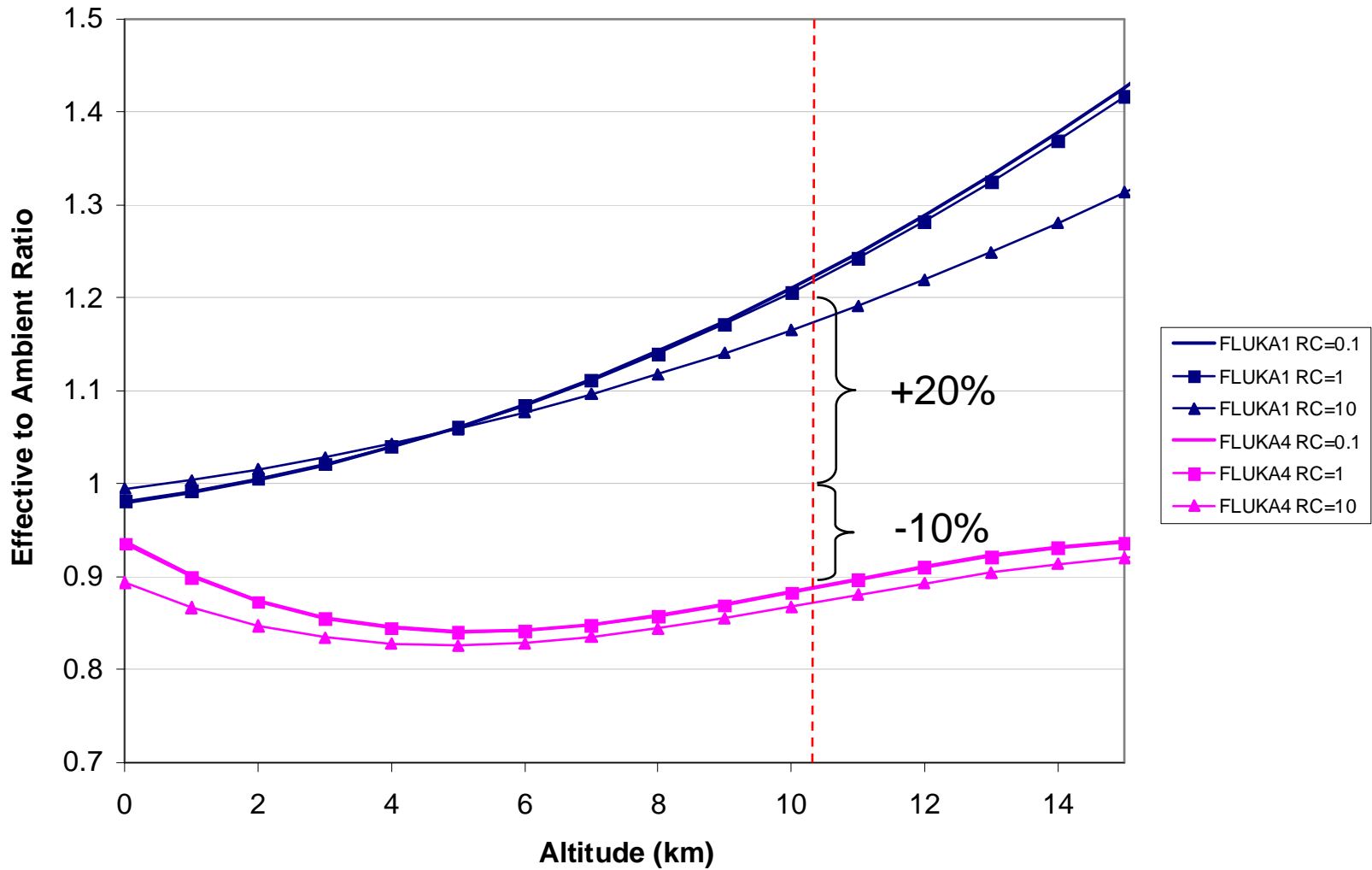
Ambient dose equivalent



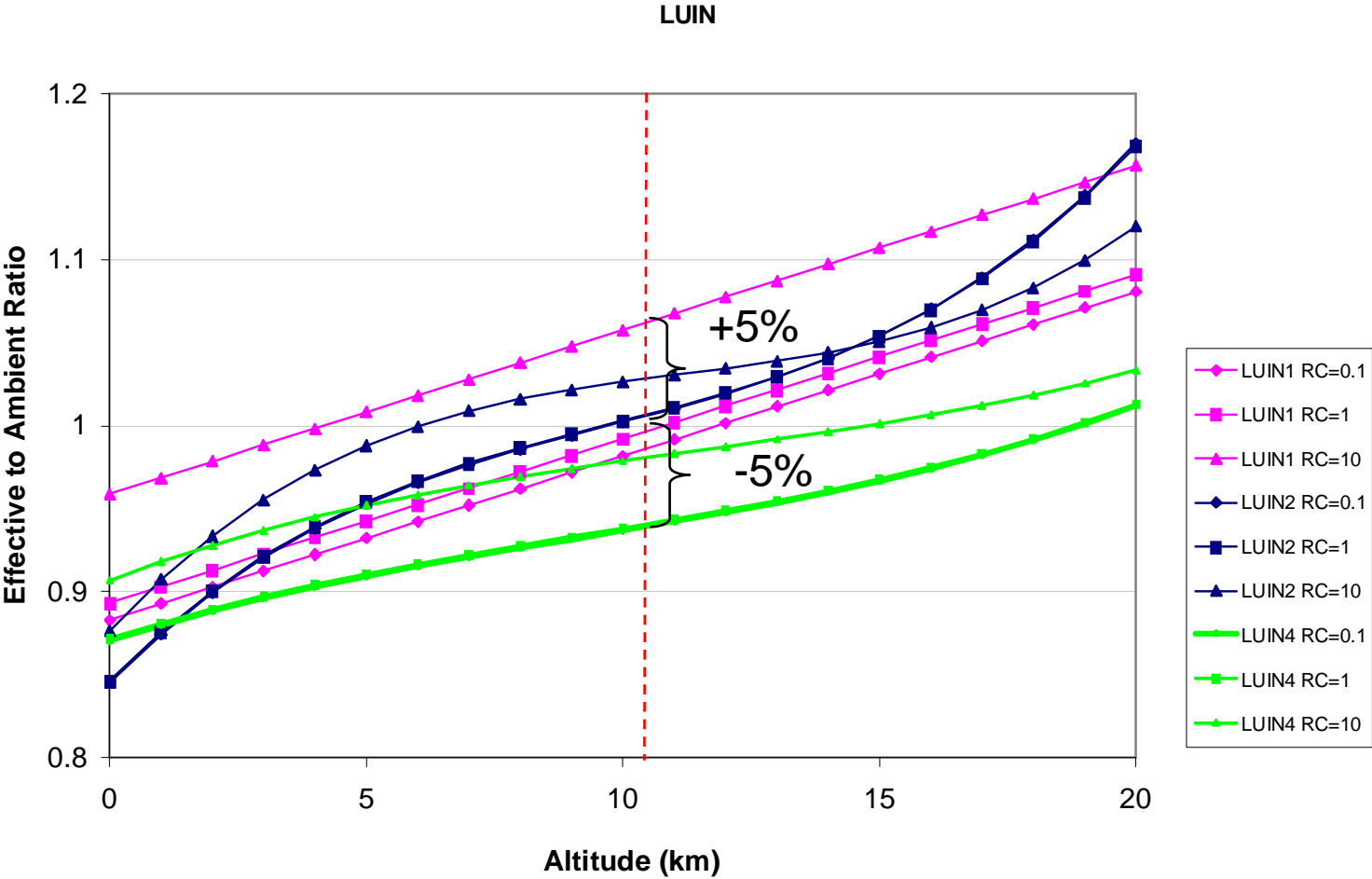
Radiation weighting factors

Radiation	Energy (MeV)	Radiation weighting factors ICRP 60	Radiation weighting factors ICRP 103
Neutrons	< 0.01	5	2.5
	0.01 – 0.1	10	4
	0.1 – 2	20	20
	2 – 20	10	10
	> 20	5	5
Protons	> 2 MeV	5	2
Positive muons	all	1	1
Electrons	all	1	1
Photons	all	1	1

Ratio E/H (Fluka)



Ratio E/H (Luin)



The requirement

- Aircrew are exposed to as much or more radiation as the average nuclear worker
- International guidance recommends tracking exposure of aircrew
- Many countries have regulated this tracking
- Canada has circulated an advisory, with legislation in process

PCAIRE

- Developed specifically to address this requirement
- Only code based on in-flight measurements
- Obviates use of dosimetry equipment, except for periodic confirmation of calculations



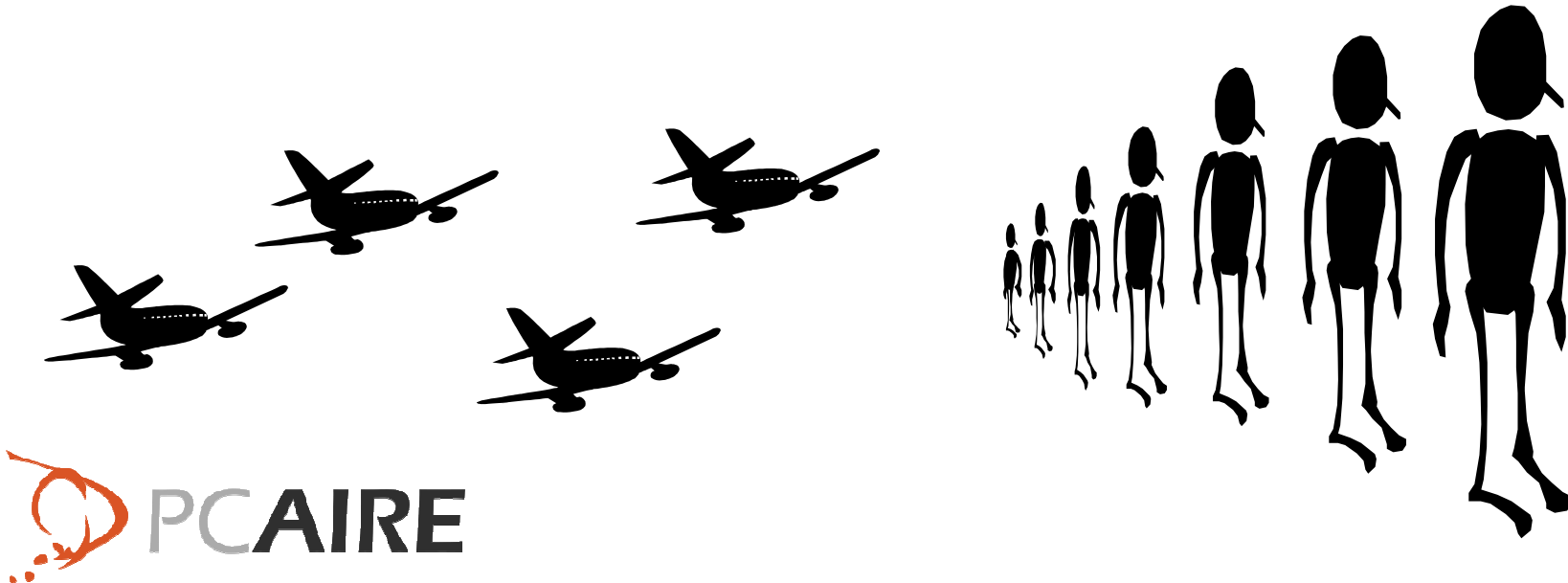
PCAIRE is:

- A mathematical model based on fine-grid measurements of radiation at various locations around the world.
- Based on a large and expanding experimental database
- A software program that uses this model to calculate doses



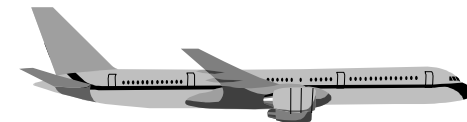
PCAIRE Sys is:

- A commercial system designed for an operational environment
- An assessment system for large number of personnel and flights



PCAIRE Sys

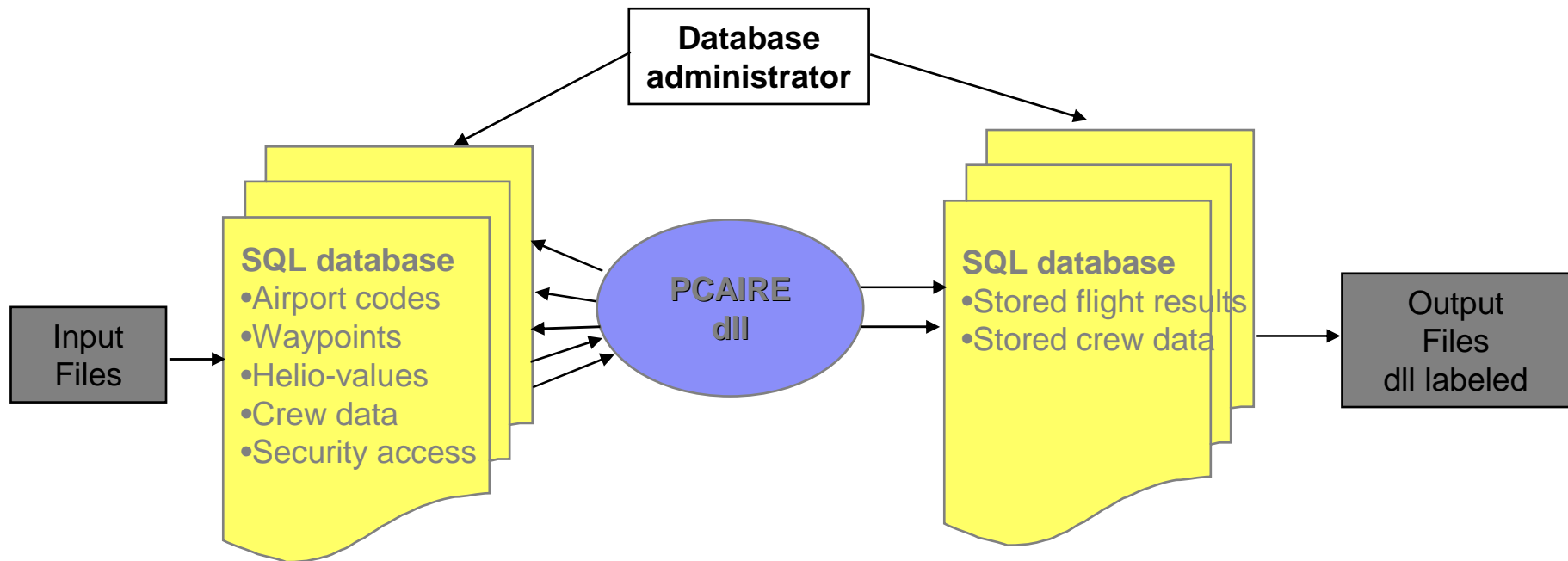
- PCAIRE Sys can operate:
 - Via web - for individual users
 - As a kernel incorporated into the airline's human resources system
 - As a data treatment centre, web/LAN-based, for processing batch files and interfacing with the airline's database



PC*AIRE* Sys architecture

- One calculational dll
 - Compiled and secured
- Secure database access only
 - For storage and retrieval of required data
 - Using Microsoft's latest security design
- Output files labeled with dll version
 - All input and output data is rigorously verified by the code

PCAIRE Sys architecture



PCAIRE Sys functionality

- Single flight entry or batch file processing
- Great circle route or way points
- Tailored to the needs of the airlines (e.g. reporting by employment category)
- Secure access (encrypted password)

PCAIRE Sys web access



[Flight Query](#) [Flight Entry](#) [Crew Summary](#) [Administration](#) [Reports](#) [About](#) [Logout](#)

Flight Entry

Welcome **Mike J McCall of Mike**

Your accumulated dose:
(μSv = microsieverts)

Current Quarter
0 μSv

Current Year
0 μSv

All Time
283.3 μSv

Organization:

Departure Date: * (month day year)

Departing: *

Bound For: *

Flight Number: *

Initial Ascent: * (minutes)

Final Descent: * (minutes)

Altitude (feet)	Altitudes Time At Altitude (minutes)	Crew List
1: <input type="text" value="37000"/>	<input type="text" value="360"/> *	1: <input type="text" value="Lafortune, Jeff"/> <input type="button" value="v"/>
2: <input type="text"/>	<input type="text"/>	2: <input type="text" value="--select a crew member--"/> <input type="button" value="v"/>
3: <input type="text"/>	<input type="text"/>	3: <input type="text" value="--select a crew member--"/> <input type="button" value="v"/>
4: <input type="text"/>	<input type="text"/>	4: <input type="text" value="--select a crew member--"/> <input type="button" value="v"/>
5: <input type="text"/>	<input type="text"/>	5: <input type="text" value="--select a crew member--"/> <input type="button" value="v"/>
6: <input type="text"/>	<input type="text"/>	6: <input type="text" value="--select a crew member--"/> <input type="button" value="v"/>
7: <input type="text"/>	<input type="text"/>	7: <input type="text" value="--select a crew member--"/> <input type="button" value="v"/>
8: <input type="text"/>	<input type="text"/>	8: <input type="text" value="--select a crew member--"/> <input type="button" value="v"/>

[Import Flight Information](#)

NOTES:

Items marked with * can not be left blank.

Press **Calculate Dose** to calculate the dose without saving a flight record.

Press **Save Flight** to calculate the dose AND save a new flight record.





PCAIRE Inc.

The company



PCAIRE Inc.

- A Canadian company
- PCAIRE is run on secure servers at the Ottawa office
 - Individuals may use this service to track annual dose (e.g. aircrew not covered by EC 96/29)
- PCAIRE is also run on airline servers
- Current airline clients are worldwide



Clients

- Air Berlin
- LTU
- HAPAG
- TUI
- Blue Wings
- Sun Wings
- Veissman
- Privatair
- Air Canada
- NATO Germany
- German Air Force
- Canadian Air Force

Certification

- PCAire has been certified by the airline regulator in Germany – LBA
 - Completed in June 2004
 - Nine month certification process
- This certification is recognized by all EU countries
- PCAire has conducted detailed data collection and R&D and will propose an updated version for re-certification:
 - New H^* to E conversion based on ICRP 103 proton/neutron weighting factors

Conclusion

- PCAIRE is founded on years of in-flight measurements by RMC
- PCAIRE was developed specifically for air carriers
- PCAIRE Sys is designed for a production environment
- PCAIRE Sys is ready for use by all sizes of air carriers



