

Case Study

“Defense in Depth”

Hotellier Connectors

John J. Scott

Defense in Depth



Within the study of Safety and Accident Avoidance the term “Defense in Depth” is often used.

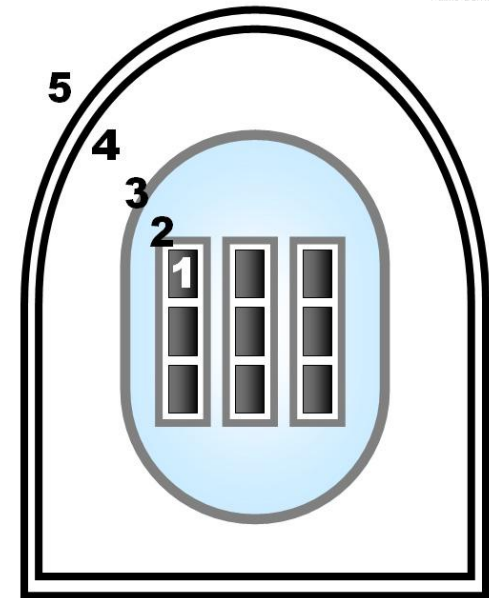
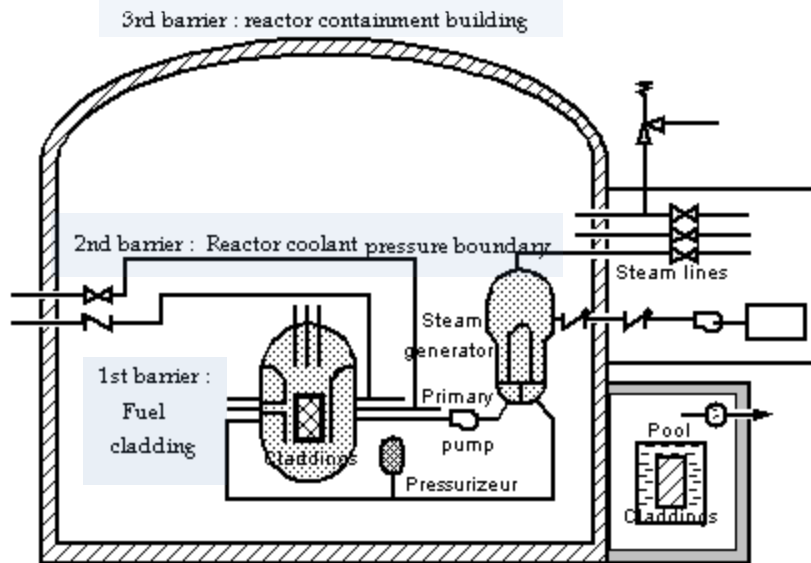
The term is somewhat overused as it means slightly different things to different people.

Defense in Depth



Within the Nuclear Community it can refer to successive layer of physical barriers.

Pekka Tuominen '06
Public Domain

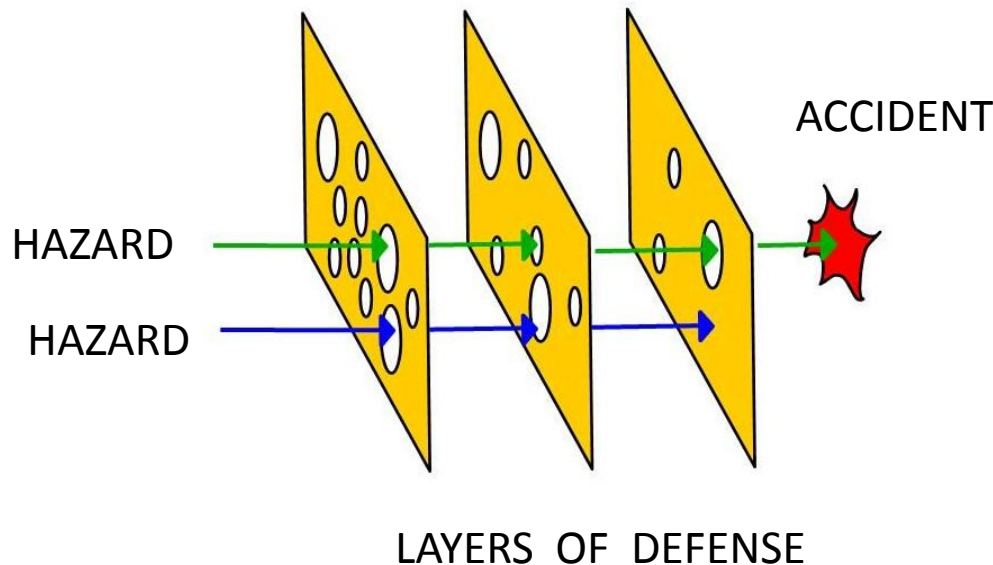


Once defeated, they stay defeated.

Defense in Depth

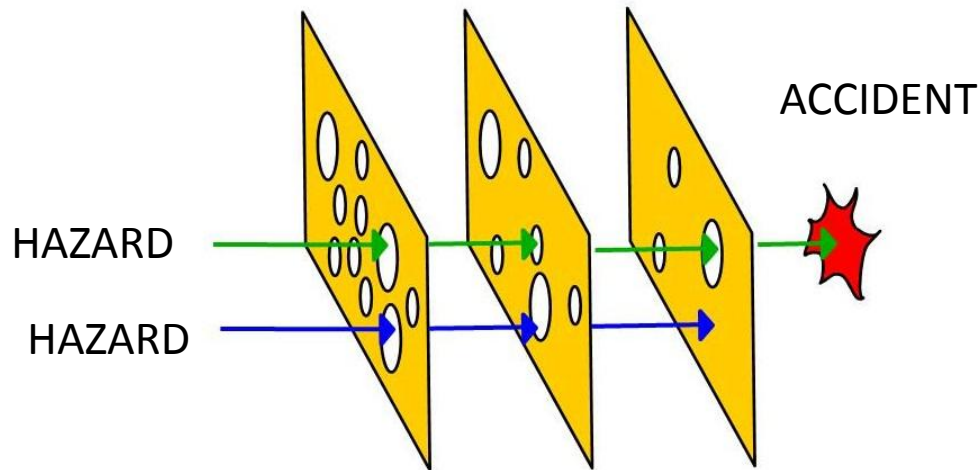


Within the aviation community, the Reason's Model is a commonly used approach to examine accident prevention. It is also referred to as the "Swiss Cheese" model of accident causation.



The model shows "holes" in each barrier to reflect the fact that no control is perfect. This is especially true when considering human factors.

Defense in Depth



The greater the number of barriers the more "Depth" there is to the "Defense".

"Barriers" or "Controls"

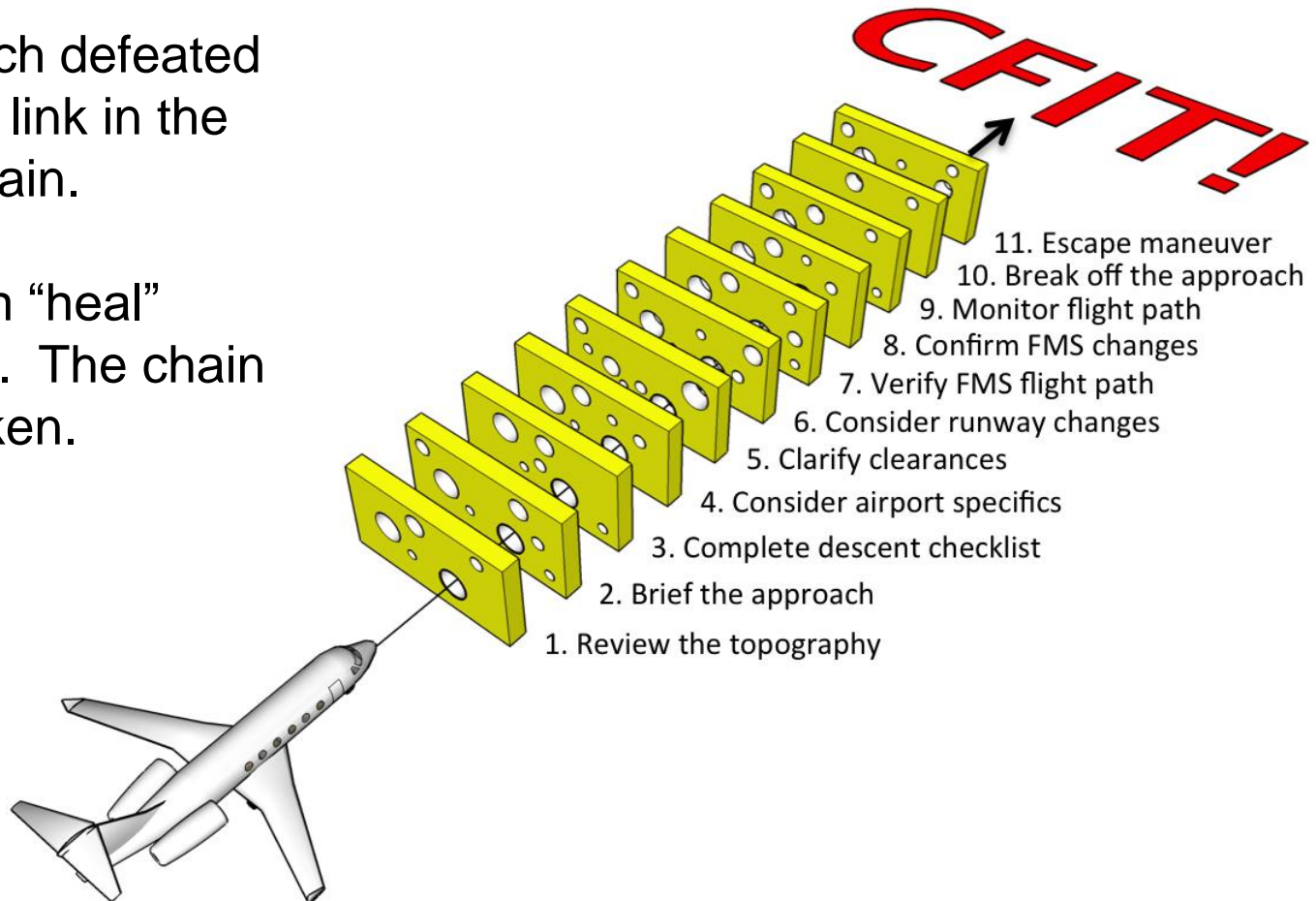
Controls can be Engineering or Administrative.

Defense in Depth



Think of each defeated barrier as a link in the accident chain.

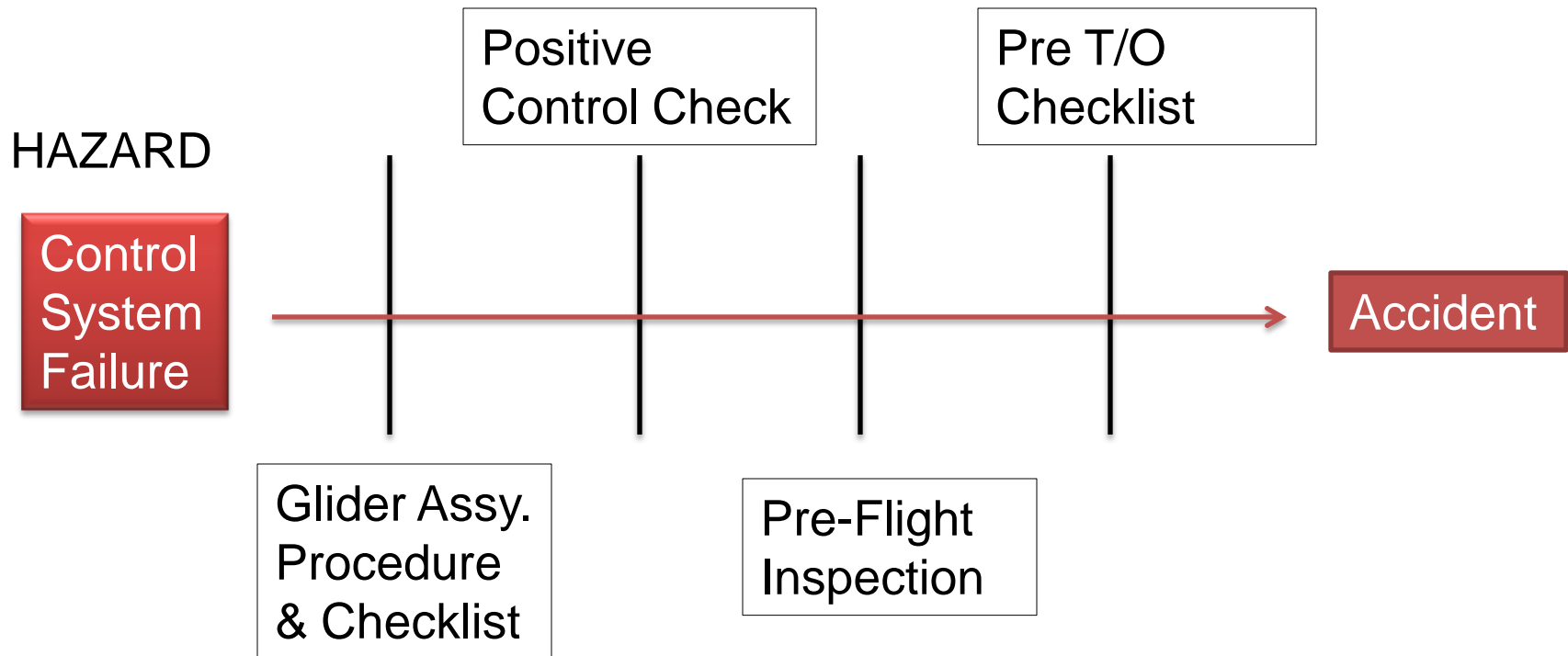
Barriers can “heal” themselves. The chain can be broken.



Defense in Depth



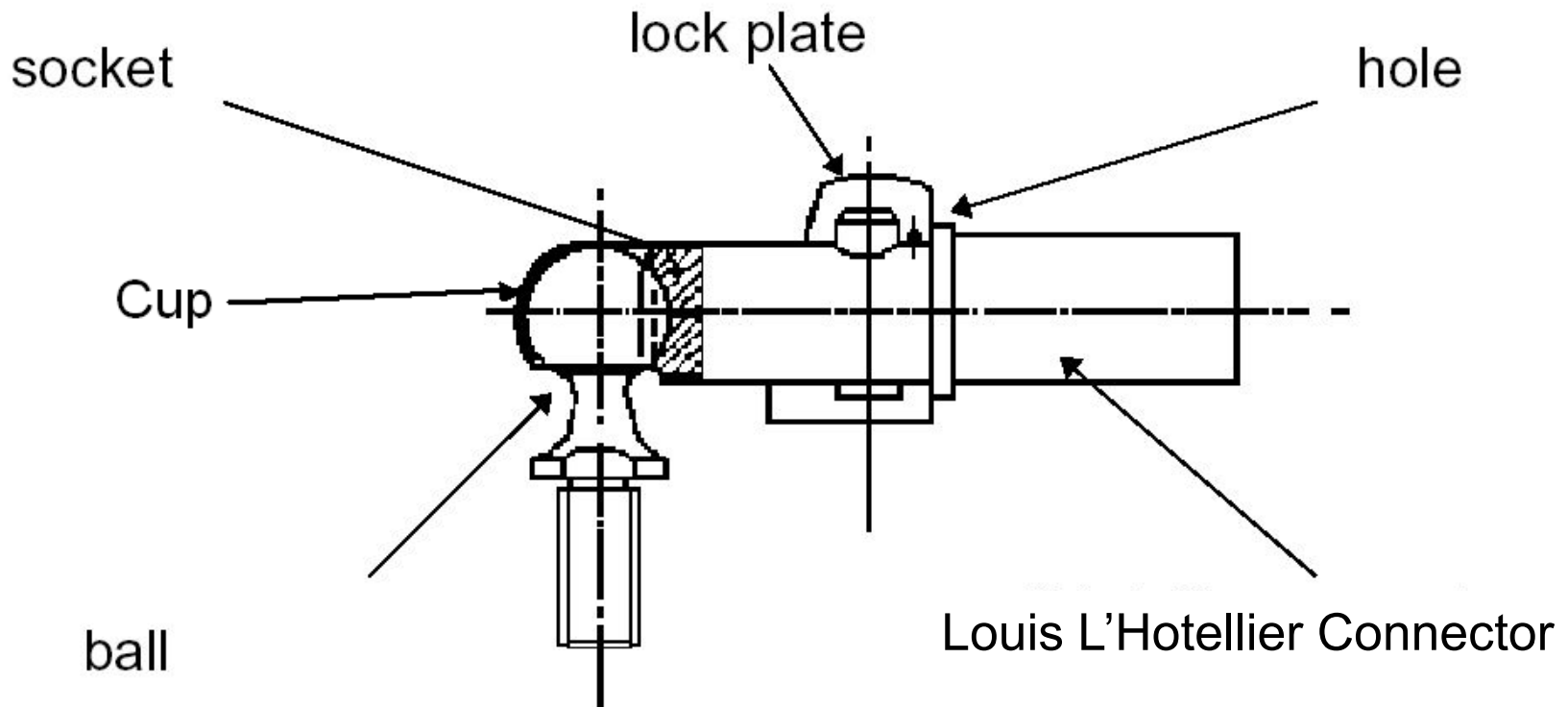
Here is our glider example.



Defense in Depth



Unfortunately, these layers of defense aren't always enough !



Defense in Depth



Advantages

Allow “kinematic” operation (linear to rotational).

Cost effective, compact, quick and easy to connect.

Disadvantages

Injured or killed too many glider pilots.

Hotellier connector can be “partially installed” allowing a defeat of all four (4) protective layers.

This connection status is unstable and will either “fall on” or “fall off” when vibrated or loaded.

Defense in Depth



Hotellier connectors are used on a number of the older gliders.

The Pegasus (1981) was about the last glider to use a Hotellier connector on the elevator.

Many of these gliders can be found at Air Sailing.

Manufacturer	Models
Alexander Schleicher	ASK21, ASK23, ASW 12, ASW15, ASW15B, ASW17, ASW19, ASW19B, S 12, AS-K13.
Centrair, S.N	101, 101A, 101P, 101AP, and 201B.
Eiravion	PIK 20, PIK 20B, and PIK 20D.
Glaser Dirks	DG100, DG400, and DG-500M.
Burkhart Grob	G102 Astir CS, G102, G103 Twin Astir, G103 Twin II, G103A Twin II Acro, G103C Twin III SL, G109, and G109B.
Intreprinderea ICA (Lark).	IS-28B2 and IS-29D2.
Rolladen Schneider ...	LS1-f and LS3-a.
Schempp-Hirth	Cirrus, Std. Cirrus, Nimbus 2, Nimbus 2B, Janus, Discus a, Ventus a/16.6.

ASW20A,B

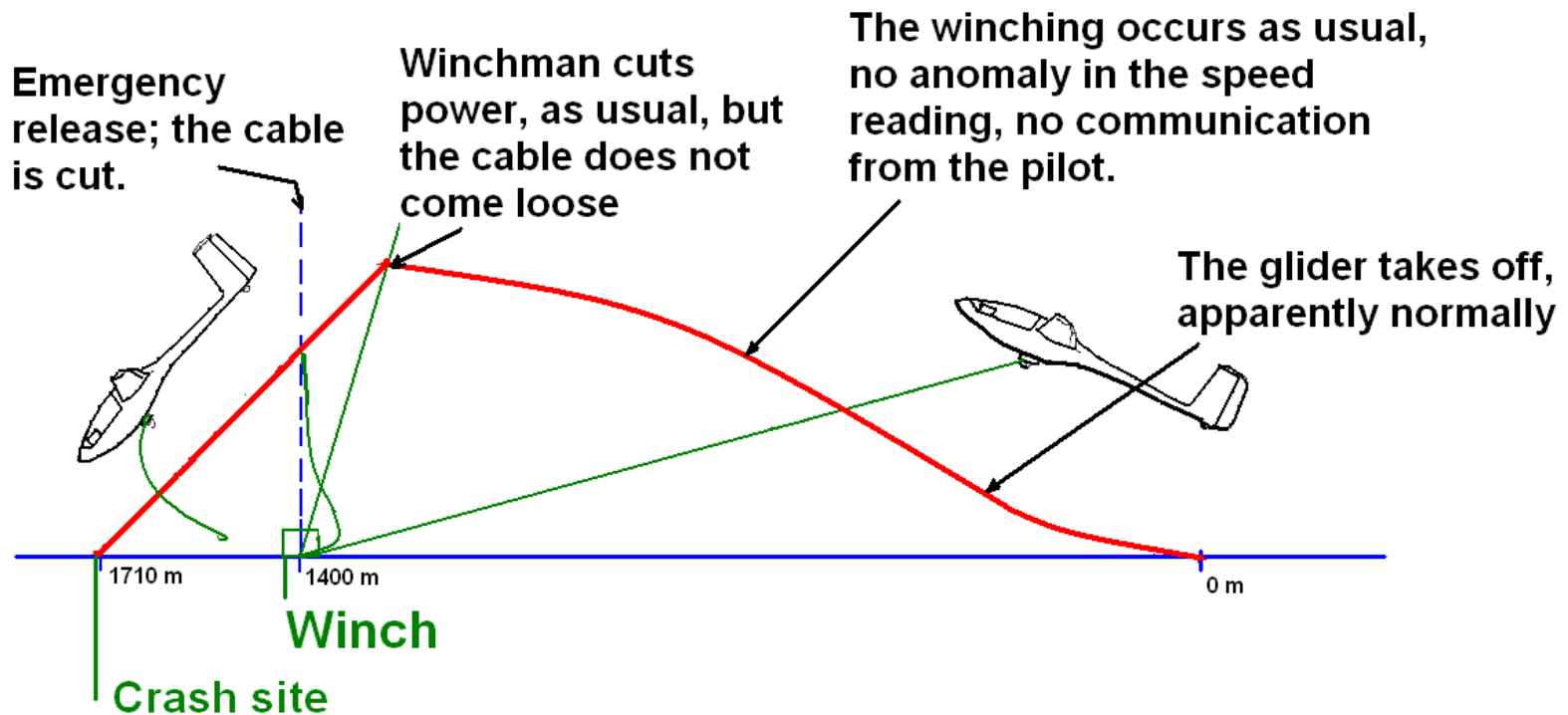
Defense in Depth



Elevator Connection

- Hard to Reach
- Hard to Manipulate
- Hard to See
- Hard to Verify

Defense in Depth



The "Classic" and too often repeated accident scenario

Defense in Depth



The accident scene.

Defense in Depth



Another fatal accident. One of many for Hotellier connectors.

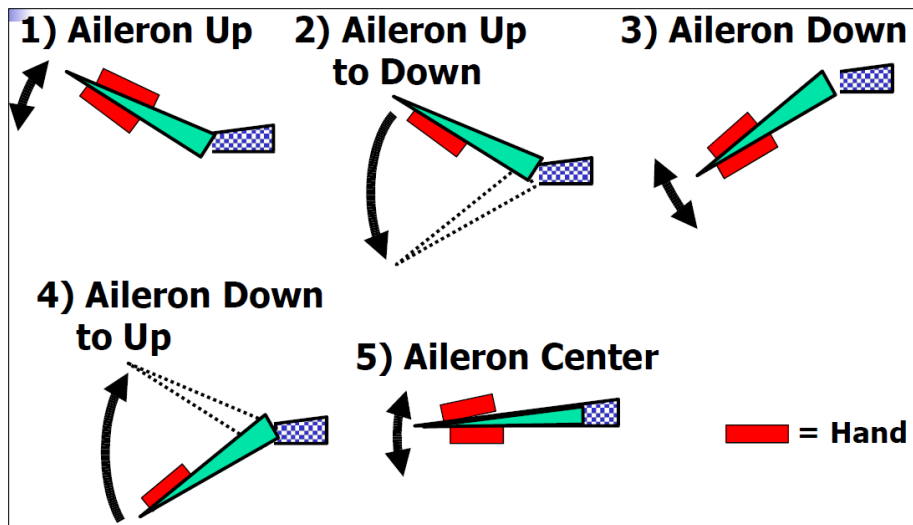
Defense in Depth



Many pilots have survived these crashes.

Q: Why didn't you do a "Positive Control Check?"

A: "I did !!" "But there was no one around so I did it by myself."



A "Positive Control Check" requires 2 people so that force can be applied to the mechanism.

Defense in Depth



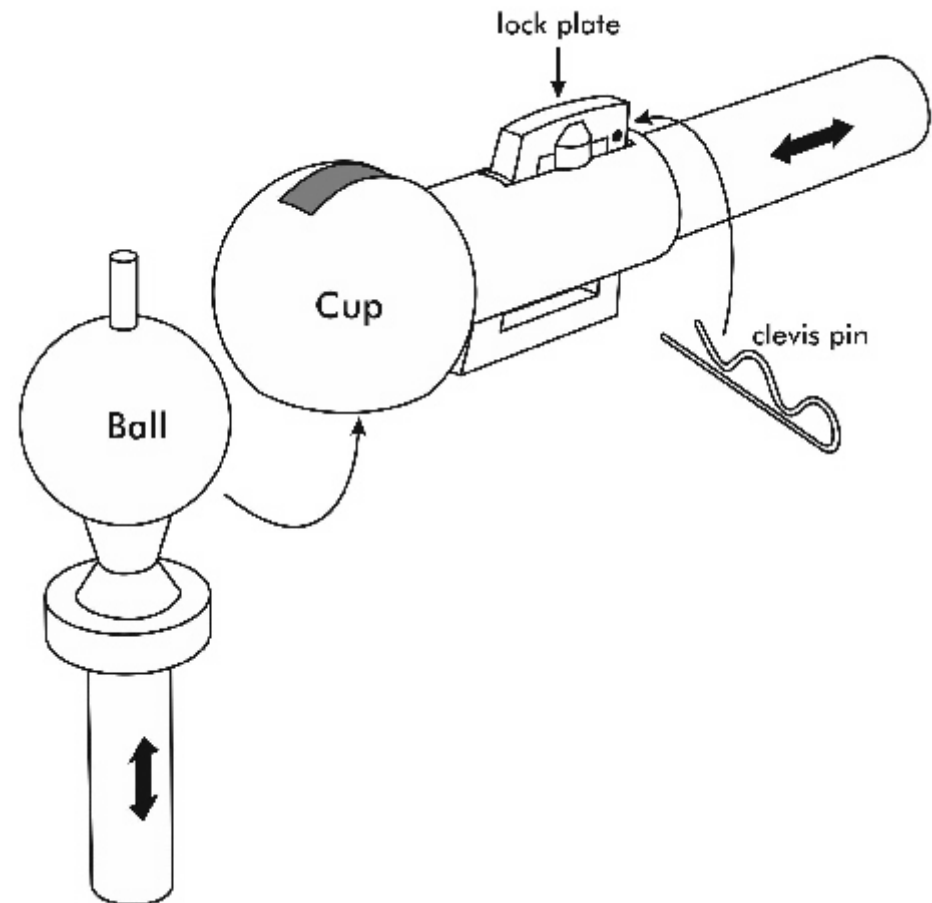
Defense-in-Depth Solution:

Add another layer of defense that requires a “Clevis Pin” be installed.

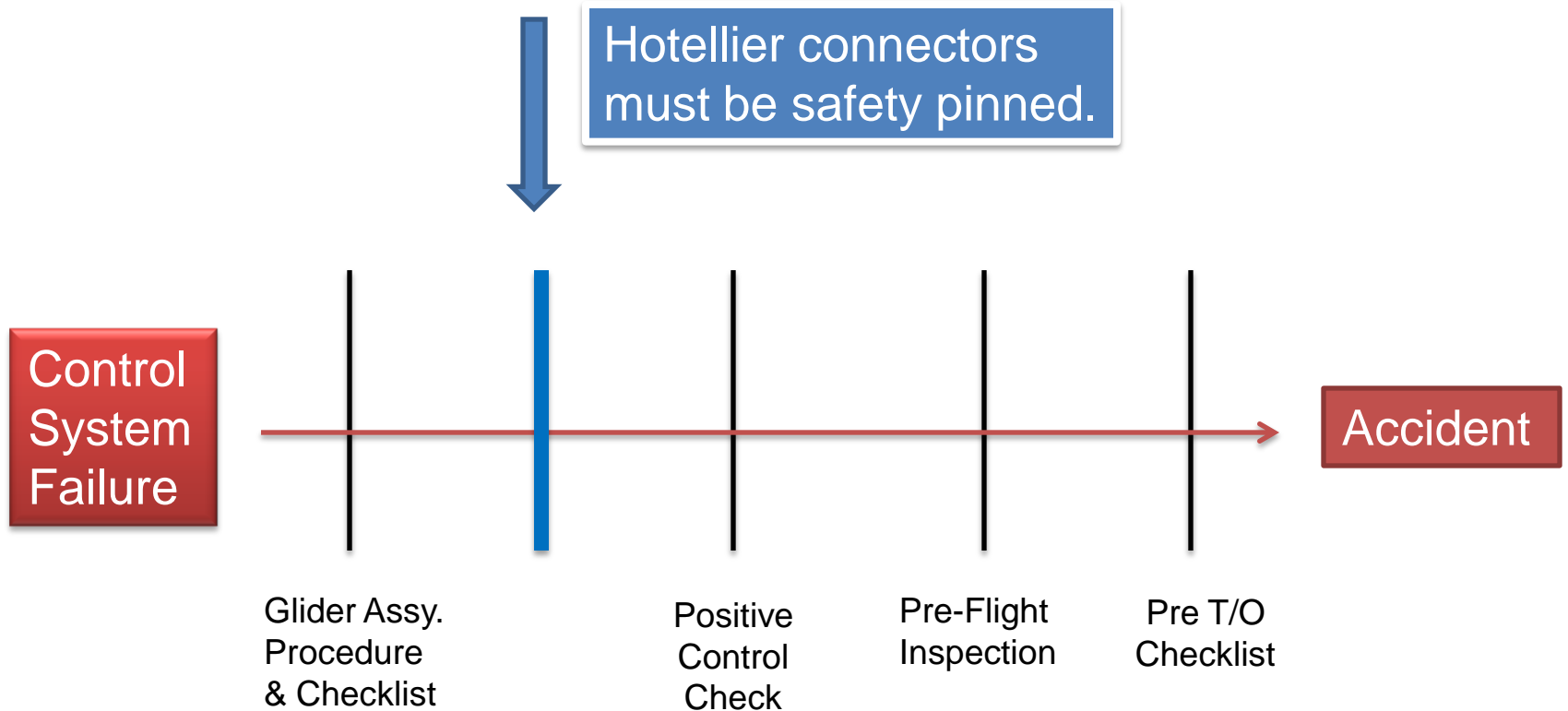
This ensures that the mechanism is fully closed.

There are ADs in Europe and the US that require this.

The ADs also require that a placard be installed.



Defense in Depth



The added layer of defense guarantees discovery.

The End