An integrated system for safety analysis and management in LPG industry

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LPG industry

- Liquefied petroleum gas (LPG) industry is important in Italy and worldwide
- LPG depots and bottling facilities are the most simple and common, among hazardous industrial facilities
- This industry is ruled worldwide by standard codes and regulations.
- In many countries the facilities are small sized and operated by persons with high skill but low education level.
- A suitable benchmark to study the limits of present safety management systems and to experiment new solutions

A new method, aimed to fill the gap between safety documents and operational experience.

Deductive or inductive?

- In a small sized haz. facilities the first concern of operators is complying with the regulations.
- Due to the poor expertise, the safety documents are usually outsourced to consulting firms.
- The inspiration of the present work is to reverse the reasoning way of duty operators.
- Operators may learn a lot of things from experience and may improve definitely the safety system

Safety digital representation

- Equipment digital representation used for supporting hazard analysis. In previous papers* it has been derived from a CAD model, here a new solution will be presented.

- Safety Digital Representation = Equipment digital representation + digital safety documents + link

- Safety digital representation to assist duty holders in preparing and updating the safety documents (safety report & safety management system)

- Safety digital representation to analyze near misses

* Bragatto &al. (2007) *J. of Loss Prevention in the Process Industry* 20 pp. 69-78

The pillars of the Safety System

- Safety Assessment (Annex II Eu. Legislation)

Hazard identification and ranking

Analysis of historical accidents

List of top events (with likelihood)

- Safety Management (Annex III in Eu. Legislation)

Safety Policy – Safety Management Manual

Operating Manual

Inspection Plan

Emergency Management

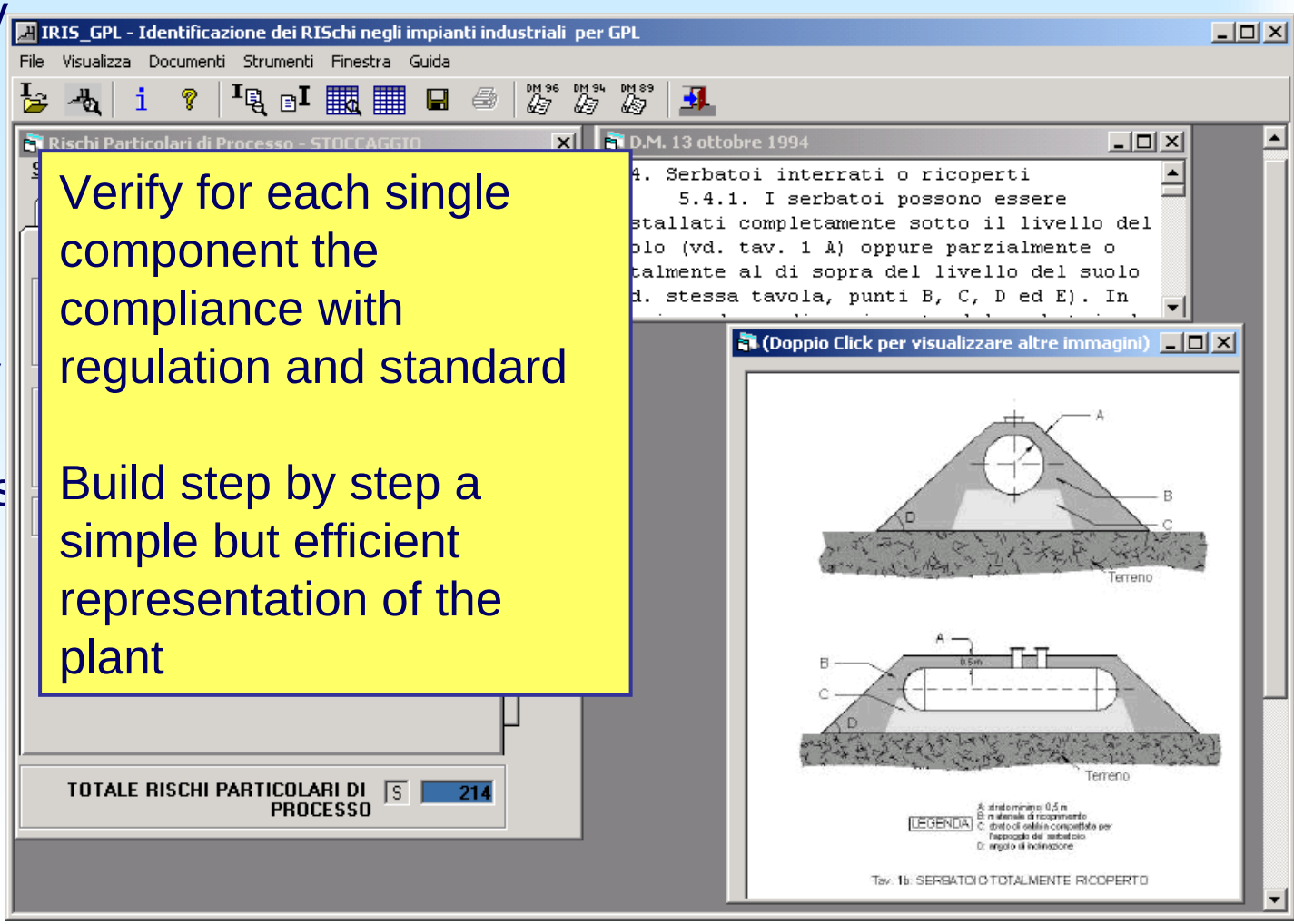
Mond index customized for LPG industry

- A tailored method version of Mond Index for LPG depots and bottling facilities (enforced in all LPG establishments since 1996). It is based on check list, penalities and credits.
- An accurate scrutiny, according to a check list, of each unit.
- At the end of the scrutiny for each unit the risks are weighted, discriminating explosion, fire and general risk.

Mond index for digital representation

Exploit scrutiny phase to build step by step a digital representation of the plant.

By the scrutiny of the plant, two side effects may by derived:



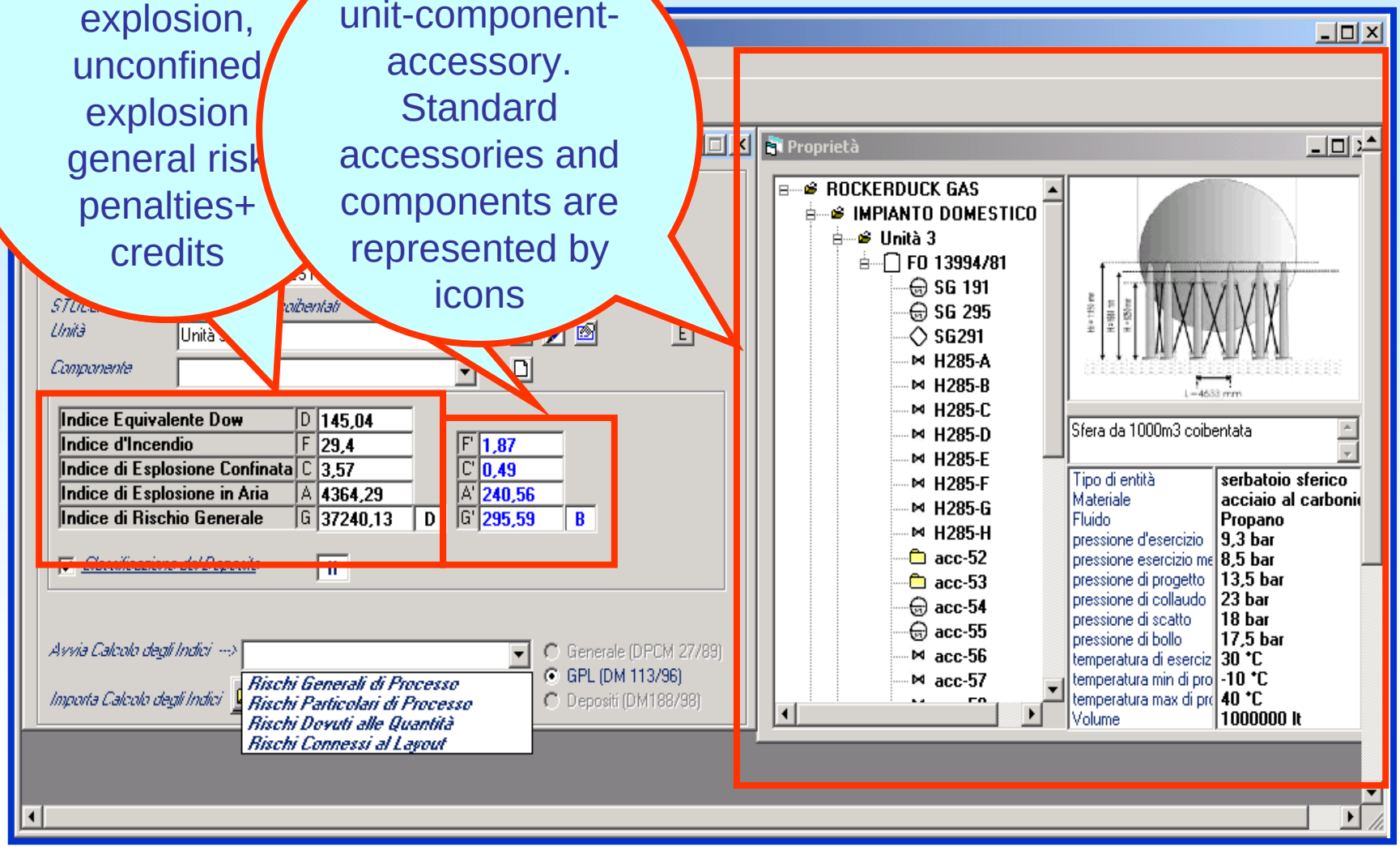
Verify for each single component the compliance with regulation and standard

Build step by step a simple but efficient representation of the plant

indexes for fire, confined explosion, unconfined explosion general risk penalties+ credits

The hierarchy unit-component-accessory. Standard accessories and components are represented by icons

ment digital representation



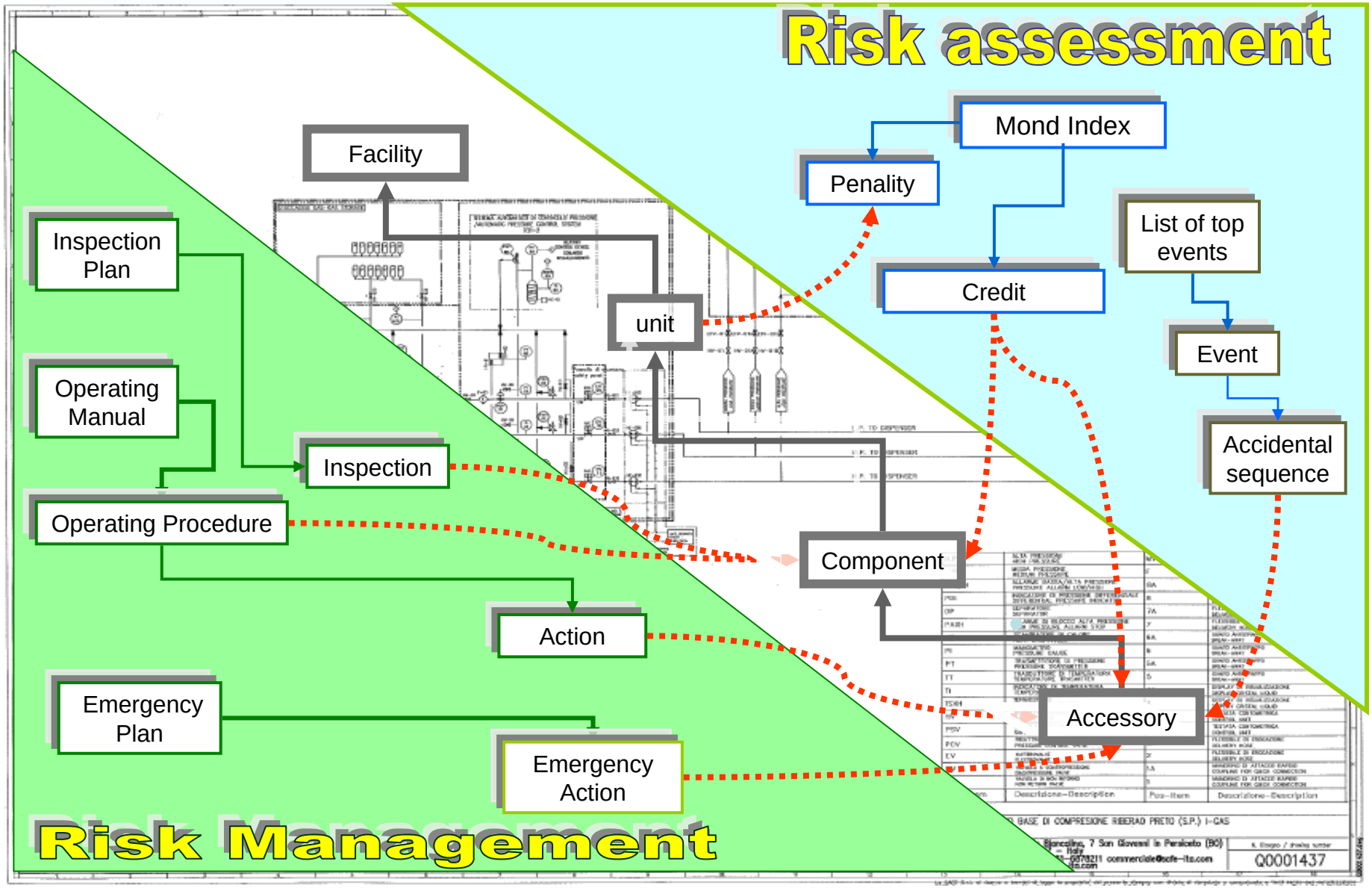
Link equipment – safety documents (examples)

- Example 1 A technical safety system, (e.g. fire-fighting component) is taken into account for computing the risk credit in the Mond/LPG index check lists. A link between the individual component and the credit factor in the Mond/LPG index may be established.
- Example 2 An accessory is critical as may have a failure , which is in the event chain that leads to an accident with major consequences. It may be tagged and linked to the single event, which is present in the list of top events, as handled in the Safety Report.

Link equipment – safety documents (examples)

- Example 3 An action of a procedure. It requires an operation to be done on an individual accessory (e.g- a valve), which is, of course, included in the equipment digital representation.

- Example 4 The inspection plan, which has a list of individual piece of equipment, which may be found in the plant digital representation.


Risk assessment
Mond Index
Penality
List of top events
Credit
Event
Accidental sequence
Facility
unit
Inspection Plan
Operating Manual
Inspection
Operating Procedure
Component
Action
Accessory
Emergency Plan
Emergency Action
Risk Management
Q0001437

Benefits from safety digital representation

- A definite consistency between Safety documents and actual equipment may be assured in this way.
- Any change in installation may be reflected in the Safety documents.
- For any piece of safety document the piece of equipment may be found, which may be affected.
- Revision /reviewing of Safety Assessment every 5 years or following plant or process changes
- Revision /reviewing of Safety Management every 2 years

As easier as possible ..

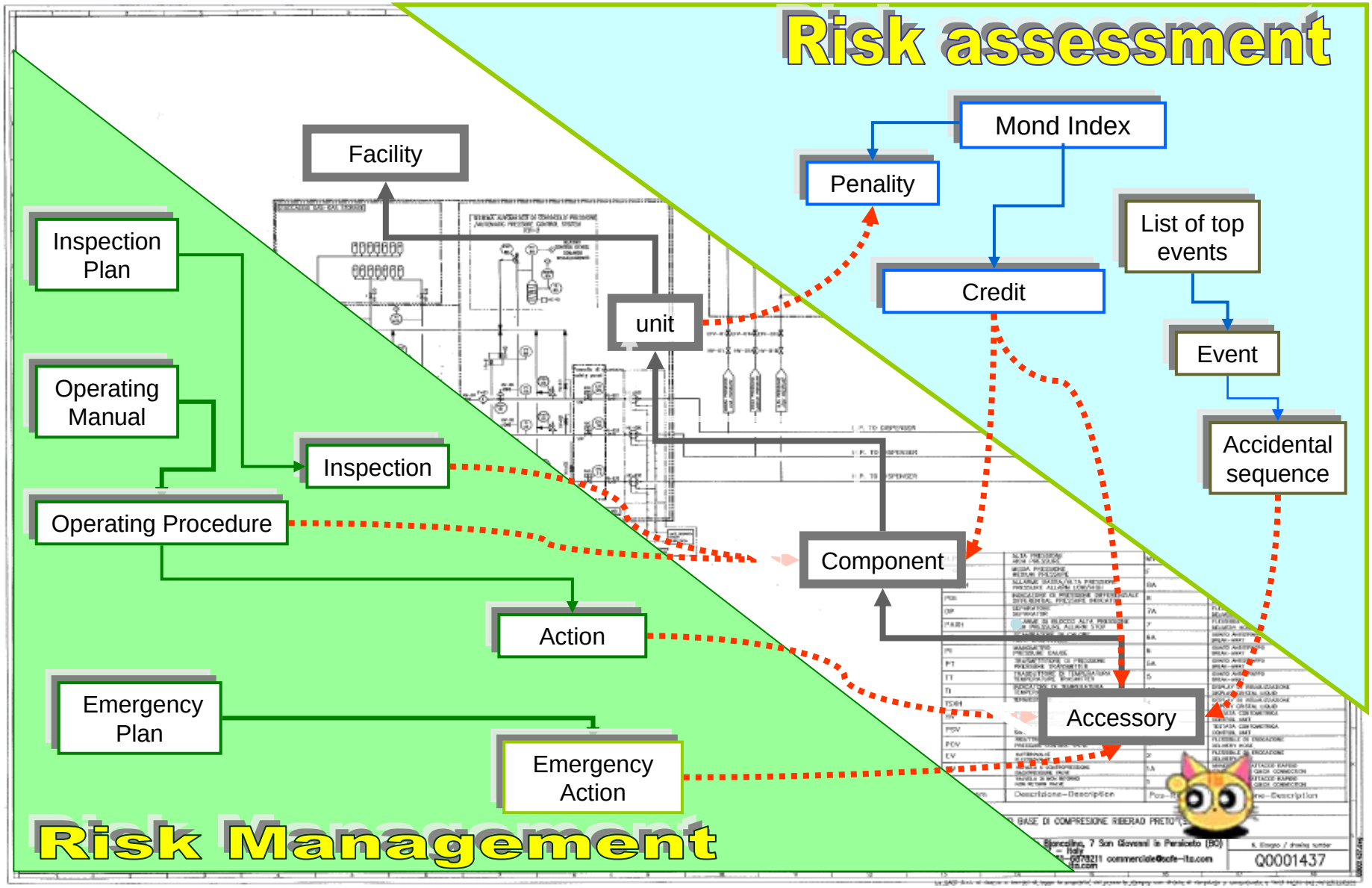
- The need of recording and analyzing non-conformances, near-misses and failures, which are much more frequent than accidents.
- The usual formal approach for accident analysis is too difficult

Our approach: **navigate the documents, which are the pillars of the safety system**. The chart for the navigation is the SAFETY DIGITAL REPRESENTATION

The information coming from near misses may be used basically for :

✓Safety Management System (operating manual and inspections plan)

✓Safety Report (hazard identification and list of the top events)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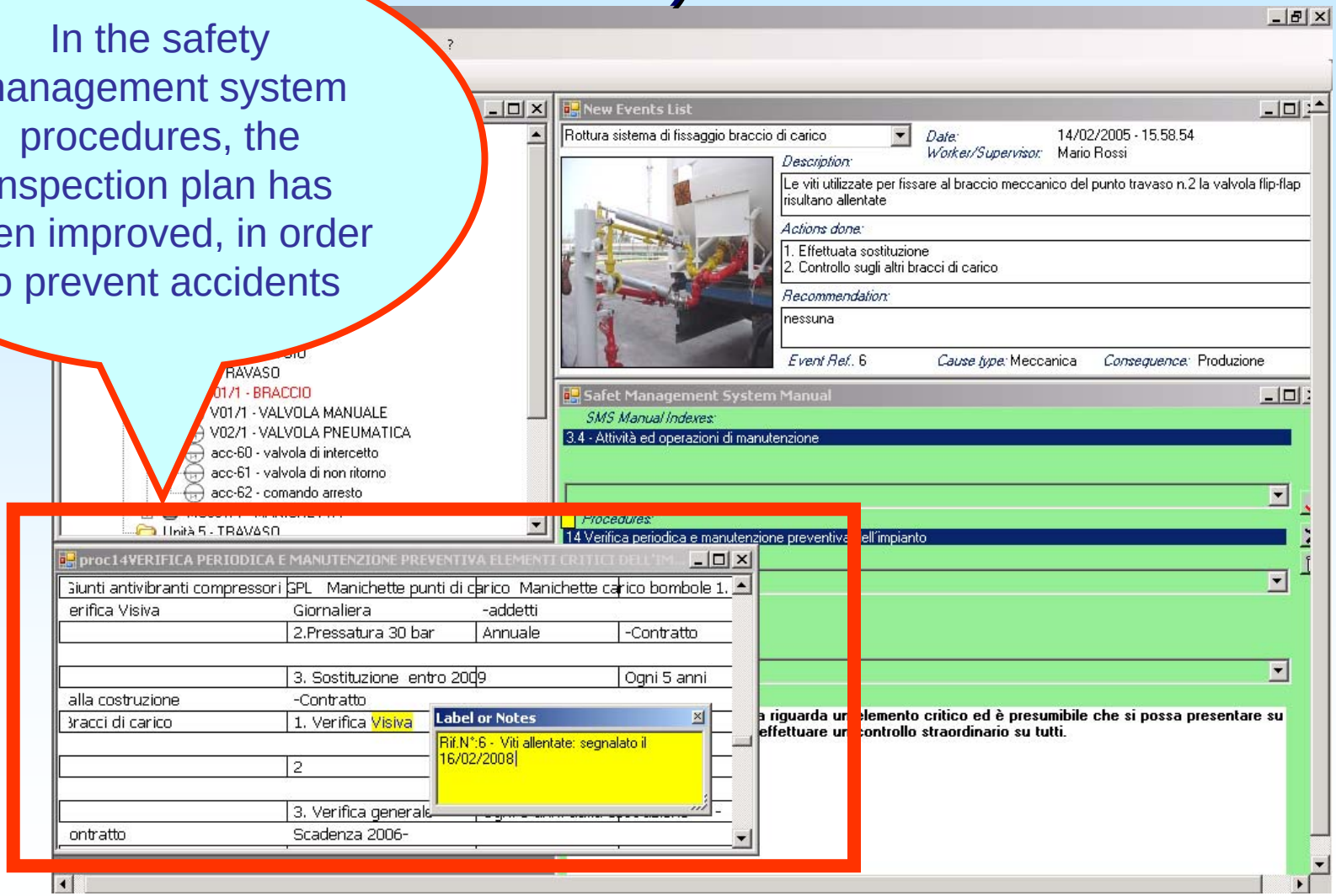
Non Conf. Event (Safety Assessment Top Events)

Unit - Mond/GPL index D-Dow; F-Fire;Confined Expl;

From the list of top events in the Safety Report: the failure; the top event, which could happen; The events sequence

Non Conf. Event (Safety Mgmnt - Inspection Plan)

In the safety management system procedures, the inspection plan has been improved, in order to prevent accidents



Exporting Results

- It is possible to build a “safety digital representation”, which may be used for reporting and analyzing near misses, as well as for updating safety report and related documents. For building the digital representation, no extra duties are required; but exploiting in a smarter way documents which are already present.
- The high standardization level of LPG industry has been exploited to build the equipment reperesentation during the plant scrutiny. If the standardization was lower this step could be more difficult.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