Early analysis of technical or organisational changes

An early analysis of technical or organisational changes often proves to be insufficient, or overlooked altogether, resulting in numerous accidents. In many cases, it is simpler and less costly to use existing installations in order to develop or advance a particular process. Such a step however does require an in-depth analysis of the modifications, combined with an accurate identification of the risks tied to anticipated changes.

This document presents a few examples of accidents before revealing the tools available to enable the successful completion of such analyses.

1. Accidents recorded in the ARIA base

1.1. Typology of events

Among the most significant accidents sampled for this study, the following cases merit attention :

- Hastily planned modifications, carried out in the aim of saving time or money, without an adequate risk analysis :

  - ARIA 16632 : Replacement of a 1-kW heating mantle by a 3-kW model on a chlorine bottle in order to raise workshop productivity. 4-kg leak of chlorine.

  - ARIA 31317 : Increase in the colour change frequency for electrostatic bowls inside a paint booth, thus eliminating the possibility of dissipating electrostatic charges between 2 bowl loads. Consequences : 2 deaths, several injuries, tremendous property damage.

- Modifications introduced but not tracked and “forgotten” : ARIA 2900, 43616.

- Evolution accompanied by technical modifications, yet without sufficient risk analysis :

  - ARIA 43685 : Modified nitrogen injection but with inadequate recognition of the presence of hydrogen (insufficient sweeping of the expansion space). Partial opening of a tank roof.

  - ARIA 27467 : Installation of a second cooling circuit, though without a proper backflow preventer, to efficiently separate the two networks. Introduction of glycol in the water supply network.

  - ARIA 32640 : No resetting of instrumentation subsequent to modifications allowing individual compactors to no longer feed one, but several, tanks. Spreading of $ZrCl_4$ following a break in the vent pipe.

  - ARIA 37060 : Modification, consisting of reincorporating manufacturing rejects, that failed to be taken into account in lowering the product ignition temperature induced by the modification. Destruction of a drying oven.

  - ARIA 49121 : Installation of new stirrers, undermining the reliability of temperature probes (electromagnetic disturbances). Runaway reaction, release of ammonia.

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- Technical modification inducing a change in process settings and leading to a loss of process control:

  - ARIA 22693 : Modification of a mixer to extend its pipes, thus requiring a higher mix temperature to offset the load losses. This temperature increase led to exothermic decomposition of the chemical substances being transferred.

- Poor management of modifications and lack of communication: ARIA 35863, 39354, 40496.

ARIA 43685 © Site operator

1.2. The consequences of these accidents

The study focused on 28 French accidents representative of this particular topic. Though the sample was rather small, certain trends could be detected. Nearly half of these accidents resulted in injuries. Property damage was recorded in nearly 70% of them, and eleven were responsible for a pollution incident.

Consequences	Number of accidents	Percentage
Deaths	1	3,7%
Injuries	12	44,4%
Property damage	18	66,7%
Pollution	11	40,7%

2. Set of tools available

2.1. Full understanding of the history behind the unit or the equipment and its characteristics

Over the life cycle of a given unit or equipment, it is commonplace for modifications to be introduced subsequent to a process update or change in manufacturing protocol. Having complete knowledge of this history is key to making the right choices regarding which modifications to perform. As such, the following questions need to be asked :

- What does the unit produce or what has it been producing over its service life (should production have been discontinued) ?
- Which materials had been used as equipment inputs, which substances had been present ?
- Have the modifications performed been commensurate with the product / equipment characteristics ?
- In the event of modifications leading to a change in process settings (temperature, pressure, etc.), have process controls continued to be maintained ?
- How are the various networks (reagents, water, steam, etc.) laid out, can they still accommodate the planned modification ?
- Has attention been paid to controlling degraded operating conditions (cooling circuit design, retention basins, blowdown systems, etc.) ?
- Are the safety barriers in place still adapted (relief valves, rupture discs, etc.) ?

2.2. Risk analysis for any modification, even one considered to be minor

Risk analysis is critical to any alteration in unit operations. A good understanding of the unit history, along with effective communication between departments and close monitoring of operations, still falls short when not accompanied by a preliminary risk analysis. Third-party expertise may prove helpful in successfully conducting such an analysis.

2.3. Training, organisation, control, communication

Technician training, well-coordinated internal company organisation and effective communication between departments ensure that modifications and controls are being well monitored and moreover serve to answer the following questions:

- Who was doing what ?
- Have modifications been performed ?
- Which controls had been implemented, on which equipment ?

2.4. Procedural updates, written operating instructions, potential modifications

Procedures and instructions offer guidelines for technicians. Producing a document that retraces the history of operations is important as a means by which technicians can relate to the other teams and learn the exact condition of equipment. In association with effective communication, such documents help safeguard the unit's smooth operations.