Fact sheet

Risk analysis and works projects

*Accidents analysis related to works projects, whether maintenance, modifications, improvements, or even the dismantling of installations, are often discussed and point to the seriousness of such events, particularly in terms of human consequences. Over the 20-year period 1992-2012, while these phases **gave rise to circumstances surrounding 10% of all accidents occurring at France's classified facilities, they were the source of 30% of all recorded accidents involving deaths**; this high value can be explained at least in part by additional human presence in the vicinity of installations when carrying out these works. These observations encompass tasks conducted not only by site personnel, but also subcontractors more or less frequently present in this environment not always familiar to them.*

*Many accidents recorded in the ARIA database illustrate that works-related tasks are too often being performed today **without first thoroughly analysing the risks**. All industrial sectors are involved (led by chemicals, steelmaking and food processing), including the most common ones like filling stations.*

This **"risk analysis" constitutes an essential preliminary step** to any works intervention regardless of its scope and moreover requires a detailed description of the scheduled tasks. To ensure its thoroughness, an analysis takes into account the specific unit targeted by the project in addition to all nearby units likely to be affected, shared supplies, measurement chains and common safety functions. The concern for **workers' safety** must be an integral component of the evaluation undertaken prior to initiating the works, namely as regards toxic risks or asphyxia. Attention must also be focused on **potentially "ATEX" explosive zones**, both those easily identifiable (vapour space of flammable liquid tanks, enclosures with accumulation of combustible dusts, gas tanks, etc.) and all **confined zones** used as the site of future hot works; atmosphere verification using an explosimeter, draining and "rinsing" of containers, and inerting are just some of the measures capable of mitigating risks.

Source: BARPI

In many instances, an imprecise representation of the installation (due, for example, to an **overly cursory examination** or drawings that fail to be updated following unit modification) yields a faulty risk analysis, hence a potential source of accidents.

Ultimately, this analysis must lead to **adopting procedures** and a works schedule, as well as to laying out safety instructions and, if applicable, hot work permitting. **An accurate and detailed dissemination of information to task participants** (supervisors and crew members) and all site personnel eventually involved proves essential. In addition to this information, subcontracted personnel must also be informed about the site's inherent risks (e.g. gas or dust explosion, fire, product toxicity), existing knowledge of the targeted installations and adjoining facilities, emergency response measures and evacuation exits, and contacts to notify should a problem arise.

Beyond this essential risk analysis phase prior to initiating works, the operational phases, which consist of **preparing the worksite, ensuring compliance with safety procedures and measures by assigned work crews, accepting the completed works and restarting installations**, are elements just as critical whose absence or inadequacy has been the cause of many accidents.

1. Hot liquid leak in a refinery:

ARIA 26757 – 25/11/2003 - 76 - PETIT-COURONNE

19.20 - Oil refining

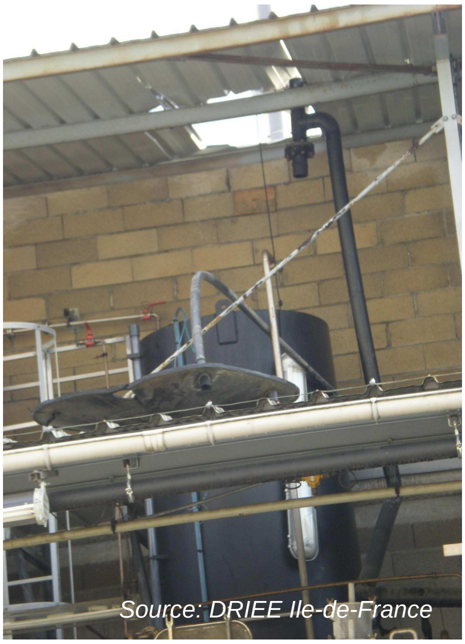
Inside a refinery, during repair works conducted while a vacuum distillation unit was down, 3 workers were sprayed by a hot liquid and a product leak was detected. At the outset, the work crew employed by a subcontractor was scheduled to repair two devices: exchanger 602, which had been inoperable since March 2002 and whose gland needed to be disassembled; and exchanger 581, which had to be plugged by means of joint replacement subsequent to a water leak. On 25th November around 2 pm, the crew was informed that the sleeve on the 602 device had been successfully disassembled. The workers proceeded to climb the scaffolding and began to remove some of the exchanger equipment when a hot oil leak occurred: all 3 of them on the scaffolding were sprayed by the 200℃ product and sustained 2nd-degree burns. A loss of confinement was detected at the level of the column corresponding to exchanger 581. **In reality, the accident was caused by mistaking one piece of equipment for another:** the crew was working on the other exchanger, which was still running since it had been scheduled for only minor repairs. The device did not seem abnormally hot to the crew. Following this accident, the refinery operator adopted plans to: **improve information disseminated to crews prior to performing works,** better prepare work zones (clear indication of devices, site accompaniment, **systematic risk analysis before initiating repairs**). The operator also made an effort to explain the technique for quickly operating safety showers, since their use was delayed during this accident.

2. Bursting of a tank at a chemical plant:

ARIA 43284 – 18/10/2010 - 91 - VERT-LE-PETIT

20.14 - Manufacturing of other basic organic chemical products

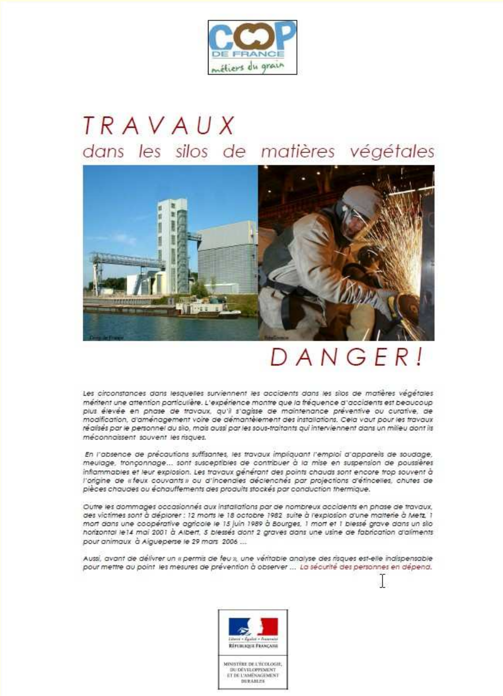
In an upper-tier Seveso-rated organic chemical plant, a subcontracted employee had been involved in welding work on a pipe running 2m aboveground for 30 minutes while perched on a stepladder. This repair job, requiring a gas tungsten arc welding (GTAW) station, was intended to connect a pipe used to inert a temporary solvent storage tank to the plant's nitrogen supply line. **This weld was undertaken following a quick nitrogen flush performed by the employee**. At 4:45 pm, just a few seconds after completing the operation, as the welder was climbing down from the stepladder and exiting the zone, the 10-m³ polypropylene tank burst, sending its plug through the roof of the hangar housing the storage tanks. The worker and two other subcontractors in the zone were not injured. The classified facilities inspectorate was duly notified. A level sensor installed on the tank plug was ejected onto the roof and fell to the ground; the manhole, filling tap and pressure relief valve were also found on the hangar roof.


Source: DRIEE Ile-de-France

The damaged tank had been drained 3 months prior and degassed. **All of the damaged pipe had previously been verified by running water through it**. No combustion traces, combined with the fact that the damaged tank had been the only one capable of receiving nitrogen on the day of the accident (i.e. its shut-off valve had remained open), led to the hypothesis of a pneumatic explosion inside the tank. Despite being set at 30 mbar (strength threshold of the tank), the nitrogen expansion valve was capable of supplying a maximum pressure of 37 mbar and moreover, its good working order had not been assured. In contrast, the tank's pressure switch found on the floor indicated a pressure of 27 mbar. The accident might also have been caused by the rapid dilatation of nitrogen subsequent to its reheating when passing through the pipe segment nearest the weld (the GTAW weld had reached 1,000℃) , though the level of the tank's liquid seal had not varied (it should have risen and overflowed in the event of a pressure increase).

A works authorisation that included a hot work permit for welding had been issued for the maintenance operation. This operation was part of an installation optimisation programme conducted in experimental mode, for the purpose of both limiting the risks of product reflux from the tanks into the inerting network and identifying points where nitrogen was escaping from the network. This mode had been selected in order to carry out investigations as the tests progressed and to complete the works in accordance with observed findings. The programme was suspended until a determination could be provided of the specific accident causes. **An analysis of *potential hazards had been primarily focused on risks tied to the presence of petroleum solvents*.** The Classified Facilities Inspectorate noted that in addition to the lack of tank isolation, **these works had not been carried out within the scope of the SGS** installation maintenance procedure and furthermore displayed an **insufficient risk analysis** (regarding the risk of equipment subjected to a pressure surge or drop). In a span of 5 months, this accident was the 3rd on the site and the 2nd pertaining to works assigned to subcontractors.

As the logical consequence of the risk analysis, the **hot work permit** is the operational document associated with works carried out at hot spots (welding, grinding, slicing, etc.) and is to be produced ahead of the intervention. Co-signed by the site operator (user firm) or the operator's representative, as well as by the designee for physically overseeing the general safety of hot spot work and (when subcontracting is involved) by the contracted firm, this document is often regulatory in nature and legally frames the scheduled works. This **limited-term authorisation** is sometimes considered by companies as a simple obligation drafted in "superficial" terms by replicating standard clauses. The hot work permit must in fact provide a detailed list of all **risks associated with the particular works** (e.g. presence of dust, gas, the risk of explosion, spreading, projections of incandescent particles) and indicate the **safety measures to be implemented** regarding both prevention and protection (cleaning of the work zone, use of flame-retardant tarps, fire-fighting resources, alarm systems, site monitoring following the completion of work by hot spots over a suitable time period). If subcontracting is an option, then these safety measures must be determined out of a joint agreement between the subcontractor and the site operator (user firm). Explaining the nature of the hot work permit (both risks and related measures) to technicians is also essential.


COOP DE FRANCE métiers du grain

TRAVAUX
dans les silos de matières végétales

DANGER!

Les circonstances dans lesquelles surviennent les accidents dans les silos de matières végétales méritent une attention particulière. L'expérience montre que la fréquence d'accidents est beaucoup plus élevée en phase de travaux, qu'il s'agisse de maintenance préventive ou curative, de modification, d'aménagement voire de démantèlement des installations. Cela vaut pour les travaux réalisés par le personnel du silo, mais aussi par les sous-traitants qui interviennent dans un milieu dont ils méconnaissent souvent les risques.

En l'absence de précautions suffisantes, les travaux impliquant l'emploi d'appareils de soudage, meulage, tronçonnage... sont susceptibles de contribuer à la mise en suspension de poussières inflammables et leur explosion. Les travaux générant des points chauds sont encore trop souvent à l'origine de « feux couvants » ou d'incendies déclenchés par projections d'étincelles, chutes de pièces chaudes ou échauffements des produits stockés par conduction thermique.

Outre les dommages occasionnés aux installations par de nombreux accidents en phase de travaux, des victimes sont à déplorer : 12 morts le 18 octobre 1982 suite à l'explosion d'une malterie à Metz, 1 mort dans une coopérative agricole le 15 juin 1989 à Bourges, 1 mort et 1 blessé grave dans un silo horizontal le14 mai 2001 à Albert, 5 blessés dont 2 graves dans une usine de fabrication d'aliments pour animaux à Aigueperse le 29 mars 2006 ...

Aussi, avant de délivrer un « permis de feu », une véritable analyse des risques est-elle indispensable pour mettre au point les mesures de prévention à observer ... La sécurité des personnes en dépend.

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Fact sheet developed in 2008 by a professional body, in conjunction with BARPI, in order to build awareness among silo operators of the risks inherent in hot spot works and moreover assist them in improving their understanding.