RISKS TO MAINTENANCE WORKERS DURING PLANT SHUTDOWNS

WORKSHOP 1: Risk assessment in maintenance

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**Introduction**

- **It is important:**
  - for both client and services provider to be aware of all relevant safety aspects,
  - to include safety already at the negotiation phase.

- **A good assessment tool for maintenance risks should address**
  - work planning (organisations/management),
  - work supervision (client/contractor), and
  - the workers (client/contractor).
The maintenance framework

- Maintenance workers may:
  - be permanent workers with varying tasks on a certain site,
  - specialize on some certain tasks that are executed on various customer sites,
  - carry out various tasks in changing working environments (e.g. shutdowns, temporary evening out of workloads between customer sites).
Maintenance situations

- Regular/routine maintenance
- Unscheduled repairs
- Maintenance during scheduled shutdowns
Taking a risk?
Get a life-jacket

Start-up, shutdown and transition actions are often the most dangerous periods of operation for large scale continuous chemical and petrochemical plants and oil refineries. Yet more often than not, safety instrumented systems, used during steady state, continuous production are bypassed during these important dynamic phases of operation. As a result, safety control is left to a combination of manual procedure, plant interlock systems and the operator's efforts.

The use of safety instrumented systems, or SIS as it is known in industry parlance, is common throughout high hazard process industry sectors, particularly in the chemical, petrochemical, oil & gas and power industries. Here, compliance with the functional safety standards IEC 61508 and IEC 61511 is the accepted and preferred method of demonstrating that functional safety has been managed in accordance with the legal requirements facing all companies.

The inherent danger of flux
For continuous processes the probability of a hazardous condition occurring is often proportionately greater when the process is in a state of flux such as during start-ups, shutdowns, process transitions and maintenance states. Around 70% of major accidents occur during non-routine operations even though plants may be in that mode of operation for 5% or less a year.

The safety instrumented systems associated with these processes are often designed around steady state conditions, but in order to accommodate the non steady state transitions, certain safety instrumented functions are bypassed or overridden. This is where the potential for increased risk starts to appear.

It seems incongruous that just when it is needed most, the safety instrumented system in place is temporarily sidelined, abandoning the intent of the functional safety standards and leaving operators to not only deal with the complexities inherent within any process transition, but to also perform the safety instrumented system function as well.

For a continuous process plant such transitory states are often infrequent and can be of relatively short duration. In such cases it may be that making the safety instrumented system dynamic enough to provide protection at such higher risk occurrences is deemed to be simply not worth the time and expense involved. The lack of similarity between processes or between the transition state and the steady state may make it too difficult,
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A good risk assessment method

-The method should:
  - be suitable for all working environments,
  - emphasize the significance of planning, including, e.g. scheduling and risk assessments regarding new maintenance operations and sites,
  - take into account management, and supervision of the work,
  - take into account various situations, such as working during the night, working alone, and workers with foreign cultural background,
A good risk assessment method

The method should:

- take into account risks related to the maintenance tasks performed and the maintained object (including, e.g. machinery, chemicals, and the handling of objects),
- support safety management, e.g. by identifying hazards in machinery, working methods, and working environment,
- draw attention to safety measures.
Proposed structure of a good risk assessment practise

 Contractor:

1. Safety planning: Used e.g. when receiving a new customer site; before planned maintenance operation; after changes on old sites.

2. Hazard identification: Used e.g. when receiving a new customer site; before a planned maintenance task; after changes on old sites.

3. Worker’s check-list: On site, Used before performing any maintenance task.
Proposed structure of a good risk assessment practise

- **Plant operator:**

  1. Safety planning and management of change: Used e.g. before a planned maintenance operation; when familiarizing a new contractor; when planning changes at old sites.

  2. Hazard identification: Used as above.

  3. Worker’s check-list: Used on site, e.g. before allowing a maintenance task (as part of the work permit procedure).
A Finnish Study on Chemical Safety during Process Plant Shutdowns

- Starting point: Work done during a shutdown should be executed so that the safety level is not decreasing – or is decreasing as little as possible.
The chemical hazards perspective

- Shutdowns need to be addressed because hazardous process chemicals are still present at the installation in storage tanks, warehouses, silos and pipelines even when the production process is not running and some of the equipment have been emptied and cleaned.
Management of Change Procedures

➢ To our knowledge, no published MOC procedures tailored for plant turnarounds exist, even though a plant shutdown is typically characterised by a variety of changes: technical and organisational, temporary and emergency changes.
Temporary Organisational Changes

- The organisation carrying out a shutdown is typically significantly different from the organisation during normal plant operation and, for the most part, the tasks of the plant’s own personnel are different to their routine production tasks.
Shutdowns as temporary changes

- The question is: Can companies be sure that they stay within “the current safe operating range” during a maintenance shutdown and therefore do not need to consider Management of Change procedures?

- We found no proof that such certainty exists.
Some observations

- A management procedure should be put in place to make sure that the operators (and indeed the foremen) are fully aware of how to make the plant – or a part of it – safe prior to maintenance work and how to maintain this level of safety throughout the entire shutdown and start-up periods.
Some observations

- **Risk analyses** related to the shutdowns must not focus only on the safe execution of individual tasks carried out by external contractors.

- The **tasks of the own personnel** and the overall planning of the shutdown should be equally included.
Some observations

- It is not enough to train external contractors prior to the shutdown.
- The own personnel must also be trained, as their duties during the shutdown differs radically from their normal ones.
Some observations

- If safety related equipment such as alarms, ventilation, water, inert gas, safety valves, electrical systems, computers, etc. need to be turned off, alternative solutions to ensure safety must be applied.

- Control rooms should not be left unmanned during the shutdown, if this means that alarms will go unnoticed.
SEISOKKI Tools

- The Finnish SEISOKKI research project developed several tools to be used in order to minimise the risk of chemical accidents during a plant shutdown.

- The tools have been published in Finnish at seisokki.vtt.fi
SEISOKKI Tools

- A **Guidebook** describing the topic from various perspectives,
- An **Internal Auditing Method**, by which various management issues related to chemical safety can be addressed by key persons at the plant,
- A **Hazard Analysis Method**, which is developed especially for the purpose of identifying hazards associated with process chemicals during shutdowns
- A **set of Safety Checklists** for quick reference during the shutdown, and
- A **set of Work Permits**.
Acknowledgements & Disclaimer

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