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- Process Technology Review for SIS
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Safety Interlock Bypassing

End
About the Presenter

- Hans van Dongen – EMEA Safety Interlock and Alarm Management Consultant
- Over 30 years with DuPont
- E&I Engineer several Dordrecht SBU’s
- Special assignment SAP Release update PS module
- Instructor for PSM training
  - Safety Interlock
  - PFD calculator
  - Alarm Management
  - Functional Safety Assessment
- Development team for S27A Interlock Bypassing and Alarm Suppression
Safety number 1

DuPont was established more than 200 years ago starting a gunpowder facility at the Brandywine river in Wilmington DE

During the last 2 centuries experiences with hazardous chemicals

Anno 2011 globally more than 150 sites with higher hazard processes

Safety is a core value.
Process Safety Standards

S21A Process Safety Management
- Procedures to control the hazards associated with chemical processing
- Protect personnel from serious injuries, prevent environmental harm, property damage and business losses
- Complex because it crosses over many functional areas.
- Integrated systematic approach to implement process safety elements.

S24A Process technology
- Identifying, documenting and managing the process technology element of process safety management.
- Mandatory requirements and advisory guidance apply to Higher Hazardous Processes and Lower Hazard Operations.

S25A Process Hazards Analysis
- Mandatory requirements and advisory guidance for the conduct of process hazards analyses
- Used to identify, evaluate and develop methods to control significant hazards associated with the hazardous processes and operations.
- Conducted on new and existing facilities.
Functional Safety Standards

**DX_S Interlock Design / Safety Integrated function**
- Methods for selecting appropriate interlock implementation.
- Design criteria for interlocks identified or recommended by the PHA teams to prevent undesired hazardous events.
- Consistent with requirements in ANSI/ISA s84.00.01-1996 (adopted by OSHA as a Recognized And Generally Accepted Good Engineering Practice)
- Based on Approved Independent Backup principle.

Other design standards
- Bypassing of safety interlocks
- Requirements for periodic testing and inspection of Safety Interlock systems
- Human Machine interface in Safety Interlock Systems
- Field devices in Safety Interlock Systems
Approach to functional safety

- Initiative led by a corporate team comprised of experts for functional safety as well as PSM (Process Safety Management)
- Site leads for functional safety responsible
- Regional experts support
- Process technology review for all safety interlocks
- PFD calculation
- Detailed evaluation during cyclic PHA’s – Gap analysis.
- Site PHA resources responsible
Process Technology review for SIS

- DuPont has recognized ANSI/ISA 84.00.01 (IEC61511) as RAGAGEP, through our own clarifying SIS standards.
- Effective January 1, 2008 an analysis of the existing process technology design basis of Safety Instrumented Systems shall be conducted and documented according to current RAGAGEP.
- Finalized January 1, 2011.
- Questionnaire to analyze the gaps of process technology
Process Technology review for SIS

Basic questions e.g.:

- Is the SIS logic solver separated from the BPCS logic solver.
- Watchdog function to monitor communication between SIS logic solver and HMI
- If logic solver not according IEC 61508, have proven in use requirements been met?
- Is HMI designed that operator cannot make changes or forces in SIS.

Questions for each safety interlock.

- Are requirements documented?
- Is documentation of each Safety interlock current and complete?
- Have PFD calculations been made for each interlock?
- Is component redundancy included in SIL 3 designs?
- If online test methods are used, have interlocks been designed to safely perform these tests?
- Location of solenoid valve on control valve correct
SIS evaluation in PHA

- Event classification – required SIL
- Use of conservative AIB method (consequence based) or LOPA
- Gap analysis of current technology and requirements
- No use of risk graph/matrix
- Upgrades of SIS if needed
Current topics

- Update DX_S Standards regarding IEC 61511 Ed.2
- Expanded SIS bypass standard to include general, machine interlocks and suppression of alarms.
- Adopt of WIB / Namur Batch into a Best practice
- Expand FSA
- Cyber security
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Safety Interlock Bypassing

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Bypassing of Safety Interlocks

One of the High Risk activities.

Requires

- Preparation
- Involvement Control / Safety Interlock Specialist
- Hazard Identification
- Alternates
- Documentation
- Qualified personnel
- Protection
- Permits
- Extension of permits
- Bypass checklist
Safety Contact

Formosa Incident
## 1.1. Formal request for interlock by-pass

(not part of existing process technology)

<table>
<thead>
<tr>
<th>Request Category</th>
<th>Details</th>
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<tbody>
<tr>
<td>Exact Location</td>
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<tr>
<td>Equipment and/or process description</td>
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<tr>
<td>Date of request</td>
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<tr>
<td>Interlock description</td>
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<tr>
<td>SIL classification</td>
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<tr>
<td>Reason for by-pass</td>
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<tr>
<td>Proposed by-pass period</td>
<td></td>
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<tr>
<td>Proposed alternative and action limit</td>
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</tbody>
</table>

- Interlock bypass at Tank 704
- Interlock bypass at inlet line Tank 704
- Clear description

Tank - 704
1.2. Consult Control Specialist

Process Design Base

Interlock functionality description

1. Sensor

2. Logic solver

3. Final element

SIL classification 1 / 2 / 3

Operator alert on LOPA alarm (Layer Of Protection Analysis)

Machine interlock

Process interlock
1.3. Identify & evaluate all interlock by-pass related hazards

Impact on:
- Safety, Health, Environment,
- Facilities
- Quality
- Business

Consult- or perform additional Risk Analysis / PHA
- Avoid consequence threshold
What will the impact of not conducting the bypass?

- Evaluation between risk and the cost of e.g. 1 day downtime.

- Think about only one hour downtime... this should encourage people to consider not to place / make a bypass. Eventually adapt the process conditions.
1.4. Define alternate protective function *

Can be based on manual or automated actions

If Manual:

- Appropriate back-up measurement
- Define approved limits
- Qualified and dedicated person to monitor and take action if required

Examples of alternate manual function:

- Operator reading local tank gauge on timely base.
1.4. Define alternate protective function *

- Can be based on manual or automated actions

- If automated:
  - Appropriate back-up measurement
  - Define approved limits
  - Alternate to achieve safe state of final element.

- Examples of alternate automated functions:
  - Redundant interlock.
  - Alternative process value.
  - Correlation Pressure / Temp
1.5. Establish and verify technical proposal is prepared

- **P&ID**

- **Schematics**

- **Logic**

- **Matrix diagrams**

**If needed : develop technical description to provide additional essential information.**
1.6. Complete and document all relevant aspects

**Bypass permit best practice:**
- Unique number
- Date of request
- Duration
- By-pass period
- Exact Location
- Equipment and/or process description
- SIL classification
- Reason for by-pass
- Alternative and action limit
- By-pass installed / removed by: ....
- Approval by interlock guardian
- Authorization by line manager
- Additional authorization for extending duration by-pass permit at higher level
1.7. Ensure availability of qualified personnel to perform the interlock bypass

All own employees shall be trained and qualified to the degree warranted by their job assignment (ref. training matrix)

Documentation for each employee shall include:

- Employee’s name and job assignment
- Date of training
- Content of the training received
- Name of the trainer
- Method of verifying the employee’s understanding of the training
2.1. Establish and Verify that the area / equipment is prepared as per risk analysis / job plan

- Identify Line of fire
- Area barricading (operations)
- Area barricading at location of bypass
- Access control
- Rescue ways / access & egress possible as per plan
2.2. Establish and Verify that the personnel is prepared as per risk analysis / job plan

- Personnel Protective Equipment:
  - release check (e.g. label / certificate)

- PPE correctly worn

- Communication
3.1. Job turnover and authorization and signing bypass permit by all involved

- Involved:
  1. Proprietor / owner
  2. Operator direct related to by-passed equipment / process
  3. Capable Person: installing and removing the by-pass
  4. Capable Person: executing repair and / or testing activities

- In the field at the work location and at shift turn-over
3.1. Job turnover and authorization and signing bypass permit by all involved

- Communication of:
  - Hazards
  - Alternate protective function
  - Rescue methods
  - Job plan / task execution

- All personnel performing the work sign for understanding and acceptance via Bypass Permit

- Additional permits may apply
3.2. Perform the bypass as per approved plan

- According to the planning / instructions
  - Bypass permit(s)

- Best practices:
  - Use of red- or labeled wire.
  - Put permit on the door of cabinet, or somewhere else on the spot.
  - Information board in Control Room.
3.3. Process or equipment running with active bypass

- Continued operation

- Testing of redundant interlock channels.
  - As per approved test procedure

- Instrument calibration by-pass
4.1. Extend bypass approval

- Special attention for Safety interlocks

- Limited to 10x 24h

• By-pass permit shall be limited to 24 h duration withy a maximum of 10 re-authorizations

• Unless authorized by plant manger or documented by Management of Change
4.2. Remove bypass, document and return to Standard Operating Conditions

Who?:

1) Capable Person: executing repair and / or testing activities
   - Testing is not always possible.
   - 4 eye principle can help to create a higher level of confirmation that system is put back in original status.

2) Capable Person: installing and removing the by-pass
3) Operator direct related to by-passed equipment / process
4) Proprietor / owner

Documentation include
   - Date / Name
   - By-pass checklist

Sign off permit

<table>
<thead>
<tr>
<th>Loop nr</th>
<th>By-pass installed by:</th>
<th>Date</th>
<th>By-pass description</th>
<th>By-pass removed by:</th>
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Summary: Bypassing of Safety Interlocks

Requires
- Knowledge of the Hazards
- Alternates as good as the safety interlock
- Documentation
- Qualified personnel
- Permits
- Limited time
- Bypass checklist
Thank You!
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