

Prepared by the Safety Advisory Group

Safety Info HF - 05/09

Task

Maintenance Error



Maintenance Error: failing to perform a task or performing it incorrectly during routine testing, checking, servicing or breakdown repair. Result - the equipment malfunctions or the error results in an incident causing damage to plant or personnel.

Human errors and violations in servicing and repair tasks have many of the same root causes as errors in other types of task. However, with maintenance, a fault introduced into the system by human error today might have no effect for several months and then cause a sudden unexpected hazardous breakdown or incident.

Learning more about maintenance error

If the answer to any of the questions below is 'no', then you need to take action

- 1. Are you fully aware of what maintenance errors could lead to an incident?
- 2. Is there a clear strategy and plan on maintenance?
- 3. Are resources allocated and roles, responsibilities and accountabilities clearly identified?
- 4. Are there good defences in place to make sure maintenance errors are very unlikely to result in incidents? E.g.
 - 'Administrative' controls (permits, procedures, checklists).
 - Management controls (supervision and checking of tasks).
 - Highly competent maintenance teams.
 - Physical barriers and guards.
- 5. Are maintenance tasks well designed (interesting, no time pressure, comfortable conditions, adequate task lighting, good access)?
- 6. Is the maintenance programme part of the incident risk assessment programme?
- 7. Is maintenance progress or status communicated well during shifts and between shifts?
- 8. Do plans take special consideration of temporary or inexperienced maintenance technicians and contractors?
- 9. Do managers and supervisors perform walk around inspections of maintenance tasks in progress?
- 10. Do engineering design departments consider the ease of maintaining systems and continually improve it?
- 11. Do managers or supervisors look for early signs of problems (e.g. a large backlog of jobs; excessive repair times; adverse feedback from staff)?
- 12. Are maintenance requirements assessed for new projects and modifications (Management of Change)?

- 13. Do you investigate near misses and accidents to learn from human failure in maintenance and to improve the systems?
- 14. Is there a training and competence assurance system for maintenance teams?
- 15. Are there measures in place that monitor safety and reliability for maintenance activities?

What can we do about it?

Management responsibility:	The factors that can lead to human error in maintenance are basically the same as for other types of job.
	To avoid such errors and encourage good performance in maintenance work, it is important that management should, as a minimum, make sure that there are:
	• Enough competent people to carry out maintenance work and to check work done.
	 Adequate supplies of spares and consumables.
	 Good communications so that maintenance teams (and others who might be affected by maintenance, including contractors) know what work has to be done and where (particularly important at shift handover).
	 Good permit to work systems in use. These are crucial and should be developed against formal safety analyses so that major hazards, as well as personal/occupational safety are considered.
	 Contingency plans; for example, if a job looks as if it might overrun, or if other problems arise.
	 Systems for investigating problems that occur and for making improvements.
	 Structured processes to identify and assess human error potential in safety critical maintenance tasks (and to reduce this potential).
	And that:
	Maintenance tasks are realistic and achievable.
	 All maintenance work is carefully planned and scheduled including unscheduled maintenance tasks.
	Particular attention is given to
	 whole plant shutdowns where the company has to manage a large number of contractors,
	 work in which any safety systems may be taken out of service.
	• The design of equipment to be maintained, and its location, doesn't encourage errors.
	 Working conditions are tolerable (e.g. enough light, not too noisy or too hot or cold, well ventilated and clean).
	 Suitable tools and equipment (including safety equipment and PPE) are provided for the work.
	• Written instructions, permits, diagrams and other paperwork, and labels or notices are clear and up to date.
	The impact of any proposed change in maintenance is properly assessed.
	Up to date standards are adopted.

Look for common failures found at major hazard sites:	 Major accidents and near misses resulting from maintenance errors are often not separately identified and addressed, Risk assessments, training and procedures do not usually assure adequately against error, Many sites do not have even simple assurance against error, Safety critical maintenance tasks and procedures are often not identified, Sites don't make the link between maintenance error and their risk assessments, 		
Defences against maintenance error:	Like most human errors, the root cause of maintenance errors can usually be traced back to management of maintenance processes. Management are responsible for putting in 'defences' against error. Defences are anything designed to prevent or reduce the chance of human errors or to deal with the consequences of unpreventable or unforeseen accidents. However, accident reports often show that management are responsible for breaking down these "defences against error" by making poorly considered changes in administration. The table below illustrates a human error analysis of a general maintenance task and shows the types of defences that should be considered to prevent hazards arising from human errors		

Task	Need to	Physical Defences	Administrative Defences
Plan the job	Identify safety critical parts of the job and how to manage them (risk assessment)	 Physical barriers around items that could be damaged by maintenance; maintainable systems (designed for easier maintenance); barriers to contain or control hazards if released (e.g. bunds; water curtains; fire detection and fighting systems; PPE ; "safe havens"). 	 Ensure Piping and Instrumentation drawings are current; Safety Management System; good safety culture and morale; permit to work system; procedure and documentation update system procedures for shift handover if task extends over 2 or more shifts; good communications between maintenance and operations personnel; manage possible fatigue or time of day effects on task or decision making; team selection; site emergency plan; incident analysis system

Task	Need to	Physical Defences	Administrative Defences
Isolate the system	Use best means of containing hazards.	 'Blinds' in pipes etc rather than rely on valves; bleed valves; remove circuit breakers rather than rely on switches; take readings to check isolation 	 Permit system and lock out / tag out procedures should specify defences to be used; conduct spot checks of permits in use;
to the system	covers/hatches	 Housekeeping systems to keep track of tools and components; physical protection of surrounding areas if opening up requires force 	 Spares, tools and consumables storage and an issuing system
Carry out service or repair task	Test by eye or using instruments; replace damaged or worn out items; replenish fluids	 Mostly administrative but, could make systems more 'maintainable' (easier to maintain) and make it impossible to do key tasks incorrectly (e.g. design components that will only fit in one way) 	 Competent technicians; up to date maintenance procedures/ checklists/ job aids; independent checks by second technician or supervisor; system designed to accept only correct components; good calibration procedures; team training if required; stagger maintenance tasks so that multiples of the same item are not serviced at the same time by the same crew (same fault could be introduced into each item); system of reminders to ensure nothing is left out
Reassemble	 Align the system correctly; do not leave any components out; don't leave foreign object(s) in the system 	 Design of system to resist errors (e.g. by providing only one means of reassembly; components that cannot be damaged by forcing) 	 Housekeeping system to ensure that all replacements have been fitted and all old ones accounted for. Independent checking, random checking during reassembly

Task	Need to	Physical Defences	Administrative Defences
Remove isolation	Make sure it is safe to refill or restart system	 Isolations physically locked; barriers against the specific hazard (e.g. screens; protective clothing) 	 Strict procedure for reinstating equipment, removal of lock out / tag out; observe for signs of problems; be able to re-isolate the system quickly
Commission and test the system; put back into service	Make sure the system works properly and is in the correct state (running or standby)	 Allow only authorised personnel access to the system 	 Strict procedure for closing work permits; Good test procedures; clear measures or criteria for pass/fail; independent checks

Useful Reference Information

- 1. Institute of Petroleum, <u>Maintenance Error</u>, Human Factors Briefing Notes No 4, 2003.
- 2. Health and Safety Executive, Maintenance Error, HSE Human Factors Briefing Note No 6.
- 3. Health and Safety Executive, HSE Human Factors Toolkit, June 2004.

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