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Management of Reliability Systems

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Successful reliability-centred maintenance relies upon numerous elements in order to succeed. Management, coordination and enforcement of all those elements can be the difference between marginal success and truly world-class performance.

Numerous specific programs can be used to improve equipment reliability. Balancing of rotating elements will have benefits. Quality alignments will yield results. Vibration monitoring is useful. Mechanical seals have advantages. These and numerous other initiatives will improve equipment reliability, but utilized together and more importantly managed properly, the payback is greater than the sum of the components. There are synergies to be realized in combining the impact of these efforts. Conversely, reliability initiatives can yield few benefits if key elements are overlooked; a good vibration-monitoring program will not compensate for a poor lubrication system. Further, programs that exist only as un-enforced paper policies are meaningless.

Many aspects require attention and proper management techniques can make the difference between satisfactory and outstanding. Automate those processes that can be, and enforce the others.

Specification of Equipment

Proper specification of equipment is essential. Nothing is more frustrating and costly than to be burdened with equipment that is not capable of performing the job required of it:

- The process conditions that equipment will be subjected to must be thoroughly investigated, both under normal and (more importantly) abnormal operating circumstances. Approximations are commonplace and simply not good enough. Future demands that may be placed on the equipment must be considered and documented. Oversized equipment is every bit as troublesome as undersized.
- Wetted components must be suited to the service, in order to minimize potential for flashing, cavitation, corrosion, erosion, etc
- External ambient conditions frequently damage equipment from the outside, yet are often overlooked.
- Energy management must be considered – wasted horsepower, or worse – insufficient horsepower requiring upgrade.
- Experience with similar equipment and spares availability must be factored into the specification. Equipment that does not conform to mill standard impacts on training of personnel and on stocked spare parts.

Management tool: Carefully constructed, well documented and thoroughly enforced standards for specifying equipment.

Design

Good design considers future maintenance:

- Jacking bolts, lifting lugs or beams, access for rigging or mobile equipment
- Guards that keep people safe while permitting on-the run inspections
- Isolation valves (with ready access to them), flush ports for corrosive services, and ease of access to all components for monitoring and cleaning

Management tool: Mandatory adherence to published design standards.

Good design of operational logic (and its management) will reduce opportunities for mistakes:

- Designers must immunize equipment against human error. If a pump can be run against a closed discharge valve or with its suction valve closed, eventually it will be. If the device can be started without seal water flow established to packing or mechanical seal, sooner or later this will happen. If a pump is allowed to start 15 times in succession in 1 minute, someone will do it.
- The solution is to design interlocks and safety equipment that will anticipate and prohibit equipment-damaging events.
- Expert systems can utilize process data to infer conditions that will damage equipment.

*Management tool: Well considered control systems and standards, all properly documented and strictly managed to ensure their function***.**

Installation and Commissioning

- No benefits are realized from proper specification and design unless the physical installation adheres to the required criteria.
- Commissioning is a detailed process that requires time, discipline and documentation. Deficiencies accepted during commissioning become instant liabilities for operations and maintenance alike.

Management Tool: Standards, specifications and design documents must be in the hands of those performing the installation. Inspection and sign-off are necessary to ensure compliance.

Some of the many specific considerations that will promote long, reliable life from rotating equipment:

Balancing (and its management)

- Dynamic balancing to a high standard reduces vibration, minimizing energy wasted into components that can be adversely affected.
- Balancing standards must be set, equipment and training provided, time allotted to perform the work and documents maintained to demonstrate that the work is complete.

*Management tool: Clearly stated standards and a policy of sign-off to ensure that all rotating equipment is always balanced before installation. Deviation from policy requires signed authorization***.**

Alignment (and its management)

- High quality laser alignment reduces wear and vibration, preventing premature failure of equipment.
- Alignment standards must be set, equipment and training provided, time allotted to perform the work and documents maintained to demonstrate that the work is complete.

Management tool: Clearly stated standards and a policy of sign-off to ensure that all rotating equipment is always aligned before commissioning. Deviation from policy requires signed authorization.

Sealing components (and their management)

- While initial cost is significant, mechanical seals have a number of advantages over packing. Regardless, proper sealing is vital to keep fluids where they belong and away from components that can be damaged.
- Seal water quality is important. Proper filtration and monitoring ensure long life of mechanical seals.
- Monitoring water flow into and out of seals will identify opportunities to reduce consumption and minimize fluids entering process streams, both of which have hidden high costs, including filtering, horsepower, contamination of process and effluent treatment.
- Where sealing water is required, measures must be taken to reduce damage arising from loss of flow. Seal water flow switches on supply lines, interlocked to the drive, will prevent equipment from starting or running if adequate flow is not established on start-up or is interrupted during service.
- Proper commissioning and start-up procedures are vital to ensuring long life from sealing systems.

Management tool: Clearly stated standards to ensure that high quality seal water is always delivered as required, with interlocks to prevent operation without it. Defeated interlocks are documented through a formal process requiring authorization and timely corrective action.

Lubrication (and its management)

- Initial lubrication is essential, along with regular inspection by trained personnel.
- Regular oil analysis will provide early fault detection.

*Management tool: Documented standards for equipment lubrication requirements, coupled with routine inspections and oil analysis program. Clear procedures to manage problems identified by inspections and analysis***.**

Vibration analysis (and its management)

- Baseline vibration signature required after balancing and alignment and prior to releasing equipment to operations.
- Routine vibration analysis by trained personnel on all rotating equipment.

Management tool: Mandatory completion and data analysis of documented vibration routes. Clear procedures to manage problems identified by inspections and analysis.

Interlocks, Protective Equipment (and their management)

- Essential services and protective features must be interlocked to equipment, such that the equipment cannot be operated unless all necessary conditions are satisfied; seal water, # of motor starts, speed switches on driven components, etc.
- Alarms are useful, but are no substitute for interlocks.
- Interlocks and protective equipment have no value if they are defeated. A formal mechanism to manage interlocks is a necessity.

Management tool: Easy-to understand, consistently applied interlocks on all protective systems, coupled with a formal mechanism to authorize, track and promptly restore defeated interlocks.

Start- up and Shutdown Techniques
Significant damage can occur when equipment is started (especially remotely), without point-by-point inspections.

- Initial commissioning of equipment requires attention to detail. It is vital that all components are installed, tested and confirmed as correct, using checklists and signoffs.
- Routine start-ups require that operators physically inspect their equipment, confirming that protective equipment is functional including valves, lubrication, sealing, guarding, etc

Management tool: Detailed commissioning signoff checklists and standard operating procedures for routine start-ups.

Routine Inspection

- Ongoing Condition Based Monitoring (CBM) will provide the early warning systems vital to identifying and correcting problems before they result in equipment failure.
- Similar to vibration monitoring, lubrication, interlock testing, etc, operators must regularly inspect their equipment in a structured format, correcting those problems they can and reporting all other concerns.

Management tool: CBM routes generated by a computerized maintenance management system, coupled with mandatory completion and prompt resolution of problems identified.

Management of Change
Seemingly insignificant changes to processes can lead to catastrophic failures of equipment by subjecting that equipment to conditions outside its design parameters.

- Skilled persons in various disciplines must review all proposed changes prior to their implementation.

Management tool: Structured, documented Management of Change procedure applied without exception.

Failure Root Cause Analysis and Elimination
Equipment will fail for a multitude of reasons, generally a deficiency on one or more of the items listed above. It is valuable to analyze these failures in an effort to eliminate repetitions.

- Collecting data, analyzing it and understanding failure modes are time-consuming activities. The only return on these investments of time and energy is to act upon the findings.

Management tool: Documented, consistently applied root cause analysis and problem elimination program that demands and tracks follow-up actions.

The initial enthusiasm and effort dedicated to creating reliability programs are often lost over time. Initiatives are often prompted by significant events, resulting in demands for action. Unfortunately, yesterday's significant event rapidly fades as personnel change, priorities shift and new initiatives take precedence.

All too often, structured programs are reliant upon their creators for sustainability. They can lose relevance or may become paper tigers that provide little or no impact on the organization they intend to serve. Longevity and relevance can be realized when initiatives are

- Embedded in corporate culture through documentation and training
- Independent and self sustaining (through careful design)
- Assured of continued use by being clear, concise and user friendly
- Automated wherever possible
- Focused on real outcomes rather than paper policies
- Designed with integral management and enforcement tools.
- Reviewed routinely and revised as necessary.