How should you treat your spare machinery?

Conscientiously! Your company has invested a considerable amount of capital money in spare equipment and it would stand to reason to take good care of this asset. So what? We often find that operators do not pay attention to their spared equipment with the result that standby equipment ultimately is not available when needed in an emergency. Practices around spare machinery installations can range from total neglect to following standby or spare operational policies as described in Table 1.

Table 1.

STAND-BY POLICIES	CHANGING ON FAILURE	ASSIGNED SPARE	PERIODIC CHANGE (SWINGING)
	Machine **B** starts running on failure of **A** and stays running until it is its turn to fail	Machine **B** does not run until **A** has been taken out for repair	For example every two weeks or 15 days
ADVANTAGES	• Not many "maneuvers" • Good MTBF* if the spare stays is in good condition and switching is without risk • No start-up unless the machines have been repaired like new	• One strives to always have a spare in good condition	• If well managed, the chance of having an unscheduled outage is small
DISADVANTAGES	• Start-ups often take place in a "catastrophe" scenario • The spare machine could degrade	• The spare must be kept in good condition	• Multiplies various risks of swinging machines • Risks having two failures in a short time frame
IMPROVEMENTS	• Test the spare periodically	• Try out the spare periodically	• Before each change, **perform diagnostics**, i.e. condition monitoring • Run unequal time intervals

*MTBF = Mean-Time-Between-Failure

The above policies all have advantages and disadvantages. No matter what, a common trait is the need for judicious periodic servicing or exercising of the spare; there is just no other way to ascertain the condition of a "fail-to-danger" device such as a critical standby pipeline pump, an electrical emergency generator or a spare steam turbine.

We prefer a machinery standby policy as described in the fourth column of Table 1. Our basic approach however, is that simple equipment such as general purpose centrifugal pumps in a standby condition do not deteriorate provided the bearings are kept coated with lube oil. Such a coating can be applied either by rotating the shaft at approximately weekly intervals or by oil mist. The shaft may be rotated by hand, by momentary steam admission if it has a turbine driver, or by a single bump if it has a motor drive. Of the three we favor hand rotation where this is practical and safe. Frequently it is neither necessary nor desirable to bring the unit up to full speed due to the inherent risk of damage at start-up. On the other hand, we feel that on machinery units equipped for automatic start, the advantages of periodic testing the full instrumentation loop outweigh the potential damage.

What are the consequences of not looking after our spares in regular intervals? Besides an obvious inherent unreliability, we have frequently seen that some sites lack confidence in their running "spares" after the "main" machines have failed. As a consequence, maintenance forces are being expedited for a quick and often compromised repair. A vicious circle! It consists of hasty fixes followed by short running times causing a high percentage of priority work orders and overtime in the repair shops. Reliability engineering literature has defined the relationship between machinery MTBF, un-spared running time and availability[1]. For example, in order to maintain an availability of 99 percent, a spared centrifugal pump that has failed in a population with an MTBF of 16 months could stay out of service for five days – more than enough for a thorough repair. With other words, there is only a one percent chance of loss of service during the indicated outage time.

Why are existing standby policies sometimes not followed? We believe that the answer is not so much operator reluctance than a lack of feasibility caused

[1] Bloch, H.P. & F.K. Geitner, *An Introduction to Machinery Reliability Assessment,* 2nd Edition, Gulf Publishing Co., Houston TX, 1994, p.62.

by poor accessibility and operability: Many spared equipment arrangements, where spare exercising should be mandatory, require complicated swinging maneuvers which may result in a unit upset or even loss of production. Technical management must recognize these situations and change the design or provide whatever hardware is needed to make the testing of spare equipment easier or possible. For example, in a critical spared centrifugal pump installation, where swinging pumps would cause a "bump", one should think about installing controlled by-pass lines or even smart pump technology to assure spare pumps can be started up without impacting unit operation.

Here are some more improvement ideas: Personnel responsible for machinery reliability should strive to establish operational confidence by enforcing or, where a policy does not exist, by introducing a spare machinery care and exercise program as part of the plant's predictive maintenance (PdM) and monitoring concept. Why is PdM involved? The bottom right hand box of Table 1 points to a very important activity connected with critical spares exercising: There is a need for condition monitoring of both units, of the running machine about to be shut down and of the standby machine as it is being brought on line. Condition monitoring would mean the deployment of suitable weapons in our PdM arsenal, for example, vibration analysis and performance parameter checks, such as motor current, process flow, suction and discharge pressures on a critical pump. This condition assessment will tell us whether or not we are shutting down a good piece of equipment and bringing on line a similarly healthy standby machine. We are trying to answer the question: Does either of the units require maintenance attention at this time?

The foregoing is an example showing how operating and maintenance personnel can work together by exploring the connection between equipment standby practices, reliability and maintenance costs.

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References: Bloch, H.P. & Geitner, F.K., *Maximizing Machinery Uptime*, First Edition, Houston, Tokyo, London, 2006 at www.elsevier.com, ISBN: 0-7506-7725-2, 672 pages.

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