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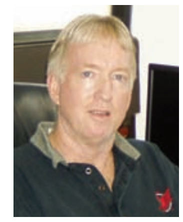

Machine design — Heavy industrial applications

You are at whit's end. The new boss has asked you to reduce the down time for cleaning a vessel and removing scale. The overall goal is to reduce a planned plant shutdown by one week. Of course the unit you are in charge of and a particular vessel is the culprit, right in the middle of all the talk and focus. Cleaning and doing maintenance on the internals involves several steps of which the most important is the safety of the personnel doing the work. The internals cannot be rebuilt or changed out until the vessel is cleaned and scale is removed. The problem is that internal welds would be contaminated and the vapor caused by reacting with the scale is hazardous. Typically the first part of the operation involves specially trained personnel wearing "space suits" to enter the vessel to clean it. The training would include, but not be limited to, vessel confined space entry procedures. This part of the operation is more than one week in itself and depending on ambient air conditions it could take much longer.

Sitting home at night watching the news on how much of the deepwater work is being done remotely, you ask the question, "Why can't a robot or machine be designed to clear and clean the hazardous scale off the vessel?" The answer is clear — it can.

Usually for a project of this type it takes several months to design and build the equipment. If the return on the investment of the equipment is millions of dollars to your company's bottom line, it is worth it. The typical steps involved with a project like this would include, but not be limited to, the following:

1. Selection of a design team to execute the work. The team should include not only the design engineers, but operations, maintenance, process, electrical, controls, metallurgical and materials, and site safety personnel.
2. Mechanical equipment specification. This is an important step to layout expectations of the design, including mechanical constraints, geometric constraints, metallurgical and material considerations, operation sophistication, process considerations, controls considerations and safety device systems.
3. Mechanical equipment specification review. After the design team completes an initial draft, it should be circulated to the design team. All team members should make comments and full agreement should be made on the final draft.
4. Conceptual design layout. Typically the designers will come up with three conceptual designs to meet the goals and objectives of the project. The design team will get together and select one concept. This concept is usually refined with all comments incorporated into the design. It is not unusual for this type of equipment to be robotic in nature with full optical visualization. It is also wise at this point to present the design to operations management for their blessing before any detail design starts.
5. Detailed design. In this step the complete design is executed.
6. Operations review. Operations, including safety representatives, performs a final review. A HAZOP is also conducted at this point.
7. Fabrication. During this phase of the operation a detailed schedule should be developed and milestone identified for interstage inspections and testing.
8. Testing. This step is executed to validate the design as fit for purpose.
9. Simulation. This phase, especially for "fly by wire" simulations, should be done to train operators and personnel for the job to be done. In the situation described in this article it might be a "mock" vessel.
10. Actual operations. During this phase of the project the equipment should be continuously monitored to ensure it and the operation of the equipment is meeting expectations. Finally it has to get the job done.

While this article is focused on a vessel, there can be many applications where a "serial No. 1" device can save your company a lot of money on the bottom line. A typical return is 10 to one, not to mention a safer way to get the job done. This project should be directed and the equipment designed under the supervision of a professional engineer competent in this type work.

For more information, visit www.knighthawk.com or call (281) 282-9200.