ACCIDENT PREVENTION IN DESALINATION PLANTS

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Keywords : Accident, Co-generation, Control room, Health hazard, Operator, Unit availability

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Summary

To control accidents in the power and desalination industry, the role of human factors in designing for training can be seen as defining an operator centered approach to design, rather than the more conventional technology-oriented approach, the benefit of which can be seen in a number of ways:

Better plant interfaces will decrease the potential for operator error and make training easier. Operation should be simple, with economics in reduced down time and saving in personnel. Reducing reliance on procedures reduces the risk of mind-set incidents and places less emphasis on procedural training to cope with specific events, which rarely occur in the way envisaged.

Operation becomes proactive as it is built around the operator's knowledge of plant behavior, rather than being reliant on a cascade of alarms to act as the triggers to procedural action. As the plant operators are released from their reactive role and have an improved understanding of the process being controlled, they are able to concentrate their efforts on the optimization of that process. This again leads to reduced downtime, improved efficiency and improved economy of operation.

The application of human factor method and tools as an integrated part of design process reduces the incidence of early operability problems. Cost savings will be seen

downstream, in fewer errors and less likelihood of costly design changes, and reduced number of accidents.

1. Introduction

As electric utility companies enter the era of year 2000, they find themselves in an expanding arena of competition from co-generation plants and independent power and water producers to which they must aggressively respond, in order to remain viable entities. One result of this new competition is the need to generate the most economic value out of available resources.

Aspects of maintenance, unit availability, operator staffing together represent an economic risk for a power and/or desalination utility. This is just one form of risk to which the utility is exposed, and there are other risks which the utility must address. These include worker safety, public health and safety, and loss of property/capital. These risks result from components either failing to operate or operating improperly. Plant modeling demonstrates that lack of proper operator action is a significant risk, needing mitigation in power/water producing plants. A great emphasis has been laid on investigating methods of qualifying the risk in water desalination plants and of controlling accidents/risk through improved maintenance, inspection/testing and machine/operator interface, in order to reduce lost man-machine hours.

One such group involved in accident prevention and control of risks is "The ASME Research Task Force on Risk Based Inspection Guideline", formed during 1986 and 1987. This task force produces guidelines on the selection of inservice inspection, techniques, frequency and scope, based upon the risk which the associated failure/accident would present. From the 1993 ASME report, it became evident that operator action could significantly reduce the risk of accident to a plant, and the further risk of component failures, and mitigate failure of control components.

2. Accident Prevention Programme

The accident-prevention program consists of three sub-programs: (1) plant failure data development; (2) system availability analysis; (3) operator task analysis. The information gathered, personnel interviewed and documents reviewed are very similar for each sub-program. Substantial savings and improved consistency can be achieved by utilizing the same personnel to do all three sub-programs simultaneously.

The operator task analysis consists of three parts:

- Functional/activity flow development.
- Activity identification.
- Manpower assessment.

2.1. Operator Task Analysis

The operator task analysis provides insight into the operation of the plant, and how the design/reliability of the plant impacts the plant operation. The operator task analysis by shifts demonstrates the flexibility of the personnel, with a specific task element being done/checked by several different people, depending upon the crew. In addition to formal training, operator training includes an observation period when qualified operators are observed in action, and individual operator notes (at site observation) are developed.

2.2. Human Factor Engineering

The combination of: (a) formal training, (b) on site observation, (c) in depth responsibility/checking produces a very reliable operating situation with a minimum of accidents. Errors by the operators and maintainers of modern, highly automated plants and control systems are still more likely than equipment failure. Human Factor (HF) engineers have traditionally reduced human error by improving usability through improvements in the user interface. This is in response to the need to reduce costs by reducing operating staff and decreasing downtime, without increasing operator error. HF engineering can now employ a range of tools and methods during the design process. Thus the potential for human error can be maintained at a low level, or even reduced for the following reasons:

- Methods and tools improve usability with lower capital investment.
- Methods and tools can be utilized in the design of training content and evaluation.

2.3. Human Factor (HF) Engineering and Accident Prevention

The demands on operators of complex systems have not decreased with the proliferation of computer-based control and instrumentation. Greater automation, through the use of software and computer-based systems and more centralized control and surveillance, has been the major thrust in design changes. The role of operator can only be based on his or her human capabilities. Cost-cutting alternatives, such as reduced manning and shortened system downtime, have increased the stresses on operating staff, and the probability for serious human error is as great as ever.

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