

The Importance of Critical Site Documentation and Training

White Paper 4

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> Executive summary

All studies of downtime in mission critical environments come to the same conclusion: human error is a leading cause. The most effective way to fight this threat to your business is with the double-edged sword of documentation and training.

Properly trained personnel understand how the plant works, how to safely operate and maintain it, and what to do when things don't function as expected. Thorough, accurate, and readily accessible documentation is both the foundation of this knowledge and the means of implementing it. The establishment of a comprehensive documentation and training program is a crucial but rarely achieved goal. This white paper describes a methodology for putting together an effective program that addresses the special requirements of critical environments.

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Introduction

One of the primary goals of any mission critical enterprise is uptime. By definition, if the mission is critical, any interruption in service is a bad thing. IT and Facilities Managers spend a great deal of time contemplating how to improve uptime in their business.

There are a multitude of factors affecting uptime, but the one that is the most difficult to control and that is called out in many studies as being the single greatest contributor to service interruption is human error. No amount of money can be spent on infrastructure design to eliminate it. In fact, efforts to create a foolproof system can actually backfire when the automation becomes so complex that it cannot easily be manually controlled when the unexpected occurs.

While human error can never be eliminated, it can be substantially mitigated with the proper tools. Two of the most important are documentation and training.

How much is enough?

First of all, it should be noted that virtually all critical facility operations have some form of documentation and training programs in place. After all, just look at the amount of drawings, manuals, and vendor service reports stacked up on the shelves of the facility office! Don't the facility technicians receive some type of training when they're hired?

The truth is that documentation and training almost always get shortchanged. It's hard, costs money and how can you decide what's adequate, anyway?

Not just any documentation and training program will accomplish the goal of minimizing the risk of downtime. Construction turnover documentation and on-the-job training alone are not up to the task, but just throwing resources at it isn't going to solve the problem either. What's required is a set of best practices and methodology that have a proven track record of success, and that can be implemented in a cost-effective manner.

Establishing a documentation plan

Vendor turnover documentation can be an impressive volume of material, but while it is a vital component of the operation, it hardly constitutes the totality of what's needed to effectively sustain operations. What's typically missing are the detailed procedures and reports that the critical environments team will need to perform such tasks as the daily walkthrough, routine operations, preventative maintenance, corrective maintenance, and emergency response.

Procedures

Virtually everything that takes place in the data center should have a written procedure. A properly constructed procedure accomplishes several important goals:

- **Process formalization**
Writing down a procedure forces the writer to examine it in a level of detail that may not otherwise occur. It invokes logical thinking and gives the writer pause to reflect on the nuances of the procedure. Even better, when the process follows an established structure, crucial aspects of the procedure are automatically included, such as safety, tools and material inventory, and a back-out plan.
- **Peer review**
Having a written procedure facilitates peer review and other types of oversight. Allowing others to review the procedure creates an opportunity for process improvement. Just knowing the work will be reviewed can help take it to a higher level.

- **Proper implementation**
A well constructed document not only provides the information needed to perform a thorough, standardized procedure, it provides a framework for performing activities in the proper sequence, empowers individuals to stop work when events deviate from expectations, and creates a written record of who did what and when.
- **Training**
Having written procedures greatly simplifies the training process. It saves time in training material development, helps ensure the topics are being thoroughly covered and provides a framework for testing.
- **Continuous process improvement**
Written procedures are a valuable reference tool, and allow an already good procedure to be improved upon by systematically examining them after each occurrence to integrate any feedback into the process.
- **Record keeping**
Completed procedures are an important record of the activity that was actually performed. This has value not only for the technical team, but also provides an auditable record of compliance with both internal and external regulations.

Procedures can be utilized in a variety of ways and have specialized formats that are specific to the particular task at hand. The most commonly used procedures are:

- **Standard Operating Procedure (SOP)**
A SOP can be functional or administrative. It details a common operating procedure and can be pulled out whenever needed. An example of a SOP would be how to rotate equipment using the Building Management System. An example of an administrative SOP (ASOP) would be how to create a work ticket.
- **Method of Procedure (MOP)**
A MOP is the detailed, step-by-step procedure that is used when working on or around any piece of equipment that has the ability to directly or indirectly impact the critical load. A library of MOP's should exist for scheduled maintenance operations, and should be written for corrective maintenance and installation activities as well. MOP's may reference a SOP that needs to be performed in the course of the procedure.
- **Emergency Operating Procedure (EOP)**
An EOP is an emergency response procedure for a predicted or previously experienced failure mode. It covers how to get to a safe condition, restore redundancy, and isolate the trouble. EOP's may also cover disaster recovery scenarios.

Reports

Another important group of documents are the various reports that are needed to track the status and condition of the facility.

- **Site Walkthrough Report**
A checklist filled out each shift during the site walkthrough, which verifies the activity was performed and documents equipment status. Readings can be taken that supplement and/or verify the site monitoring system.
- **Shift Report**
A shift-by-shift report of all significant activity that occurs in the facility. It forms a continuous narrative that can be used by the incoming crew to determine everything of consequence that has occurred since the last time they were on duty.
- **Deficiency Report**
A detailed account of a specific deficiency along with any available metrics, risk assessment, suggested remediation, and cost estimates. This is used to document issues and is useful for justifying any related expenditures to decision makers.
- **Incident Report**
A detailed account of a specific incident with a step-by-step timeline that tracks what

occurred, who was involved, when notifications were sent, what immediate actions were taken and where changes in status took place.

- **Failure Analysis Report**
A root cause analysis that would typically follow up an incident report. Its purpose is to determine the underlying cause(s) of the event in order to prevent further occurrences.
- **Lessons Learned Report**
A method of documenting important lessons learned in the course of operating or maintaining a facility that allows technicians and operators to benefit from the experience of others. Lessons learned are an important component of the continuous process improvement program.
- **Weekly Facility Report**
A weekly summary of facility status that typically includes system capacities, completed maintenance, upcoming maintenance, ongoing projects and issues, etc.

Creating a Documentation Process

Simply identifying and creating document templates are only the first steps in the process. There also needs to be a standard policy for document use that covers everything from filling out the forms to performing document reviews, implementing the procedures, and utilizing feedback for process improvement.

Procedure Development

There is a logical process to procedure development that includes the following steps:

- Identify all serviceable equipment
- Identify probable failure mode scenarios
- Create Emergency Operating Procedures
- Create Standard Operating Procedures
- Develop scheduled maintenance program
- Create Methods of Procedure for preventative maintenance
 - Begin with frequent, near term procedures
 - Follow up with infrequent, long term procedures
 - Develop corrective maintenance procedures (as needed)

Developing documents such as Methods of Procedure (MOP's) requires a disciplined approach if they are to effectively function as risk management tools. Some of details that need to be considered are:

- Schedule Information
- Site and Contact Information
- Procedure Overview
- Predicted Effects on Facility
- Supporting Documentation
- Safety Requirements
- Tool and Material Requirements
- Risks and Assumptions
- Step-by-step Work Details
- Back-out Procedures
- Approvals

- Completion Sign-offs
- Procedure Feedback

Quality Assurance

Once a procedure is written, it should undergo some form of quality assurance. The most effective method is to do a formal engineering review, but when this isn't available peer or management review can be substituted. This should be performed each time a procedure is implemented, until the process has been performed more than once without modification. At this stage it's a proven procedure that can be utilized as needed. It's a good idea to periodically review such standardized procedures to ensure that all known best practices are being utilized.

Process Improvement

Zero downtime is the goal of most mission critical operations, but the level of excellence required to achieve this is not easily attainable. No process or procedure is perfect, particularly in its early stages. It's crucial to have a plan for continuous process improvement in place to provide a mechanism for fine tuning the program. For instance, all MOP's should have a feedback section that is used to document any variance that was noted in how the procedure was performed vs. how it was written. Suggestions for improvements can be rolled immediately into a new version of the procedure and run through QA. Important lessons can be documented in a Lessons Learned Report and distributed throughout the organization.

Document Management

Finally, there must be a document management system in place. Ideally this is an automated system that can store digital copies of documents for storage, retrieval, and archiving. It may even have workflow built in for QA functions. This may not appeal to every budget, however. A more manual process may be less convenient and feature-rich, but it can still fit the bill if it includes these elements:

- A catalog that lists each piece of documentation by category and lists its location(s).
- A version control system that shows who authored the document, the current version, who owns the document, the dates of and what changes were made at each version change, and when the next scheduled review is.
- A Quality Assurance procedure for peer and/or management review of document additions, changes, and deletions.

Establishing a training plan

When a facility is built, training is commonly provided by the vendors and contractors involved with the site construction. The quality of this training varies widely, however, and is very often provided by tradesmen and technicians that have no training background. Anyone not partaking in that round of training will typically be trained by other members of the technical staff. The predominant method is on-the-job training (OJT), where the trainee learns by watching others perform their work. Again, the quality of training can be uneven and incomplete, introducing uncertainty and risk into the critical environment.

What's needed is a program that can effectively provide and verify training at progressive levels of expertise. Each individual that passes through the program becomes certified to perform specific tasks that are matched to their level of training. There are several logical progressions to such a program:

1. Qualification for basic supervised operations
2. Qualification for routine operations and maintenance
3. Qualification for advanced operations and maintenance

4. Subject matter expertise

Implementing a Training Plan

The most difficult part of any training program is developing the material. The single greatest reason for the lack of effective training programs is the time and expense of program development. When one considers the benefit of effective training however, the cost and effort are more than offset by increased uptime, lower maintenance costs and decreased employee turnover.

Training Development

The necessary steps for creating an effective critical environment training curriculum are:

- Create Drills for EOP's
- Develop theory of operation for major equipment/systems
- Create training modules for SOP's and MOP's
- Develop exams for various training levels

Training Implementation

Level 1

The goal at this level is to produce an employee that is capable of "standing watch" and properly responding to emergency situations. Ideally, there would be at least one other more highly qualified technician on duty with them. The training covers the following topics:

- Administrative functions
- Theory of operation
- Daily routines
- Security policies
- Emergency procedures

Level 2

At this level, the training focuses on learning the critical systems and being able to begin participating in routine work practices:

- Technical critical systems equipment knowledge
- Frequently performed and/or elementary operational procedures
- Frequently performed maintenance procedures

Level 3

Here the focus broadens to non-critical systems, while getting more in-depth into the critical systems:

- Technical non-critical systems equipment knowledge
- Infrequently performed maintenance procedures
- Infrequently performed and/or moderately difficult operational procedures

Level 4

This level puts the employee on the path to becoming a subject matter expert, and includes:

- Select, technically difficult procedures
- Specialized outside training
- Training course development
- Training course delivery

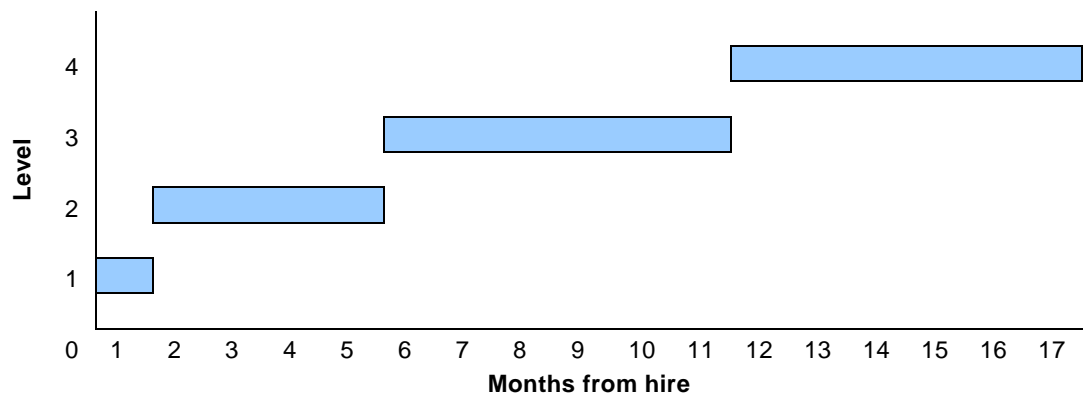
Training Timeline

The amount of time required to complete this type of training will vary with the complexity and volume of material. **Figure 1** shows an example of a training timeline for a moderately large and complex site:

- Level 1: To be completed within 30 days of hiring start date
- Level 2: To be completed within 3-4 months of completion of Level 1
- Level 3: To be completed within 4-6 months of completion of Level 2
- Level 4: To be completed within 4-6 months of completion of Level 3

Figure 1

Example of a training timeline for a moderately large and complex site



Cost of critical site documentation and training

Increased reliability does come at a cost, of course. There are a number of variables that can affect the expense of a structured documentation and training program, including the complexity of the critical systems themselves, the amount of automation designed into the system and the amount of human resources dedicated to the effort.

Function of complexity

Interestingly, the size of the site and amount of equipment in place are not good indicators of program cost. It's more tightly coupled with complexity of the installation, as defined by the sophistication of the design and the variety of equipment in use. For instance, a Tier III facility has more redundant components and system automation than a Tier II facility. The additional functionality requires documentation and training program development. Even sites with similar tier ratings that have different design philosophies can vary greatly in complexity.

The variety of equipment at a site affects the amount of documentation and training needed. For example, a site with two different UPS systems will have double the number of procedures that need developing in this area along with the associated training. On the other hand, large numbers of homogeneous equipment all utilize the same basic procedures.

Another factor is the diversity of operational activities that the facilities staff engages in. In some locations, the facilities staff is responsible for racking servers and running network connections, for example. These additional functions need to be documented and trained on as well.

Staged Cost Structure

It's important to note that the costs are not incurred all at once, but are spread throughout the program. There are three stages of expenditure for a documentation and training program:

- **Mobilization Cost** - These are the up-front costs for documentation and training material development during the initial deployment, as well as any direct training costs. Not all of the documentation needs to be created up-front, however. For instance, a new facility will not need the semi-annual or annual maintenance MOP's at startup. Similarly, only the Level 1 training development and classes need be conducted at the outset of a new program. These activities may represent from 50% to 75% of the total one-time costs.
- **First-year Cost** - During the first year, the remainder of the standard document set is developed, including scheduled maintenance MOP's and operating procedures for the less frequent or technically demanding activities. Previously established procedures are ironed out and expanded upon. On the training side, Levels 2-4 are developed and implemented. The remainder of the startup cost is incurred throughout this period.
- **Ongoing Cost** - Somewhere in the second year of the program, the initial documentation and training effort levels off to a normal level of activity. The ongoing costs at this stage consist of developing MOP's for non-scheduled procedures such as corrective maintenance and other operational procedures and reports as needed. QA work is still performed for new or still evolving procedures, and periodic reviews of the documentation set are conducted. Advanced training and recertification will also take place, as well as any new hire training that becomes necessary.

Conclusion

Fulfilling the goal of uninterrupted operation requires more than an investment in redundant critical infrastructure systems. It also requires an investment in their sustained operation. Creating an effective maintenance program, while minimizing the risk of human error, can only be accomplished with a highly structured documentation and training effort. The cost of these programs should be considered necessary to fulfill the critical mission and to protect the original infrastructure investment. In practice, the expense can be offset by increased uptime, longer asset life and less employee turnover.



About the author

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Mr. Woolley has been involved in the critical facilities management field for over 25 years. Bob served as Vice President of Data Center Operations for Navisite, as well as Vice President of Engineering for COLO.COM. He was also a Regional Manager for the Securities Industry Automation Corporation (SIAC) telecommunications division and operated his own critical facilities consulting practice. Mr. Woolley has extensive experience in building technical service programs and developing operations programs for mission critical operations in both the telecommunications and data center environments. He may be reached at rwoolley@leetechnologies.com.



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