General Electric Advanced Technology Manual

Chapter 4.13

Operability

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4.13 OPERABILITY

Learning Objectives:

1. Describe the differences between operability, functionality, & availability as applied to plant structures, systems, and components (SSC).

2. Define the terms non-conforming condition and degraded condition.

3. List the steps to resolve a degraded or non-conforming condition.

4.13.1 Introduction

An inspector in the field will often discover issues involving equipment condition or quality. It is important for an inspector to know how such equipment issues affect important safety functions and regulatory requirements such as technical specifications and the maintenance rule. In this chapter, several commonly used methods of classifying plant structures, systems, and components (SSC's) will be discussed as well as the how that classification normally relates to functions specified in a plant's current licensing basis.

4.13.2 Classification of Plant Equipment

A nuclear power plant consists of many thousands of valves, instruments, components, etc. While all of this equipment is of concern to the licensee, only a subset of this is of regulatory concern to the NRC. This subset of plant components is normally specified in the Updated Final Safety Analysis Report (UFSAR) as the basis for the licensing of the plant and will be referred to in this chapter as the plant's structures, systems, and components (SSC's).

4.13.2.1 Structures, Systems, and Components

Before a plant is licensed, it submits a safety analysis report to the NRC documenting the design features of the plant that ensure safe operation. The structures, systems, and components (SSC's) described in this report form, in part, the design basis for the plant and must be maintained and updated throughout the life of the plant. These SSC's are required to perform various functions. Some of these functions are directly related to safe operations. Some support the functioning of other SSC's and some are simply required not to interfere with a safety function. Because this report forms the basis for licensing the plant, it is part of what is generally referred to as the current licensing basis (CLB).

4.13.2.2 Current Licensing Basis

The CLB is the set of NRC requirements applicable to a specific plant, plus a licensee's docketed and currently effective written commitments for ensuring compliance with, and operation within, applicable NRC requirements and the plant-specific design basis, including all modifications and additions to such commitments over the life of the facility operating license.

The set of NRC requirements applicable to a specific plant CLB include:

- NRC regulations in 10 CFR Parts 2, 19, 20, 21, 26, 30, 40, 50, 51, 54, 55, 70, 72, 73, and 100 and appendices thereto
- Commission orders
- license conditions
- exemptions
- technical specifications
- plant-specific design basis information defined in 10 CFR 50.2 and documented in the most recent UFSAR (as required by 10 CFR 50.71)
- licensee commitments remaining in effect that were made in docketed licensing correspondence (such as licensee responses to NRC bulletins, Licensee Event Reports, generic letters, and enforcement actions)
- licensee commitments documented in NRC safety evaluations

SSC's may have one or more functions as defined by the CLB. For example, a residual heat removal pump may have a safety function to provide low pressure coolant injection and a maintenance rule function to remove decay heat. The actual details of these functions are plant specific and inspectors should familiarize themselves with key CLB documents for the plant to which they are assigned. This is important, as when a condition affecting the performance of an SSC is discovered, the inspector must determine if functions defined in the CLB are maintained and verify that the licensee takes appropriate action to protect public health and safety.

4.13.2.3 Safety-Related

One of the most common classifications of SSC's is the term safety-related. Though specific definitions vary throughout the industry, 10 CFR 50.2 defines safety-related SSC's as:

> *…those structures, systems and components that are relied upon to remain functional during and following design basis events to assure:*
>
> *The integrity of the reactor coolant pressure boundary*

The capability to shut down the reactor and maintain it in a safe shutdown condition; or

The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in § 50.34(a)(1) or § 100.11 of this chapter, as applicable.

Thus, a subset of SSC's described in the UFSAR is normally considered safety-related and requires additional programs and procedures to ensure their functional capabilities and maintain their quality. This chapter will not discuss quality assurance (QA) programs in detail, but an inspector may find it useful to review a licensee's QA program and the SSC's scoped under 10 CFR 50 Appendix B for insight into a particular plant's SSC classification scheme. Additionally, many plants will provide details of component classifications in the UFSAR or a licensee specific procedure.

4.13.2.4 Important to Safety

Another commonly used term is "Important to Safety". The term is used in regulations (e.g., 10CFR50 Appendix A, 10CFR50.49, 10CFR50.59) to denote equipment that is relied on to ensure safe operation of the plant of which Safety-Related equipment is a subset.

General Design Criteria 1 requires that structures systems and components *important to safety* shall be designed, fabricated, erected and tested to quality standards commensurate with the importance of the safety functions to be performed. Generic Letter 84-01 was issued to clarify the use of the term. It states that "important to safety" and "safety-related" are not synonymous terms as used in Commission regulations applicable to nuclear power reactors. The Quality Assurance program described in 10CFR50 Appendix B applies to only Safety Related equipment. Normal industry practice is generally acceptable for most equipment not covered by Appendix B. Nevertheless, in specific situations in the past where the Staff has found that quality assurance requirements beyond normal industry practice were needed for equipment "important to safety," they have not hesitated in imposing additional requirements commensurate with the importance to safety of the equipment involved. Specific examples where the NRC has imposed additional quality requirements include Fire Protection, ATWS, SBO and RG 1.97 post-accident monitoring instrumentation).

10CFR50.59 requires the licensee to evaluate malfunctions of equipment important to safety. The licensee must address not only safety-related equipment, but also other equipment that may be relied upon such that safety-related equipment performs its intended functions and equipment that can initiate accidents and transients. Generally, the equipment important to safety for a particular plant is determined as part of the

licensing reviews and the malfunctions are evaluated in the FSAR to the extent that they affect plant safety.

10 CFR 50.49 defines it in terms of the environmental qualification of electric equipment as encompassing safety-related components, non-safety related components whose failure under postulated environmental conditions could prevent satisfactory accomplishment of safety functions, and certain post accident monitoring equipment.

4.13.2.5 Engineered Safety Features

NUREG-0800, Chapter 6 states that engineered safety features (ESF) are provided in nuclear plants to mitigate the consequences of design-basis or loss-of-coolant accidents. 10 CFR Part 50 requires that certain systems be provided to serve as ESF systems. Examples of typical ESF systems include containment systems, residual heat removal systems, emergency core cooling systems, containment heat removal systems, containment atmosphere cleanup systems, and certain cooling water systems.

While it is important to be familiar with the above terminology, an inspector should focus on how the licensee uses an SSC to meet regulatory requirements. That is, if an SSC performs a specific safety function or some other function specified in the regulations, it is the capability of that SSC to perform that function or the actions taken by the licensee following a loss or degradation of that function which should be assessed.

4.13.3 Operability

A system, subsystem, train, component, or device shall be operable or have operability when it is capable of performing its specified safety functions, and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication and other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its function(s) are also capable of performing their related support function(s).

Additionally, to be operable an SSC must be capable of performing the safety functions specified by its design, within the required range of design physical conditions, initiation times, and mission times and meet all surveillance requirements (SR). An SSC that does not meet a SR must be declared inoperable. For operability determination purposes, the mission time is the duration of SSC operation that is credited in the design basis for the SSC to perform its specified safety function. Operability applies to a subset of SSC's detailed by a specific plant's technical specifications (TS). Thus, the term operability will only be applied to the ability of TS equipment to perform its specified safety function.

4.13.3.1 Technical Specification Equipment

10 CFR 50.36 details the regulatory requirements for technical specifications (TS). They are to be derived from the UFSAR and include:

Safety limits - limits upon important process variables that protect against the uncontrolled release of radioactivity. If any safety limit is exceeded, the reactor must be shut down.

Limiting safety system setting - settings for automatic protective devices having significant safety functions. A limiting safety system must cause automatic protective action before a safety limit is exceeded. If an automatic safety system does not function as required, the licensee shall take appropriate action, which may include shutting down the reactor.

Limiting conditions for operation – specify the lowest functional capability or performance levels of equipment required for safe operation. When a limiting condition for operation is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. A technical specification limiting condition for operation must be established for each item meeting one or more of the following criteria:

Criterion 1. Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary.

Criterion 2. A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

Criterion 3. A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

Criterion 4. A structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety.
Surveillance requirements - requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met.

Administrative controls - the provisions relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary to assure operation of the facility in a safe manner.

4.13.3.2 Technical Specification Support Equipment

Some SSC's, while not specifically listed in the TS, nevertheless perform important support functions for TS SSC's. As mentioned in the Operability section, a TS SSC can not be considered operable unless all support systems required by the TS system are also capable of performing their related support function(s). Thus, the functionality (discussed below) of non-TS systems can directly affect the operability of TS systems.

4.13.4 Functionality

An SSC is functional or has functionality when it is capable of performing its specified function, as set forth in the CLB. Functionality does not apply to specified safety functions, but does apply to the ability of non-TS SSCs to perform other specified functions that provide support to systems providing a specified safety function. Specified functions may be described in various elements of the CLB including the Updated Final Safety Analysis Report (UFSAR), technical requirements manual, emergency plan, fire protection plan, or various regulatory commitments.

4.13.5 Availability

Availability is another term, like operability or functionality, used to designate the ability of an SSC to perform certain functions. It is normally defined by the licensee in reference to the requirements of a given program. For example, just as operability refers to the capability of an SSC to perform a TS required safety-function, availability refers to the capability of an SSC to perform a specific function as defined by the maintenance rule or performance indicators programs. Additionally, while operability is deterministic, availability is often determined using "real world" or best estimate conditions. Thus, if it is more likely than not that the system can perform its function; it will often be considered available, even when the TS require it to be declared inoperable. As an example, in many plants it is standard practice after diesel maintenance to declare the diesel available when maintenance tags have been cleared even though it can not be declared operable until after a successfully TS surveillance test.

The term "available" is unfortunately sometimes used in a deterministic fashion in technical specifications as well. In this case, it usually means "available for use, but not necessarily running". For example, the section 3.4.9 in the BWR/4 standard technical specifications required action A.1 discusses verifying an alternate method of decay heat removal is available. In this case, "available" refers to a non-TS system that is capable of removing enough decay heat to maintain or lower reactor coolant temperature and

can be placed in service if required. In this chapter, the term “available” will be used in reference to licensee maintenance rule and performance indicator programs.

4.13.5.1 Maintenance Rule

The maintenance rule (MR), 10 CFR 50.65 a(1) & a(2), requires that the licensee monitor SSC’s that perform certain intended functions and to take corrective action when needed to improve performance. The scope of these intended functions can include both safety-related and non safety-related SSC’s. The capability of SSC’s to perform their MR functions is usually referred to as availability (i.e., if the component can perform its MR function, it is available).

10 CFR 50.65 a(4) requires the licensee to assess and manage risk for a subset of these SSC’s (and their intended functions) that have been shown via a risk-informed evaluation to be significant to public health and safety (i.e., risk significant). Most licensee’s have a program to implement each part of the MR. Thus, the definition for a given MR function may vary by the type of MR program, and thus the definition of availability may also vary depending upon which portion of the MR is being considered.

When the condition of an SSC changes, the licensee must take appropriate action to minimize the risk to public health and safety. 10 CFR 50.65 a(4) requires that the licensee assess and manage risk prior to performing maintenance. Many plants implement this requirement by tracking the availability of SSC’s using an on-line risk model. This model tracks incremental changes in plant core damage probability (CDP) and calculates how changes in risk significant SSC’s affect the CDP. If the loss of an SSC causes risk to rise above a certain predefined level, the licensee will take risk management actions such as protecting a redundant equipment train. Thus, it is important for an inspector to understand how the licensee determines availability and to ensure that appropriate action is taken when an SSC is not available.

4.13.5.2 Performance Indicators

Performance indicators (PI’s) are used by the reactor oversight process (ROP) to assess licensee performance. The PI program tracks the status of various SSC’s and uses its own definition of SSC availability for this purpose. PI availability, in some cases, is different than the MR availability for the same SSC. This, in part, may be due to a difference in scope or definition between the PI required function and the MR intended function. For example, the function monitored by the NRC Mitigating System Performance Indicator (MSPI) for decay heat removal is limited to suppression pool cooling where as the maintenance rule functions that are monitored for the RHR system would typically include LPCI injection and shutdown cooling in addition to SP cooling. NRC inspectors must periodically review PI data for accuracy and thus, they must

understand the specific definitions used by the licensee for availability and the potential differences between them.

4.13.6 Degraded or Non-conforming Conditions

One of the major benefits of in-field inspection, is the ability to observe and assess the condition of plant SSC's. When a condition is discovered that may affect the capability of an SSC to perform its defined function or functions, the licensee must take appropriate action to protect public health and safety. Part of this assessment will be to identify what functions (TS, TS-support, EP, Fire protection, MR, etc.) the SSC provides and whether the SSC can be considered operable, functional, or available to support this function.

4.13.6.1 Definitions

Per the current inspection manual technical guidance, the following definitions are used for identified SSC conditions.

4.13.6.1.1 Non-conforming Condition

A nonconforming condition is a condition of an SSC that involves a failure to meet the CLB or a situation in which **quality** has been reduced because of factors such as improper design, testing, construction, or modification. In other words, the design of the SSC may be inadequate.

The following are examples of nonconforming conditions:

a. An SSC fails to conform to one or more applicable codes or standards (e.g., the CFR, operating license, TSs, UFSAR, and/or licensee commitments).
b. An as-built or as-modified SSC does not meet the CLB.
c. Operating experience or engineering reviews identify a design inadequacy.
d. Documentation required by NRC requirements such as 10 CFR 50.49 is unavailable or deficient.

4.13.6.1.2 Degraded Condition

A degraded condition is one in which the **qualification** of an SSC or its **functional capability** is reduced. In other words, material condition may prevent the SSC from meeting its design specifications.

Examples of degraded conditions are failures, malfunctions, deficiencies, deviations, and defective material and equipment. Examples of conditions that can reduce the capability of a system are aging, erosion, corrosion, improper operation, and maintenance.

4.13.6.1.3 Unanalyzed Condition

An unanalyzed condition is a condition which has not been considered or analyzed per the UFSAR or other portion of the CLB and thus its impact on public health and safety has not been determined.

4.13.6.1.4 Reasonable Expectation

Reasonable expectation is the high degree of confidence based on evidence that an SSC is operable after the discovery of a degraded or nonconforming condition affecting that SSC. Reasonable expectation does not mean absolute assurance that the SSCs are operable. The SSCs may be considered operable when there is evidence that the possibility of failure of an SSC has increased, but not to the point of eroding confidence that the SSC remains operable.

4.13.6.2 Operability Determination

When a degraded, non-conforming or unanalyzed condition is identified, the licensee must have a process to assess the continued operability of any SSC affected by this condition. There can be no such thing as an indeterminate state of operability. If there is insufficient information to justify operability, the SSC must be declared inoperable.

4.13.6.2.1 Immediate

An immediate determination of operability should be made without delay using the best available information. Licensees should not postpone the determination until receiving the results of detailed evaluations. If a piece of information material to the determination is missing or unconfirmed, the licensee should declare the SSC inoperable. The immediate determination should document the basis for concluding that a reasonable expectation of operability exists. When a reasonable expectation of operability does not exist, the SSC should be declared inoperable.

4.13.6.2.2 Prompt

A prompt determination of SSC operability is a followup to an immediate determination of SSC operability. A prompt determination is warranted when additional information, such as supporting analysis, is needed to confirm the immediate determination. A prompt determination, when needed, should be done without delay. Licensees should make continuing progress toward completing the determination. A reasonable expectation of operability should exist while the prompt determination is being completed.

4.13.6.2.3 Continuous Assessment

After an immediate and prompt (as required) operability assessment has been completed, the operability of the SSC should continuously be evaluated as new information becomes available. The SSC must be declared inoperable if reasonable expectation of operability is lost at any point prior to corrective actions restoring full qualification to the SSC.

4.13.6.3 Functionality Assessment

Functionality and operability are similar but separate concepts. While all licensees have a specific operability determination process for making operability determinations for SSCs described in TSs, including consideration of necessary and related support functions, most do not have a specific process for evaluating the functionality of SSCs not described in TSs. Normally, functionality is assessed and documented through other plant processes such as the corrective action process. It is appropriate to consider safety significance in determining the appropriate depth of a functionality assessment. Also, the effect of nonfunctional SSCs on compliance with other regulatory requirements (e.g., Appendix R, station blackout, ATWS, environmental qualification, maintenance rule) should be determined.

4.13.6.4 Availability Assessment

Per the licensee's specific MR program and PI program, assessments of equipment availability should be made and, where appropriate, risk management actions taken. It should be noted that in the case of unavailable safety significant SSC's, 10 CFR 50.65 a(4) requires the licensee to assess and manage risk. The licensee must follow its risk management implementing procedures and the inspector must determine if these actions were adequate based upon the risk significance of the issue.

4.13.6.5 Reportability Assessment

In addition to the above assessments of SSC capability to perform a given TS, CLB, or MR function, loss of function may be reportable per regulatory requirements such as those defined in 10 CFR 50.72 and 10 CFR 50.73. If a condition results in a loss of function, it should be evaluated against the licensee's current reporting requirements to ensure that appropriate notifications to the NRC have been made.

4.13.6.6 Corrective Actions

Corrective actions should be taken in a timely manner to restore the SSC to a fully qualified condition. The timeliness of these actions should be commensurate with the risk significance of the issue i.e. the more risk significant the condition, the more quickly the licensee should seek to resolve it.

An SSC that is determined to be operable but degraded or nonconforming is considered to be in compliance with its TS LCO, and the operability determination is the basis for continued operation. However, the degraded or non-conforming condition should be entered into the licensee's corrective action program and should be corrected at the first available opportunity.

4.13.7 Summary

Each plant classifies SSC's according to the methods, programs, and regulatory requirements in its CLB. A common classification method designates SSC's relative to their safety functions. Thus, some SSC's may be considered safety-related, important to safety, or an engineered safety feature. Additionally, several programs are used to track and maintain the functions of SSC's. Technical specifications are one deterministic method of tracking the important safety functions of equipment in terms of operability. Additionally, the capability of non-TS SSC's to perform their CLB function is described in terms of functionality and may support a regulatory requirement such as EP or Fire Protection. The MR is implemented by licensee programs to track and trend SSC capability and to assess and manage risk in terms of availability.

When a degraded or non-conforming condition is discovered, it must be assessed by the licensee in terms of operability, functionality, and availability. The licensee is expected to take appropriate action to protect public health and safety.

4.13.8 References

1. IMC Part 9900: Technical Guidance
   a. STSODP: Operability Determinations Process
   b. STS10: Operability

2. Regulatory Information Summary 2005-20

3. 10 CFR 50.2/50.34/50.36/50.65