General Electric Systems Advanced Technology Manual

Chapter 1.1

Conduct of Operations

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1.1 CONDUCT OF OPERATIONS

Learning Objectives:

1. Given a copy of the Conduct of Operations Administrative Procedure, ADM-01, be able to perform the following:

   a. Identify the minimum operating shift staffing requirements.

   b. Recognize the duties and responsibilities of the following operating shift crew members:
      - Shift Manager (SM)
      - Unit Supervisor (US)
      - Shift Technical Advisor (STA)
      - Unit Operator (UO)
      - Non-Licensed Operator (NLO)

   c. Identify how access to the control room is controlled.

   d. Identify how control room operators respond to annunciators.

   e. Recognize the different types of briefings used and when their use is appropriate.

   f. Recognize what constitutes a reactivity manipulation and the additional controls placed on them by the licensee's Reactivity Management Program, including maintaining licensed power level.

   g. Identify the human performance (HU) error prevention tools used by the licensees.

   h. Recognize the different "level of use" designations for procedures.

   i. Recognize the importance of tracking equipment status and the methods used for status control.

   j. Identify how the licensee monitors and controls maintenance risk, both on-line and during outages.

1.1.1 Introduction

Following the accident at Three Mile Island, the NRC implemented a number of programs that significantly improved the reliability of personnel performance and the safety of nuclear power plants by reducing the likelihood of core damage and containment failure. Together, these programs have significantly improved human performance. These programs included:

- Detailed control room design reviews resulted in substantial improvements to the human engineering design of control rooms, as well as to control stations and panels outside the main control room. Examples include system mimicking on the panels, designated color schemes for redundant divisions of systems, etc…

- Emergency procedures were modified to include symptom-oriented mitigation strategies and were refined to be more useable, reducing errors in their implementation. These new procedures encompassed a much wider range of physically possible scenarios, including those beyond design bases.

- Systematic approach to training (SAT) based training programs for licensed operators, and later for other important plant personnel, were adopted such that job-task analyses were performed which formed the basis for the development of learning objectives, training materials and approaches, objective-specific testing, and appropriate program improvements based on feedback from personnel performance in the field.

- Other policies and programs implemented by the NRC improved staffing, overtime controls, and fitness-for-duty of plant personnel. Still others improved security and safeguards operations, emergency planning and response, and health physics controls (both occupational and public).

The nuclear industry also took several initiatives to improve performance. These include issuing specific guidance documents for human performance, equipment status control, reactivity management and conservative decision making.

As part of the NRC's Reactor Oversight Program (ROP), each finding is evaluated as to the cause of the finding to identify underlying cross-cutting themes that would be indicative of weaknesses in safety culture. One of these areas is Human Performance. The aspects of human performance include:

- The licensee makes safety-significant or risk-significant decisions using a systematic process, especially when faced with uncertain or unexpected plant conditions, to ensure safety is maintained.

- The licensee appropriately plans work activities by incorporating risk insights; job site conditions, including environmental conditions which may impact human performance; plant structures, systems, and components; human-system interface; radiological safety; and the need for planned contingencies, compensatory actions, and abort criteria.

- The licensee plans work activities to support long-term equipment reliability by limiting temporary modifications, operator work-arounds, safety systems unavailability, and reliance on manual actions.

- The licensee utilizes human error prevention techniques, such as holding pre-job briefings, self and peer checking, and proper documentation of activities.

- The licensee defines and effectively communicates expectations regarding procedural compliance and personnel follow procedures.

Virtually every utility has administrative procedures to implement these guidelines. The licensee's policies for these areas are typically contained in various operations' administrative procedures, with titles such as "Conduct of Operations for Shift Personnel," "Reactivity Management," "Control Room Conduct and Control Room Shift Activities," "Risk Management," etc…

As part of the baseline inspection program, the NRC conducts inspections on these programs, both directly and as part of other inspection procedures. Likewise, these processes and procedures weigh significantly in the NRC inspector/examiner evaluation of operator performance. Prior to conducting these inspection activities, inspectors/examiners should familiarize themselves with the licensee's procedures, expectations, and policies including:

- Operator compliance and use of plant procedures, including procedure entry and exit, performing procedure steps in the proper sequence, procedure place keeping, and technical specification entry and exit.

- Component manipulations, both in the control room and in-plant.

- Communications between crew members.

- Use, interpretation and diagnosis of plant instruments, indications, and alarms.

- Use of human error prevention techniques, such as pre-job briefs and peer/self checking.

- Documentation of activities, including initials and sign-offs in procedures, control room logs, technical specification entry and exit, and entry into out of service logs.

- Management and supervision of activities, including risk management and reactivity management.

The purpose of this chapter, in conjunction with the Conduct of Operations procedure (ADM-01), is to familiarize students with these programs. The programs presented are typical of a nuclear utility, **<u>but each licensee has their own specific guidance</u>**. Prior to conducting inspection activities at a specific plant, their procedures and processes should be reviewed. The chapter will refer to the Conduct of Operations procedure, but this terminology should be interpreted as that procedure, series of procedures, or other plant policies that govern the program being discussed.

1.1.2 Leadership and Management

The Operations department is in the unique position of leadership in the plant organization. Only licensed operators can operate the reactor. All work and equipment status changes that can impact safe operation are approved by the on-shift crew. There is always an operating crew on shift regardless whether at nights, on a weekend, or on a holiday. The Shift Manager is responsible for overall safe operation of the plant and shall have control over those onsite activities necessary for safe operation and maintenance of the plant. With these responsibilities comes tremendous scrutiny and accountability for safe operation.

The typical Conduct of Operations procedure will contain policies and expectations that the Operations Department leads the site by, not only operating the plant in accordance with procedures and policies, but also by ensuring all plant personnel demonstrate the same rigor in their performance. Not only do operators adhere to and enforce the principles of nuclear safety, industrial safety, and radiological safety, they establish the priorities for maintenance activities, maintain status of all equipment important to safety and maintain the highest standards for professionalism and material condition of the plant.

1.1.3 Shift Staffing and Qualification

The minimum shift staffing of operators is defined in the Conduct of Operations. The requirements take into account all regulatory requirements and licensee commitments to ensure safe operation of the plant. In addition, the Conduct of Operations will define the requirements to maintain an operating license active and how to re-establish proficiency if it is lost.

1.1.3.1 Code of Federal Regulations (CFR)

The minimum number of licensed operators, both senior reactor operators (SROs) and reactor operators (ROs), are established by regulations (i.e., 10CFR50.54(m)). Table 1.1.1 lists the minimum number or licensed operators required depending on the number of units at the site and number of units operating (not in cold shutdown or refueling).

10 CFR 50.54 also provides requirements that at least one SRO and an additional SRO or RO shall be in the control room at all times for each unit that is operating and that an SRO or SRO limited to fuel handling, shall be present during core alterations with no concurrent duties assigned.

10 CFR 55 not only provides guidance on obtaining a license, but it provides guidance on maintaining the license and re-establishing proficiency if lost. Operators must actively participate in a re-qualification program, including passing an annual requalification examination. They must also stand a minimum number of hours on watch each quarter to remain active.

To remain active, an operator must stand at least seven 8-hour shifts or five 12-hour shifts each calendar quarter. If active status is lost and the license is still current and valid, an operator must complete at least 40 hours on-shift under the instruction of an active licensed operator. The 40 hours must include a complete tour of the plant and all required turnover activities.

1.1.3.2 Technical Specifications (TS)

In addition to referencing the requirements of 10 CFR 50.54(m), the Technical Specifications contain additional guidance for shift staffing.

It requires a minimum number of non-licensed operators (NLOs). Each reactor containing fuel will have one NLO assigned and each reactor that is operating shall have at least one additional NLO assigned.

The TS also require that an individual shall provide advisory technical support to the shift operating crew in the areas of thermal hydraulics, reactor engineering, and plant analysis with regard to the safe operation of the unit. This watch station is known as the Shift Technical Advisor (STA). The person can have specific STA qualifications or may be an SRO with specific additional training and qualifications.

The TS allow shift crew composition to be less than the minimum requirement of 10 CFR 50.54(m) (including NLOs and the STA) for a period of time not to exceed 2 hours in order to accommodate unexpected absence of on-duty shift crew members provided immediate action is taken to restore the shift crew composition to within the minimum requirements.

1.1.3.3 Fire Protection Program (FPP)

10CFR 50.48, Fire Protection, and Appendix R, contain requirements for fire protection programs and for the capability to safely shutdown the unit during a fire. Each licensee's program is submitted to the NRC and is referenced in the licensee's Condition of License. The program can be included in the Final Safety Analysis Report (FSAR), can be in the form of an administrative procedure (or procedures) or may be a standalone document (or documents).

Part of the Fire Protection Program is the establishment of a Fire Brigade. 10 CFR 50 Appendix R requires that the fire brigade consist of at least five brigade members on each shift. The brigade leader and at least two brigade members shall have sufficient training in or knowledge of plant safety-related systems to understand the effects of fire and fire suppressants on safe shutdown capability. The brigade leader shall be competent to assess the potential safety consequences of a fire and advise control room personnel. Such competence by the brigade leader may be evidenced by possession of an operator's license or equivalent knowledge of plant safety-related systems. Most utilities either staff the fire brigade with members from the on-shift operators or supplement the brigade with operators. In addition, the brigade leader will normally have an SRO or RO license, or operations will provide an individual with the requisite knowledge to advise the leader and coordinate with the control room staff.

Appendix R also requires an alternative or dedicated shutdown capability be provided for a fire in each fire area. Although some utilities were licensed to different requirements, the current guidance in Appendix R is that this shutdown capability shall be able to:

- achieve and maintain subcritical reactivity conditions in the reactor;
- maintain reactor coolant inventory;
- achieve and maintain hot shutdown for a BWR;
- achieve cold shutdown conditions within 72 hours; and
- maintain cold shutdown conditions thereafter.

Utilities perform a Safe Shutdown Analysis (SSA) to determine what equipment would be lost for a fire in each fire area and how the plant can achieve hot shutdown and cold shutdown if required. In many cases, the utility will credit manual operator actions to achieve safe shutdown conditions. In those cases, operators must be assigned in sufficient numbers to take these actions in the worst case fire areas. These requirements often are the limiting factor in determining minimum shift staffing, especially for non-licensed operators. If an operator is assigned safe shutdown operator actions, they cannot perform other required duties such as fire brigade member.

1.1.3.4 Conduct of Operations

The Conduct of Operations (or other administrative procedure or policy) will define the minimum shift staffing for operators. It will take into account all regulatory requirements such that there are sufficient operators available each shift to perform these functions. Table 1.1.2 is provided as an example for a single unit plant. In addition, the procedure will require that the person responsible for each function, including fire brigade and safe shutdown, be designated in writing for each shift and that the off-going personnel will not leave until relieved from all duties assigned.

The Conduct of Operations will also define the requirements for maintaining qualifications and re-establishing proficiency, including documentation of under instruction watches and which specific areas of the plant are to be toured.

1.1.4 Duties and Responsibilities

The duties and responsibilities of operators are contained in a number of documents depending on the process being address. The typical Conduct of Operations procedure may outline duties and responsibilities applicable to any nuclear worker as well as specific duties for operations department personnel by organizational title (such as Operations Manager) and by watchstation.

Specific duties and responsibilities for the on-shift crew are covered in the following sections. Duties and responsibilities applicable to all nuclear industry personnel include the following:

- Follow procedures
- Come to work fit for duty
- Observe all radiological rules
- Comply with security procedures and access control
- Use the corrective action program to identify and resolve issues

1.1.4.1 Shift Manager (SM)

The Shift Manager is the senior management representative on shift. The SM is responsible for overall safe operation of the plant and shall have control over those onsite activities necessary for safe operation and maintenance of the plant. Although Shift Manager is the standard title for this position, many utilities have other titles such Nuclear Plant Supervisor, Supervisor on Shift, Senior Shift Supervisor, etc.

Regulations require that the licensee designate individuals who hold a senior reactor operator license, to be responsible for directing the licensed activities of licensed operators. The SM fills that role. Not only is the SM ultimately responsible for plant operation (response to abnormal and emergency operation, plant status changes, compliance with TS, etc…), he/she is also the manager of his/her crew. As such, the SM is responsible for training the crew, reinforcing management expectations to the crew, scheduling absences, administering discipline if warranted, etc. Other duties and responsibilities of the SM are listed in ADM-01, Conduct of Operations.

Some specific responsibilities include:

- Determining operability of TS equipment and returning TS equipment to operable status.

- Notification of plant management and NRC of events that occur on-shift that meet the threshold defined in the conduct of operations procedure.

- Declaring an emergency per the plant's Emergency Plan and serving as Emergency Director following the declaration until relieved by the designated manager in the Emergency Response Organization.

1.1.4.2 Unit Supervisor (US)

The Unit Supervisor is the SRO with command and control of the individual unit and directly supervises the Unit Operators assigned to the unit. He/she provides oversight and coordination of specific activities on the unit and reports to the SM. Other duties and responsibilities are contained in ADM-01, Conduct of Operations.

Unit Supervisor is the standard title used in ADM-01, but many utilities have other titles such Control Room Supervisor, Assistant Nuclear Plant Supervisor, Assistant Supervisor on Shift, etc.

1.1.4.3 Shift Technical Advisor (STA)

The Shift Technical Advisor is responsible for advising the operating crew during abnormal or emergency operations. The STA position was created following the accident at Three Mile Island (NUREG 0737) to ensure that there were personnel on shift with expertise in reactor physics and thermodynamics. The STA need not be licensed, but many utilities use licensed SROs to fill this role.

In addition to providing independent assessment during abnormal and emergency conditions, many utilities use the STA as an independent review of Technical Specification operability, reportability evaluations, Emergency Plan declarations and risk assessments.

1.1.4.4 Unit Operator (UO)

Unit operators are licensed reactor operators who, under the direction of the US, manipulate the controls on the main control panels. There are typically two UO assigned to each unit (although regulations allow two units to share one of the unit operators if they have a common control room). One of the UOs is designated Operator at the Controls (OATC) and the other as Balance of Plant Operator (BOP).

The OATC has the primary responsibility to monitor the control panels and perform routine adjustments to plant process parameters (power, level, pressure, etc…). The Conduct of Operations may provide specific guidance for control board monitoring for the OATC, including requirements for periodic board walkdowns, and restrictions on other activities (such as phone and internet use) that could distract the OATC. If the

OATC has to leave the reactor controls area, he/she must be relieved and another operator assume the role.

The BOP operator conducts surveillances and performs other activities that would distract the OATC from his/her primary duties. In general the UOs coordinate the actions of the non-licensed operators assigned to their unit. Other duties and responsibilities of the UOs are contained in ADM-01, Conduct of Operations.

1.1.4.5 Non-Licensed Operator (NLO)

The non-licensed operators monitor and operate equipment outside of the control room. In addition to conducting shiftly rounds and log taking, the NLOs conduct surveillance, hang and release clearances and act as the eyes and ears of the control room operators. Other duties and responsibilities are contained in ADM-01, Conduct of Operations.

1.1.5 Main Control Room Access and Atmosphere

The Conduct of Operations procedure provides specific guidance on control of access to the control room and what activities are allowed in the control room. Especially during complex evolutions or error likely situations, the Unit Supervisor must control the number of personnel and the level of activity. Likewise the behavior of personnel and material condition in the control room should set the standard for the plant. If an unprofessional atmosphere is tolerated in the control room, it brings into question the standards and expectations for the rest of the plant.

With the exception of the on-shift crew, certain senior managers and the NRC, all personnel must obtain permission from the Unit Supervisor (or other control room watchstander) to enter the control room surveillance area. Likewise, if conditions change or their presence proves to be distracting, the Unit Supervisor has the authority to order personnel to leave the control room surveillance area. This area will typically have a physical barrier (e.g., rope, gate, etc.) and/or contain signage informing personnel that permission is required for entry. Hard hats and other personal protective equipment (e.g., gloves and eye protection) must be removed prior to entry. Access to the Reactor Controls Area is further controlled to help prevent inadvertent operation of controls and/or prevent personnel from interfering with or distracting the OATC. This at-the-controls area is typically designated with additional barriers, colored carpet or matting. The OATC grants permission for entry to this area. Figure 1.1-1 provides an example of the Control Room Areas.

The Conduct of Operations also provides guidance on maintaining a professional atmosphere. This includes restrictions on eating and reading material, housekeeping standards, and phone and internet use by watchstanders.

1.1.6 Annunciator Response

Control rooms contain literally hundreds of annunciators. Annunciators provide warning to the operators when a process parameter exceeds a specific setpoint. Annunciator Response Procedures (ARPs) are provided that inform the operator of the alarm parameter and setpoint, potential causes of the alarm, and required actions to take. The Conduct of Operations provides guidance on the proper protocol for responding to annunciators depending on whether they are anticipated alarms due to evolutions in progress, testing or maintenance, or unexpected alarms. It also provides guidance on expectations for defeated annunciators and repeat alarms.

The design of control board annunciators varies, but in general when the parameter being monitored exceeds the alarm setpoint, an audible horn will sound and the specific alarm tile will flash. The alarm system may have a silence button or switch which stops the audible alarm, an acknowledge button or switch which causes the alarm to stop flashing (i.e., locks it in if the condition is still present) and a test button or switch. Some designs have distinct sounds for the audible alarm depending on which control board the alarm is on. Some designs have the horn stop after a certain time period while other designs have the horn continuously sound until acknowledged by the operators. Some designs also provide an audible cue when the alarm clears. In some cases a Master Silence button or switch is provided that will silence all alarms for a period of time during transient conditions where multiple alarms are being received.

1.1.6.1 Expected Annunciators

Expected annunciators are annunciators that alarm due to testing, maintenance or as a result of normal plant operating conditions or work activities. Expected annunciators are communicated to the operating crew prior to alarming by the individual performing the field activity or coordinating the activity in the main control room. During briefs for activities that will cause an annunciator in the control room, Annunciator Response Procedures are referenced or discussed to determine if any actions are required or desired due to the activities in progress.

The Unit Operator responding to the expected annunciator(s) silences the alarm, communicates to the US that the alarm is “expected”, verifies no other alarms have been received concurrently and then acknowledges the alarm. The UO need not refer to the ARP if previously reviewed. Subsequent alarms associated with expected annunciators do not require communications.

1.1.6.2 Unexpected Annunciators

Unexpected annunciators are alarms received that are not expected as part of planned activities. The UO responding to the alarm should:

- Silence the alarm.

- Communicate the alarm to the US using three part communications (as outlined in the section on Communications in Human Error Reduction Program description).
- Take any immediate actions required by the alarming condition as outlined in other sections of the Conduct of Operations (see section on Immediate and Early Operator Actions).
- Ensure no other alarms have been received concurrently (that should be addressed separately).
- Acknowledge the alarm.
- Implement the associated alarm response procedure (ARP), which will include observing redundant instrumentation to establish the validity of the alarm. The ARP action should be performed even if the alarming condition clears before they can be taken. In general, the subsequent actions in the ARP should be performed by the BOP operator such that the OATC can focus on monitoring the plant.

If multiple alarms are received, the annunciators should be reviewed and the overall causes of the multiple alarms should be communicated to the US, as opposed to communicating each annunciator individually. This can be true for a loss of an electrical bus or a loss of a major component such as a recirculation pump. The crew should prioritize the importance of each alarm to determine which ARP actions should be addressed first. As time permits, each ARP should be reviewed and the appropriate actions taken.

During transient conditions when an Abnormal or Emergency Procedure is being implemented (such as a reactor trip), there may be a tremendous number of alarms received based on the plant conditions. Formal annunciator response described above is suspended until the number and rate of alarms being received is manageable. The UOs still need to acknowledge alarms as they are received and evaluate their importance. If an alarm is normal for the current conditions, it need not be communicated or immediately addressed. Alarms that are indicative of mitigating system failures or degrading conditions should be communicated to the crew and appropriate actions taken in response.

1.1.6.3 Nuisance Alarms

Nuisance annunciators are alarms that are received repeatedly causing a distraction to the operators. A nuisance alarm can be caused by maintenance activities, alarm circuit malfunction or the process parameter being very close to the alarm setpoint. If the nuisance alarm cannot be eliminated in a short amount of time, the crew should take action to disable the alarm to remove the distraction.

When initially received the UO should respond to the alarm as described above. However, once the US determines that the alarm is a nuisance alarm; subsequent annunciation would not require communication or reference to the ARP. It is especially important for the UOs to be diligent in verifying that no other alarms are received concurrently when a nuisance alarm is present since it is human nature to assume that the alarm is being caused by the nuisance alarm.

1.1.6.4 Defeated Annunciators

Defeated annunciators are those alarms that are disabled, locked in or will not function as designed. The loss of annunciation should be evaluated to determine the impact on operations. When appropriate, compensatory actions should be established such as monitoring parameters locally at a specified periodicity. Defeated annunciators, like any material deficiency, should be tracked and assigned the appropriate priority for repair. The status of defeated annunciators are typically controlled using other plant administrative procedures such as the Equipment Clearance Process, equipment Status Control Log or Temporary Modification process (see Section 1.1.11 on Status Control).

1.1.7 Briefings

Briefings are error prevention tools used to ensure adequate communications of plant status, priorities, roles and responsibilities, and potential error traps. The structure and format of the briefs is outlined in Conduct of Operations depending on the purpose of the brief, complexity of the evolution, and the need to get information out quickly.

1.1.7.1 Shift brief

Shift briefs are conducted following shift crew turnover to ensure all crew members understand the status of the plant, priorities for the shift and to disseminate other information needed by the operators. The shift brief is typically led by the Shift Manager with input provided by each individual watchstander. ADM-01, Conduct of Operations, contains additional guidance on the content and format of the shift briefing.

1.1.7.2 Pre-job Briefings

Pre-job briefs are used prior to almost all evolutions conducted. They should include all participants in the evolution. Most utilities use a graded approach such that routine frequently performed evolutions may only require a minimal briefing while complex and infrequently performed evolutions will require a scripted brief well in advance of the evolution led by a member of plant management. The intent of a pre-job brief is to ensure all participants understand what they are doing, the interfaces between groups, individual participant's roles and responsibilities, error-likely situations, critical steps, contingency actions and abort criteria. ADM-01, Conduct of Operations, contains additional guidance on the content and format of the pre-job briefing.

1.1.7.3 Transient Briefs

Transient briefs are used during plant transients when plant conditions are changing rapidly and it is important that the operating crew understands what has happened, plant status, and future actions. Each crew member is solicited for input to ensure all important information is included and all crew members understand the situation and the path forward. It is typically led by the Unit Supervisor at transition points in the emergency operating procedures and/or when conditions allow the brief to be held without hindering the operators from taking timely mitigating actions. ADM-01, Conduct of Operations, contains additional guidance on the content and format of transient briefs.

1.1.7.4 Crew Updates

Crew updates are used to quickly share important information with other crew members and can be used in normal operation or during emergencies. The crew update provides specific information without soliciting input from the other crew members. A crew update can be initiated by any member of the crew. Examples of instances where a crew update should be used include the on-coming OATC informing the crew that he/she has formally assumed the shift, a US notifying the crew of entry into an Emergency Operating Procedure, the SM announcing declaration of an Emergency Action Level and a UO telling the crew that the High Pressure Coolant Injection pump has tripped during an emergency. ADM-01, Conduct of Operations, contains additional guidance on the content and format of crew updates.

1.1.8 Reactivity Management

The safe operation of the reactor core requires deliberate control and monitoring of reactor power. Regulations require that operation of apparatus and mechanisms which may affect reactivity shall only be made with the knowledge and consent of licensed operators. Utilities have adopted specific rules and guidelines to ensure changes in core power are only made slowly and deliberately, change in power is anticipated and monitored and additional error prevention tools are used to help avoid mistakes. The Conduct of Operations (or other administrative procedure) contains these additional guidelines for reactivity manipulations. In general, these guidelines contain the following requirements:

- Reactivity is changed only in a deliberate, carefully controlled manner while nuclear instrumentation and redundant indications of reactor power and neutron flux are constantly monitored.

- Activities not associated with the reactivity change are intentionally limited and controlled to minimize distractions to the individuals involved in the reactivity change.

- All reactivity manipulations shall be approved by the US other than in an emergency.

- Reactivity manipulations should always have a peer check by another licensed operator.

- Reactivity changes shall only be made by one method at a time. For example control rods should not be withdrawn during power ascension while initiating shell warming of the main turbine.

- A licensed SRO shall provide direct oversight for all reactivity manipulations.

- All licensed operators are expected to take conservative action, including manual scram, when abnormal reactor conditions are encountered, to protect the reactor during reactivity events

1.1.8.1 Licensed Power Level

The Condition of License of each unit will specify the maximum thermal power at which the unit can operate. This value is known as rated thermal power (RTP). Power may fluctuate somewhat due to normal variations of conditions in the core (variations in flow, temperature, pressure, xenon, etc.) and the means of measurement (statistical uncertainties and variations in the secondary calorimetric input parameters). Utilities typically operate at 100% RTP and therefore, power may fluctuate above RTP for short periods. The NRC issued RIS 2007-21, Adherence to Licensed Power Limits, to establish guidelines for the magnitude and duration of operation above 100% RTP. The Conduct of Operations proceduralizes these requirements. A summary of these guidelines are as follows:

- No actions are allowed that would intentionally raise core thermal power above licensed power level for any period of time.

- Take timely action to prevent the 2-hour thermal power average from exceeding the licensed power level.

- The core thermal power average for the shift (12 hours) shall not exceed the licensed power level.

- For pre-planned evolutions that could cause power to exceed the licensed thermal power limit, reduce power prior to performing the evolution.

1.1.9 Human Error Reduction Program

An analysis of significant events in the commercial nuclear power industry between 1995 and 1999 indicated that three of every four events were attributed to human error. Nuclear Regulatory Commission review of events in which fuel was damaged while in the reactor showed that human error was a common factor in 81 percent of the events. Human error leading to adverse consequences can be very costly: it jeopardizes an organization's ability to protect its workforce, its physical facility, the public, and the environment.

Human performance error prevention tools are a set of discrete behaviors to help workers perform their activities more reliably. If used thoughtfully and rigorously, they serve as a foundation for everyday successful performance. However, the proper use of these tools means nothing to safety if the worker does not possess a solid foundation in the technical fundamentals of the equipment, systems, and processes he or she works with. Safety is not obtained by mindlessly using human performance tools but by people conscientiously using their knowledge, skills, insights, and the tools to accomplish their work goals.

Because people still make mistakes, managers can improve the chances of operating the plant event-free by installing a variety of overlapping defenses, barriers, controls, and safeguards and aggressively monitoring their effectiveness. Together, workers, supervisors, and managers minimize the probability of an event by reducing the occurrences of active errors and managing the effectiveness of defenses.

Situation awareness tools help the worker form an accurate understanding of the work and equipment situation, and they foster an attitude sensitive to the presence of hazards and the possible consequences of a mistake. Self-checking helps a worker eliminate doubt on what action to perform. Whenever altering a component's condition or recording technical data, the individual self-checks the action. When a procedure or other guiding document is used, expectations for procedure use and adherence apply. If verbally communicating operational information important for safety, reliability, and production, people use effective communication methods to verify understanding before acting. Together, these basic tools help the worker minimize human error, when used thoughtfully and rigorously.

1.1.9.1 Questioning Attitude

A questioning attitude is one in which individuals are alert to inconsistencies in their work and stop to resolve those inconsistencies before proceeding with their work. This technique prompts an individual or team to pause and get help if jobsite or task conditions change or unexpected responses to actions are encountered. A questioning attitude is essential in effectively using the other error prevention tools. If the worker does not understand something (procedure step, expected response, equipment status, etc.), stop the evolution until it is understood.

1.1.9.2 Briefings

Pre-job briefs ensure that all involved individuals are knowledgeable of the task and are prepared for safe and error-free performance of the task. Pre-job briefs and other types of briefings used by operations are covered in depth in ADM-01, Conduct of Operations.

1.1.9.3 Situational Awareness

The situational awareness tool is simply taking a minute of two when arriving at the job site to review the situation. That is, are conditions as expected, is the equipment configured as briefed, are there any hazards that were not previously identified, are all equipment and personnel present to safely complete the evolution? There are a variety of terms used by individual utilities for situational awareness, including Two-Minute Rule, Job-Site Huddle, and One Minute Counts.

1.1.9.4 Communications

Three-Way or three-part communications are used for plant equipment manipulations, procedure performance, and plant /equipment parameter information that will result in decision making, direction being given, or actions being taken. In general, information or an order is given by the sender, it is repeated back to the sender by the receiver, and then the sender acknowledges that the receiver correctly understood the initial information or order.

The appropriate unit designator, system designator, or noun name and appropriate phonetic alphabet component or train designator are used when communicating equipment nomenclature. The phonetic alphabet is listed in Table 1.1.3.

When providing plant parameter information, communication of indicator readings should be provided in the format of PARAMETER – VALUE – UNITS – TREND (with rate when appropriate).

1.1.9.5 Placekeeping

The circle/slash method of placekeeping is used for all continuous use procedures, including notes and cautions, and regardless if check boxes or signature/initial blanks are included in the procedure already.

The circle/slash method consists of circling the step before you start to read it, read the step, perform the action, and then place a slash through the circle when the step is complete.

1.1.9.6 Flagging

Flagging is a distinct form of marking to identify components to be worked on or manipulated, to ensure that workers do not work on or manipulate wrong components that are similar in location or appearance. A sticker, tape, ribbon or some similar short-term labeling is used for this purpose.

1.1.9.7 Self-Checking

Self-Checking shall be used for all equipment manipulations. STAR (Stop-Think-Act-Review) or sometimes called Touch STAR, is the technique used when self-checking as described in ADM-01, Conduct of Operations. Some utilities further enhance the technique by requiring the operator to verbalize (to him or herself if there is no peer check) each intended action and expected results.

1.1.9.8 Peer Checking (PC)

Peer checking is used as a tool to augment self-checking by using a second qualified operator (peer) to concur with the performer before an action is taken. Most utilities require a peer check for virtually all manipulations, both in the control room and in the field, if resources are available. Guidelines on when and how to conduct a peer-check are described in ADM-01, Conduct of Operations.

A proper peer check is not just concurring with what the performer says he or she is going to do, but also ensures the performer is on the correct step in the procedure, the anticipated response is accurate, and the actions to be taken if the system does not respond as expected.

1.1.9.9 Concurrent Verification (CV)

Concurrent Verification (CV) or sometimes called Dual Concurrent Verification (DCV) is a verification technique used when the consequences of an error in positioning are irreversible (such as an action that would result in a unit trip if performed incorrectly) or when it is impossible to perform an independent verification following the initial positioning (such as verifying the position of a locked throttle valve). Concurrent verification is conducted similar to a peer-check, but the procedure or guidance documents (e.g., clearance) require a signature for the CV.

1.1.9.10 Independent Verification (IV)

Independent Verification (IV) is the process by which a second qualified operator verifies the position of a component or results of a calculation independent of the initial positioner or original performer. As with the concurrent verification, the requirement for an IV will be contained in the procedure or guidance document and will require a signature of the operator performing the IV. ADM-01, Conduct of Operations contains guidance on what is meant by independence and when an IV is typically required.

1.1.10 Procedure Use

The availability and use of high quality procedures helps to avoid errors in operation and maintenance of reactor plants. Regulations require the use of procedures for the operation of safety related systems (10 CFR 50 Appendix B, Criteria V, Instructions, Procedures and Drawings). The Technical Specifications will also require the use of procedures for the programs listed in Section 5 of the Technical Specifications and for operation and maintenance of systems and evolutions covered in Regulatory Guide 1.33 (such as administrative procedures for clearances, general operating procedures, abnormal operating procedures, annunciator response procedures, emergency operating procedures, control of measurement and test equipment, chemistry and radiological control procedures, etc.).

Procedures are required to be used in virtually all evolutions that are complex, infrequently performed or can result in negative impacts on plant operation. Exceptions for activities that are frequently performed, simple, and can safely be performed from memory are listed in ADM-01, Conduct of Operations. These exceptions are known as Skill of the Craft activities.

1.1.10.1 Levels of Use

Procedures are categorized by their level of use designations as described below. Some procedures have multiple levels of use such that certain sections or appendices may have one specified level of use and the remainder of the procedure may have another level of use. The level of use will be clearly annotated on the procedure or a utility may elect to default to a specific level of use (e.g., Continuous Use) unless specified otherwise.

1.1.10.1.1 Continuous Use Procedures

Continuous Use procedures shall be present and directly referred to during performance of work steps (must be “in-hand”). Continuous use procedures are required to be used for complex, infrequently performed activities, or when the consequences of improper action could have direct impact on nuclear safety and reliability. Examples of continuous use procedures include safety system startup, shutdown, surveillance, and operating procedures.

1.1.10.1.2 Reference Use Procedures

Reference Use procedures shall be at the job site for reference, but they do not need to be continuously in-hand. They will be reviewed prior to performing the activity. Activities governed by reference use procedures may be infrequently performed or have some degree of complexity to them, but the consequences of improper actions are not immediate and/or are recoverable. Examples of reference use procedures may include routine power maneuvering, routine equipment adjustments or fuel handling control procedures.

1.1.10.1.3 Information Use Procedures

Information Use procedures are not required at the job site and are completed (or complied with) from memory. They should be reviewed periodically, especially following any revisions. Examples of information use procedures include administrative procedures that provide overall guidance for a plant process such as foreign material control procedures and conduct of operations procedures.

1.1.10.2 Expectations for Procedural Compliance

Conduct of Operations will provide specific guidance on the use of procedures. Some typical rules include verification of the most recent revision prior to use, completing steps in the sequence written unless specifically exempted by the procedure, performance of placekeeping, and rules regarding determination that a step is not applicable to the current performance. ADM-01, Conduct of Operations contains the specific rules for procedure use.

1.1.10.3 Two-Handed Operation

Control switches are operated single handed (one switch at a time), unless specifically directed by procedure, required for proper system operation due to system design (such as main turbine trip) or specific permission is granted by the US.

1.1.10.4 Immediate and Early Operator Actions

Conduct of Operations procedure contains expectations for prompt action, without requiring permission under specific circumstances. The conditions include inserting a manual reactor trip whenever reactor safety is in jeopardy, taking manual action to initiate safeguards systems when automatic operation did not occur when required, and to take manual control of process controllers when they fail to operate properly and time-critical action is required to stabilize the plant. ADM-01, Conduct of Operations, contains additional guidance on when early operator actions are warranted.

1.1.10.5 50.54(x) and (y)

Regulations allow SRO licensed operations personnel to take reasonable actions that depart from a License Condition or Technical Specification in an emergency when needed to protect the health and safety of the public and no action consistent with license conditions and Technical Specifications that can provide adequate or equivalent protection is immediately apparent. These actions do not require prior NRC approval, but they are to be reported to the NRC as soon as practical, but no later than within one hour of taking the actions.

1.1.11 Status Control

Safe operation depends on systems and components being aligned as designed. Any deviation from this normal alignment must be evaluated for its impact on safety (including implementing compensatory actions as needed), communicated and tracked by operators, and restored to normal as soon as practical.

Equipment alignment is initially established using valve lineups and equipment alignment checklists. This is typically done following an outage or other major maintenance period. Once established, any deviation from the normal alignment must be captured and communicated to the operating crews via formal mechanisms.

The mechanisms that authorize changing the status of equipment include approved plant procedures, clearance processes, maintenance activities (including modifications to the facility), and changes made in an emergency as authorized by crew supervision.

The processes used by utilities to track changes in status vary by site.

- Every utility has an equipment clearance process that isolates energy sources from the equipment so that maintenance can be safely performed. The clearance process will have an index for all active clearances that can be reviewed by watchstanders. Equipment clearance tags are hung on those components that isolate the equipment. Most clearance processes also have tags that are hung on control switches in the control room to alert the control room operators that the equipment is unavailable.

- Virtually every utility has an equipment out-of-service log or a limited condition of operations (LCO) tracking log to track technical specification allowed outage times.

- Most utilities also have an equipment status log which can list components for the entire unit or may be maintained by watchstation. Some utilities use the clearance program, but maintain a separate index and use caution tags or information tags instead of the danger tags. Some utilities have a separate process which lists the abnormal equipment in an index and hangs unique tags in the field. This process may be called equipment status log or deviation log.

- All utilities have a crew turnover process that will include review of status control program documents by the on-coming crew and review of abnormal conditions for each watch station. The turnover would include any abnormal equipment lineups that are a result of procedures in-use (that is procedures started earlier but have not been completed).

When components are manipulated during an abnormal or emergency situation, at a minimum the change should be recorded in the chronological log and action should be initiated to place the component in one of the formal configuration control processes. An example might be closing isolation valves to stop an air or water leak. Likewise, the abnormal operating procedures (AOPs) and emergency operating procedures (EOPs) may direct status changes, but do not necessarily restore all components to their normal position. In these cases the Unit Supervisor should review the actions taken during the event and for those components that are not in their normal configuration for the current plant conditions, initiate action to place them in one of the configuration control processes.

1.1.12 Risk Management

Risk is defined in terms of core damage frequency (CDF) and large early release frequency (LERF). Utilities establish a baseline CDF and LERF by conducting a probabilistic risk assessment (PRA). When equipment relied on to mitigate an accident becomes unavailable, the increased probability of core damage or release for the duration of the equipment unavailability can be determined.

10 CFR 50.65 (commonly called the Maintenance Rule) require that licensees assess and manage any increase in risk before performing maintenance activities. This is typically done by the work control organization during the work planning process for both on-line and outage activities. However, emergent equipment problems, extended durations of the maintenance beyond what was assumed, or external conditions (e.g., tornado warnings) that cannot be anticipated, must be evaluated as they occur.

This Maintenance Rule does not specify how to evaluate risk. Most utilities will use their PRA as a basis for evaluating on-line risk associated with removing risk significant equipment from service. There is a variety of commercially available software available for this purpose (e.g., EOOS, RASCAL, or Sentinel software). Not all utilities have developed a shutdown PRA. Outage risk can be evaluated either qualitatively using availability of redundant systems to meet each safety functions as a basis, or quantitatively if a shutdown risk model is available. Again there is a variety of commercial software available (e.g. ORAM). Operators must either be trained on the use of these tools or resources must be available around the clock to re-evaluate risk when emergent equipment issues develop or other factors change that influence the risk assessment.

The risk management program will establish risk categories based on the level of risk. They typically include categories such as Green Risk where no additional controls other than normal control of maintenance is required, Yellow or Orange risk where additional Risk Management Actions (RMAs) are required, and Red risk which is not intentionally entered and actions to exit this risk category are immediately implemented.

Again the Maintenance Rule does not specify what RMAs are required for a given activity. The licensee will establish guidelines for requiring certain RMAs based on the level of risk involved. RMAs can include pre-planning, briefing and pre-staging of equipment; providing additional oversight and technical support during the maintenance; limiting work on and protecting the redundant train of equipment; and developing contingency actions and abort criteria for the maintenance. Since Operations authorizes work to begin, they are responsible for ensuring that all required RMAs are in place prior to removing the equipment from service.

1.1.13 Operational Decision Making and Adverse Condition Monitoring

Conduct of Operations (or other policies or procedures) will provide guidance on evaluating abnormal conditions and determining what additional monitoring and/or compensatory actions are needed as a result. There are three categories of operational decisions. The first is for degraded equipment or plant conditions that exceed the thresholds for action in the ARPs, AOPs, and/or EOPs. Procedures are already in place and operators are trained to respond to this type of condition. The second category of operational decision is long-term management decisions that impact operations. This category of operational decisions includes staffing levels, investments in new equipment or processes, and prioritizing equipment modifications or upgrades. Although these decisions impact operations, they are made at the management level and are not addressed in the Conduct of Operations. The third type of operational decisions addresses degraded conditions where the procedural threshold for action has not been reached and additional guidance is needed.

Although the name of the process varies among utilities, the process itself is fairly standard. Conditions are screened by Operations to identify those that will require an evaluation and action plan; that is if conditions are not adequately covered by current plant procedures. The issue will then be evaluated by a cross functional team, including operations and engineering personnel, that will evaluate the risks and alternative actions. This team will develop an action plan which will include additional monitoring of the degraded component of condition, establishing interim action levels (prior to reaching the procedural threshold), defining the actions to take when those action levels are reached, and mandating compensatory actions if needed, while the condition exists. This plan will then be reviewed and approved by Operations or Plant management and implemented by Operations.

1.1.14 Operator Work Arounds (OWA) and Burdens

Conduct of Operations (or other policies or procedures) provides guidance on the Operator Work Around and Burden process. This process provides a method to identify, evaluate, prioritize, and track plant component or system deficiencies that adversely impact the operation of the plant.

Operator Workarounds are equipment deficiencies that significantly affect operator actions during abnormal or emergency plant operations or could cause operators to take significant compensatory measures beyond those considered in the accident analysis. Operator Burdens are significant equipment deficiencies that could place an unreasonable burden on the operators which could detract the operator from the normal monitoring of plant conditions or impact the operator's ability to respond to operational occurrences.

Operations will review those equipment deficiencies that require additional action or actions that are different than normal to determine if a work around or burden exists. When identified, and periodically, the list of burdens and workarounds is reviewed to evaluate the cumulative effect on operations for each watch station. The purpose of this initial and periodic review is to ensure the appropriate priority is assigned to correct the deficiency based on the impact and/or aggregate impact of these deficiencies.

1.1.15 Summary

Operation of a nuclear unit is complex and involves multiple departments. The Operations Department is tasked by utilities, and the NRC, to operate the facility safely. Utilities have developed a Conduct of Operations procedure, or series of procedures or policies, to provide guidance on the standards for conducting business. By implementing these guidelines, plants can achieve a high level of performance that contributes to safe, reliable plant operation. These guidelines are based on industry experience that has proved successful in operating safe, reliable nuclear electric power generating stations. The specific guidelines may vary between utilities, but all reflect generally accepted methods for conducting operations department business.

This procedure is intended to provide guidance on programs and behaviors important to plant operations. Not all operations activities are addressed, but general instructions on some major activities and general professional conduct are included. The major areas covered include operations leadership role in the plant and operations department personnel duties and responsibilities, general guidance for shift operation and conduct, human performance tools, procedure use and adherence, and equipment status control.

Table 1.1.1 10CFR 50.54(m) Minimum Requirements per Shift

10 CFR 50.54(m) Minimum Requirements[1] per Shift for On-Site Staffing of Nuclear Power Units by Operators and Senior Operators Licensed Under 10 CFR Part 55

Number of nuclear power units operating[2]	Position	One Unit	Two Units		Three Units	
		One control room	One control room	Two control rooms	Two control rooms	Three control rooms
None	Senior Operator	1	1	1	1	1
	Operator	1	2	2	3	3
One	Senior Operator	2	2	2	2	2
	Operator	2	3	3	4	4
Two	Senior Operator	-	2	3	3[3]	3
	Operator	-	3	4	5[3]	5
Three	Senior Operator	-	-	-	3	4
	Operator	-	-	-	5	6

[1] Temporary Deviations from the number required by this table shall be in accordance with criteria established in the unit's technical specifications.

[2] For the purposes of this table, a unit is considered to be operating when it is in a mode other than cold shutdown or refuelling as defined in the unit's technical specifications.

[3] The number of required licensed personnel when the operating nuclear power units are controlled from a common control room is two senior operators and four operators.

Table 1.1.2 Example Shift Staffing for Single Unit Plant

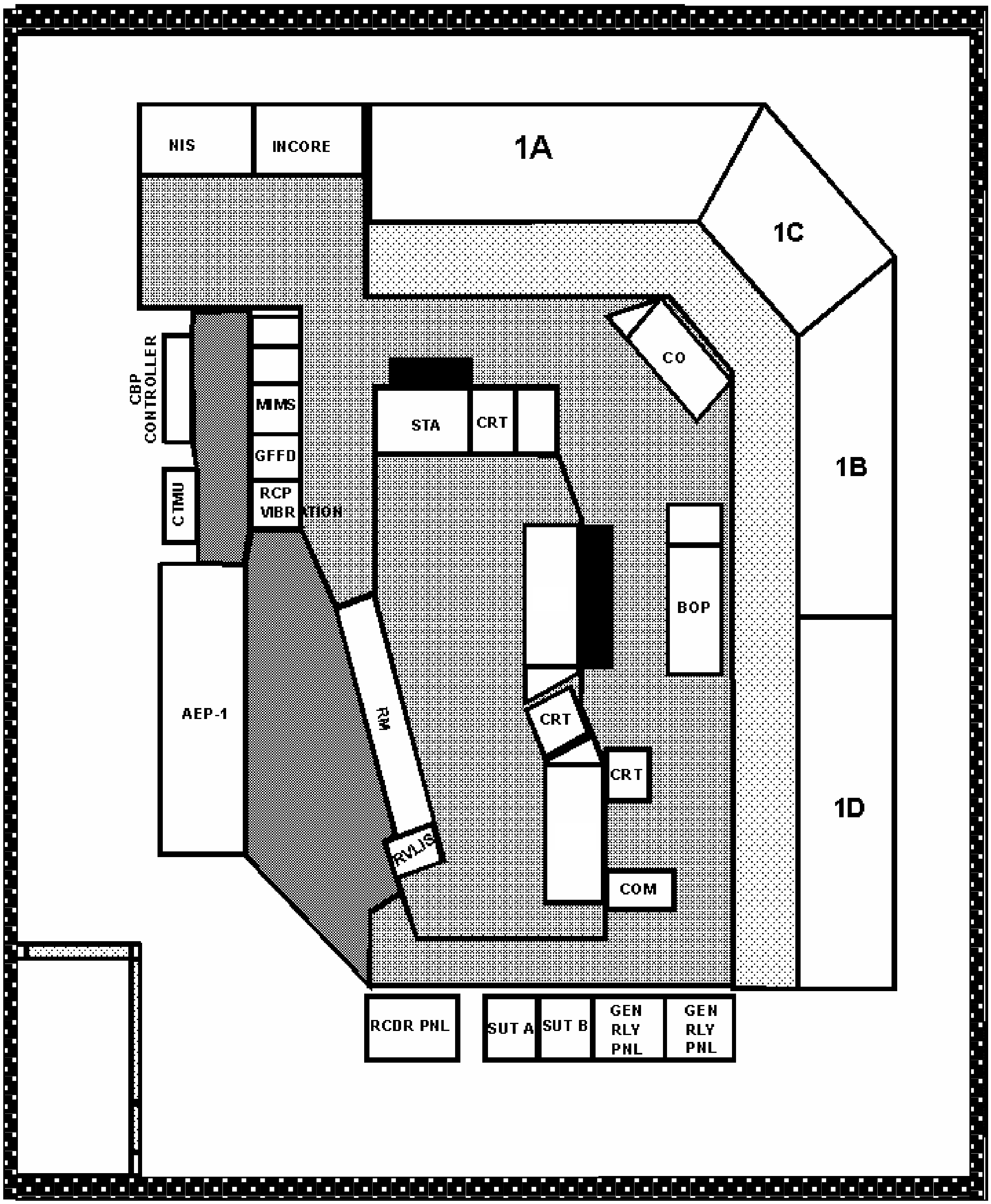
	Mode 1-3	Mode 4, 5 or Defueled
Shift Manager (SRO)	1	1
Unit Supervisor (SRO)	1	1
Shift Technical Advisor (STA)	1	-
Unit Operator (RO)	2	2
Non-licensed (NLO)[1]	6	5
Fire Brigade Leader (SRO/RO)[2]	1	1

[1] One NLO will be designated to fulfill the requirements for Safe Shutdown.

[2] Fire Brigade Leader shall be in addition to licensed operators required for the shift.

Table 1.1.3 Phonetic Alphabet

A - ALPHA	**J - JULIET**	**S - SIERRA**
B - BRAVO	**K - KILO**	**T - TANGO**
C - CHARLIE	**L - LIMA**	**U - UNIFORM**
D - DELTA	**M - MIKE**	**V - VICTOR**
E - ECHO	**N - NOVEMBER**	**W - WHISKEY**
F - FOXTROT	**O - OSCAR**	**X - X-RAY**
G - GOLF	**P - PAPA**	**Y - YANKEE**
H - HOTEL	**Q - QUEBEC**	**Z - ZULU**
I - INDIA	**R - ROMEO**	



Control Room Boundary

Surveillance Area

Reactor Controls Area

Figure 1.1-1 Control Room Areas