Conduct of Operations

GE BWR/4 Advanced Technology Course
R-504B – 1.1

Objectives

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)

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

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.

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

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.

Conduct of Operations

As experience has been gained over time, both the NRC and the nuclear industry have instituted programs to improve performance.

- Human Error Prevention Tools
- Reactivity Management
- Equipment Status Control
- Conservative Decision Making
- Maintenance Risk Management
- Human factored Control Rooms
- Systematic Approach to Training
- Symptom Based EOPs
- FFD
- EP

Conduct of Operations

Each utility issues procedures, guidance and/or policies for these programs.

- Can be a single (large) conduct of operations procedure or several smaller procedures for each program.
- Although there may be similarities between utilities, **each has their own guidance**.
- Typical Conduct of Operations is contained in ADM-01

Inspection Procedures

- IP-71111.11 Licensed Operator Requal
  - Operator compliance and use of plant procedures
  - Communications between crew members
  - Use, interpretation and diagnosis of plant instruments
  - Use of human error prevention techniques
  - Risk management and reactivity management

"Prior to the inspection, inspectors/examiners should familiarize themselves with the licensee's procedures, expectations, and policies"

Inspection Procedures

- IP-71111.04, Equipment Alignment
- IP-71111.12, Maintenance Effectiveness
- IP-71111.13, Maintenance Risk Assessments and Emergent Work Control
- IP-71114.06, Drill Evaluation
- IP-71153, Event Followup
  - Evaluate operator performance in planned and unplanned non-routine events and transients
  - Determine if the response was appropriate to the event and in accordance with procedures and training

Cross Cutting Areas

NRC evaluates the causes for all findings to identify weakness in Safety Culture including the area of Human Performance:

- The licensee makes safety-significant or risk-significant decisions using a systematic process
- The licensee appropriately plans work activities by incorporating risk insights
- The licensee utilizes human error prevention techniques
- The licensee defines and effectively communicates expectations regarding procedural compliance and personnel follow procedures

Conduct of Operations

- Duties and Responsibilities of operators
- Operations Leadership
- Shift Staffing
- Control Room Access
- Control Room Conduct
- Annunciator Response
- Log Keeping
- Turnover
- Briefings
- Reactivity management
- Human Error Reduction
  - QV&V
  - Communications
  - Situational Awareness
  - Self Checking
  - Verification
- Training, Qualification and Proficiency
- Status Control
- Risk Management
- Operational Decision Making

Shift Manning

10CFR50.54(m):

- Minimum number of Licensed Operators assigned to shift
- At least one SRO and another licensed operator in MCR
- Refueling SRO for core alterations

Technical Specifications:

- References 10CFR50.54
- Requires STA
- Requires minimum number of NLOs in each unit
- Allows 2-hour vacancy in emergency

Fire Protection Program:

- Adds requirements for Fire Brigade and Safe Shutdown

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.

Shift Manning

The minimum shift staffing required by the Conduct of Operations is the minimum operators needed to meet all regulatory requirements.

SHIFT STAFFING

	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 shift.

Duties and Responsibilities

<u>All operators</u>:

- 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
- Utilize appropriate human performance tools
- Ensure they are qualified to perform assigned tasks
- Maintain status of equipment at watch station

Duties and Responsibilities

Shift Manager:

Senior management representative on shift

Must have Senior Reactor Operating License

Ultimately responsible for operation of the plant

Develops, supervises and manages crew

Unit Supervisor:

May have different title (e.g., control room supervisor).

Must have Senior Reactor Operating License.

Responsible to the SM for supervising the day-to-day operation of the assigned unit and shift crew

Provides the command and control function (i.e., gives orders to crew during abnormal or emergency operation)

Duties and Responsibilities

<u>Unit Operators</u>:

Licensed Reactor Operators

- **Operator at the Controls (OATC):**
  - Continuously monitor plant
  - Must stay in the Reactor Controls Area
  - Routine reactivity manipulations and controller adjustments
- **Balance of Plant Operator (BOP):**
  - Performs surveillances and procedures
  - Maintains unit's narrative log

Duties and Responsibilities

Non-Licensed Operators:

- Monitor and operate equipment outside control room
- May be assigned Fire Brigade

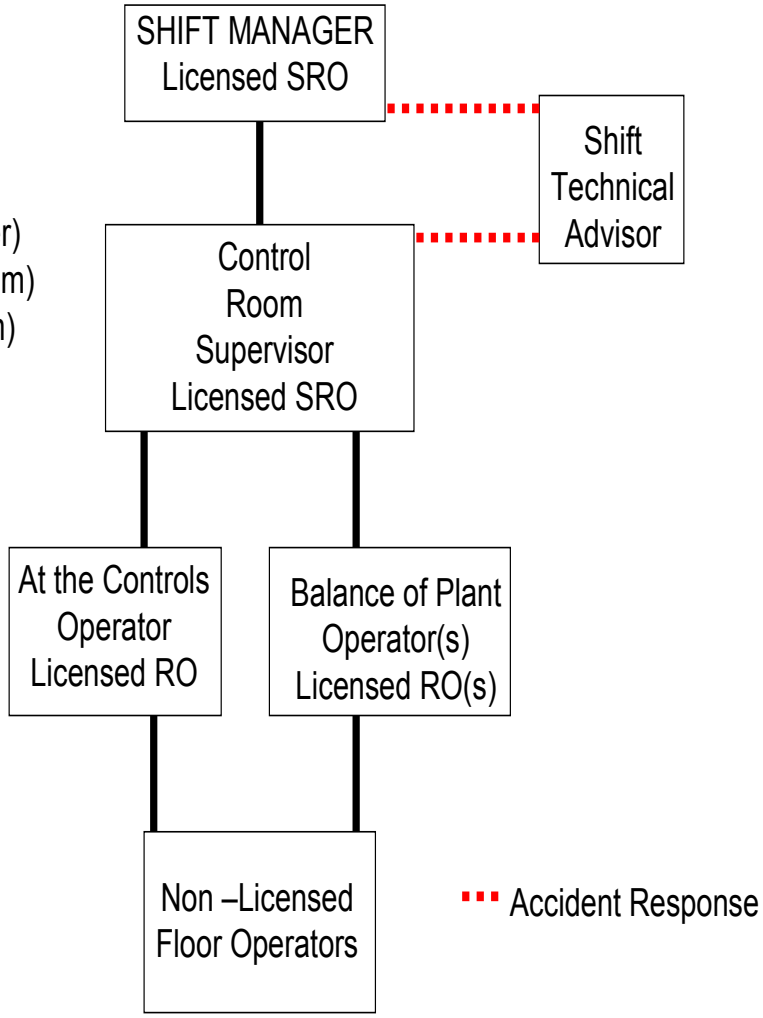
Shift Technical Advisor:

- Responsible for advising the operating crew during abnormal or emergency operations
- May be assigned other collateral duties:
  - Independently assess actions taken for degraded equipment including compensatory measures.
  - Concur with operability and functionality determinations.
  - Concur with Reportability determinations
  - Assess maintenance risk following unplanned conditions or equipment status when required due to emergent issues.

Duties and Responsibilities

Single Unit Minimum Crew Compliment (While at Power)

- 2 SRO's (1 in Control Room)
- 2 RO's (1 in Control Room)
- 1 STA (w/in 10 Minutes of Control Room)
- 2 Floor Operators



Control Room Access

Access to the main control room is managed so operators are not distracted from properly monitoring plant parameters or responding to abnormal conditions.

Access to the control room area is limited to personnel requiring access

Personnel wishing to enter the Control Room must obtain permission from a licensed operator on shift (normally the US), except:

- On-shift operating crew, including the STA
- Upper management
- NRC

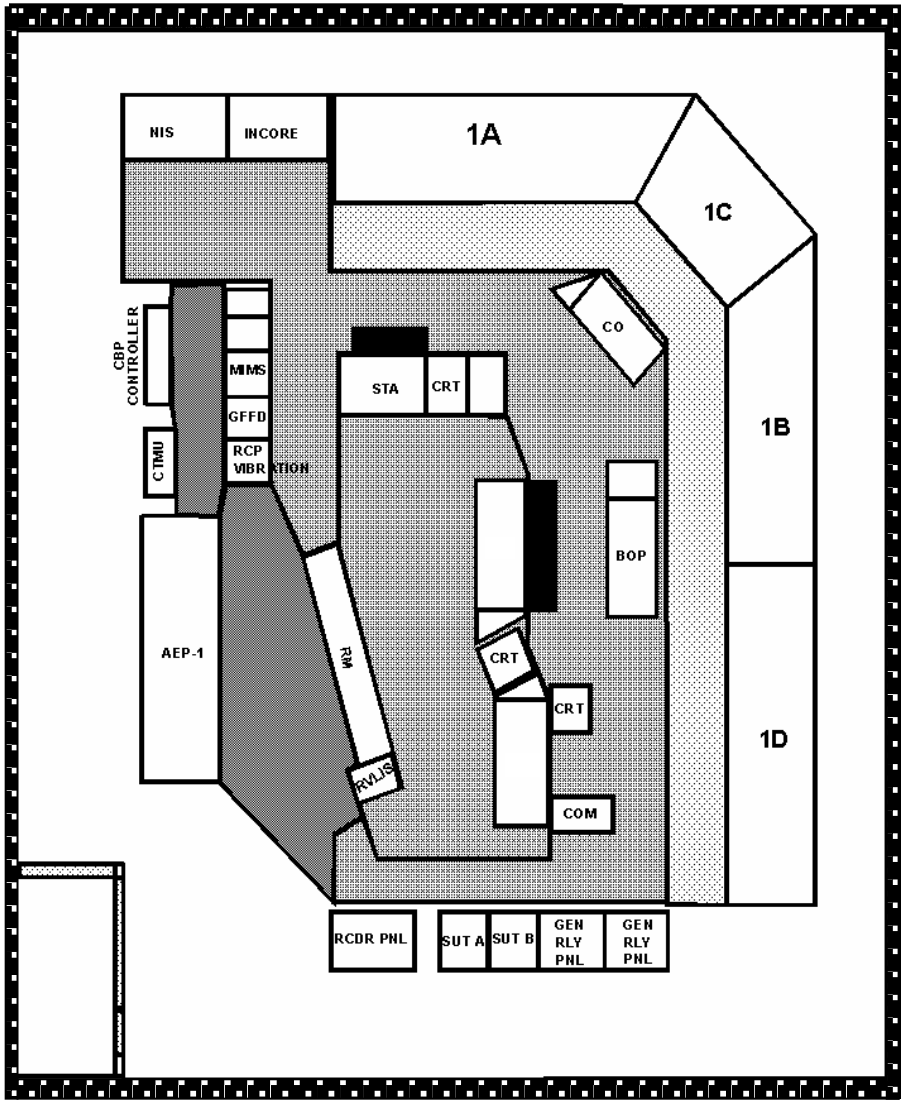
Control Room Access

The Unit Supervisor or Shift Manager is authorized to refuse entry, or direct individuals to leave if conditions change.

Access to the area immediately adjacent to the control boards (Reactor Controls Area) requires additional authorization from the Operator at the Controls (OATC).

In general, personal protective equipment, such as hard hats, leather gloves and other objects (such as tools) are removed or controlled to prevent inadvertent component mispositioning while in the control room.

Control Room Access



Control Room Boundary

Surveillance Area

Reactor Controls Area

Control Room Conduct

- Maintain a business-like approach (i.e., “rigor and formality”) to assigned duties.
- Non-work related discussions are minimized to reduce interference with the conduct of shift activities and monitoring of station parameters.
- Only personnel on official business are allowed in the control room
- Noise level will be maintained at reasonable volume to ensure adequate communications and to avoid distractions to the operators.
- Horseplay is not allowed under any circumstances while onsite.

Annunciator Response

Unexpected annunciators are alarms received that are not expected as part of planned activities

- Silence the alarm.
- Communicate the alarm to the US.
- Take any immediate actions required by the alarming condition
- Ensure no other alarms have been received concurrently (that should be addressed separately).
- Acknowledge the alarm.
- Implement the associated alarm response procedure (ARP).

If multiple unexpected alarms are received, announce the apparent cause for the multiple alarms, not each individual alarm.

Annunciator Response

Expected annunciators are annunciators that alarm due to testing, maintenance or as a result of normal plant operating conditions or work activities

- 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) communicates to the US that the alarm is “expected.”
- Subsequent alarms associated with expected annunciators do not require communications

Annunciator Response

Nuisance annunciators are alarms that are received repeatedly causing a distraction.

- Nuisance annunciators are initially responded to in the same manner as an expected/unexpected annunciator.
- The US may suspend reporting of a nuisance annunciator.
- Prompt action should be taken to disable nuisance annunciators

Transient Conditions

- The normal alarm response protocol is automatically suspended upon entry into an Abnormal or Emergency procedure.
- Alarms are acknowledged silenced as soon as practical, but not announced.
- Operators are expected to announce those alarms that are of significance to the implementation of the abnormal or emergency operating procedure.
- US determines plant when plant conditions allow formal annunciator response and will restore its use.

Briefings

Shift brief

- 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

Pre-job Briefings

- Meeting of individual performers and supervisors conducted before performing a job to discuss the tasks, critical steps, hazards, roles and responsibilities, and related safety precautions.
- Graded approach: short for routine frequently performed, formal and scripted for complex or infrequent evolutions

Briefings

Transient Briefs

- Used by US during emergency or abnormal situations when conditions are changing
  - What happened
  - Where are we at now
  - Course of action/priorities
  - Input from all crew members

Crew Update

- Used by any crew member to quickly share important information with other team members and can be used in normal operation or during emergencies.
- Simply call for an update, state the information and end the update (no discussion or input from other crew members).

Reactivity Management

Deliberate control of evolutions that affect nuclear power and/or nuclear chain reaction and those systems used to monitor power level.

<u>Reactivity Manipulations</u>:

- Moving control rods.
- Adjusting recirculation pump speed.
- Changing/manipulating turbine load.
- Reactor Vessel Pressure adjustments
- Steam demand adjustments.
- Feedwater control changes.
- Feedwater heater or MSR maintenance
- Handling fuel and other core components.

Reactivity Management

- 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.
- 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.
- A licensed SRO shall provide direct oversight for all reactivity manipulations other than in an emergency.

Reactivity Management

<u>Maintaining Licensed Thermal Power Level</u>:

- No actions are allowed that would intentionally raise core thermal power above the licensed thermal power limit for any period of time.
- Small, short-term fluctuations in power that are not under the direct control of a licensed reactor operator are not considered intentional.
- Maintain the one-hour thermal power average at or below the licensed thermal power limit.
- If 1-hr average power exceeds the limit, take prompt action to lower it.
- The core thermal power average for a shift is not to exceed the licensed thermal power limit.
- For pre-planned evolutions that could raise power above the limit, lower power before performing the evolution.

Human Performance

Questioning Attitude (QV&V) and Stop When Unsure

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

Human Performance

<u>Briefings</u>

This technique ensures all participants are fully aware of plant conditions and actions to be taken. It also provides a formal mechanism to question assumptions and actions by all crew members.

- **Pre-Shift:** the entire crew is aware of plant conditions and what the shift goals are.
- **Pre-job**: Everyone knows what is supposed to happen during the evolution.
- **Transient Briefs:** The whole crew knows what has happened, the status of the plant and the course of action to be taken.

Human Performance

<u>Situational Awareness</u>

This technique is taking a minute of two when arriving at the job site to review the situation:

- conditions as expected,
- equipment configured as briefed,
- any hazards that were not previously identified,
- all equipment and personnel present to safely complete the evolution

STOP if the unexpected is encountered.

Human Performance

<u>Communications</u>

This technique is ensuring that communications are understood and information is accurately relayed

- Phonetic alphabet
- 3-part communications
- Use noun names
- Report parameters with units, trend and rate

Human Performance

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	

Human Performance

<u>Placekeeping</u>

This technique is used to ensure all procedure steps are completed as required. Required for cautions and warnings and annunciator response procedures as well.

- Circle the step before you read it,
- Complete the step
- Slash through the circle when done.

Human Performance

<u>Flagging</u>

This technique is used to ensure that workers do not work on or manipulate wrong components that are similar in location or appearance.

- Sticker, tape, ribbon or some similar short-term labeling,
- Placement should be verified
- Does not replace self verification
- Remove when evolution is complete

Human Performance

<u>Self-Checking</u>

This technique is used for all equipment manipulations.

STAR

- Stop
- Think
- Act
- Review

Human Performance

Peer Checking

This technique 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.

Concurrent Verification (CV)

Formalized type of peer check when a verification signature is required.

Independent Verification (IV)

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.

Procedure Use

Level of Use Classification

Continuous Use:

- Present and directly referred to during performance of work steps (must be “in-hand”)

Reference Use:

- Shall be at the job site for reference, but they do not need to be continuously in-hand

Information Use:

- Not required at the job site and are completed (or complied with) from memory

Status Control

- Normal alignment established using valve lineups and equipment alignment checklists (typically following an outage)
- Before manipulating any component, operators should ensure:
  - The change is governed by a controlling instruction which has evaluated the change for impact on the design and licensing basis (e.g., approved plant procedures),
  - A mechanism exists to capture, track and communicate the configuration change to other operators,
  - Guidance is provided to either restore the component when the evolution is completed or to change procedures and drawings to make the new position the normal position

Status Control

- Mechanisms used to change status:
  - plant procedures,
  - clearance processes,
  - maintenance activities (including modifications to the facility), and
  - changes made in an emergency as authorized by crew supervision

Status Control

- Mechanism to capture, track and communicate the configuration change
  - Clearance process
  - Equipment out-of-service log
  - Temporary system alteration index
  - Caution tag
  - Equipment status board
  - Equipment deviation log
  - Watchstation turnover checklist
- In emergency, formal status control updated when plant is stable

Risk Management

- Maintenance Rule requires that;
  - The licensee assess and manage the increase in risk that may result from the proposed maintenance activities [50.65(a)(4)]
- Applies to both on-line and shutdown risk
- On-line risk typically compares baseline maintenance-free PRA with risk during maintenance configuration for duration of maintenance activity
  - Risk measured in terms of change in Incremental Core Damage Probability (ICDP) or Incremental Large Early Release Probability (ILERP)

Risk Management

- Outage risk can be measured quantitatively if utility has a shutdown PRA or can use a deterministic method (e.g., number of redundant systems available for each safety function)
- Risk determination complete before maintenance except the following which must be evaluated as they occur:
  - Emergent equipment problems,
  - Extended durations of the maintenance beyond what was assumed, or
  - External conditions (e.g., tornado warnings)

Risk Management

- Licensee's establish threshold where Risk Management Actions (RMAs) established to minimize risk
- RMAs may include one or more of the following
  - 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

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Questions?