CONTROL ROOM OPERATOR'S HANDBOOK

AT-THE-READY CONTROL ROOM & OPERATIONS CENTER GUIDANCE

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HANDBOOK CONTENT MAP

Preface

This is a unique handbook to use in your control room. At the ready are helpful reminders of things you already understand, things about which you may have heard but would like to know more, and new ideas of ways for working the many jobs you do all of the time on your shift. Everything here is intended to assist you to get the job done. It will touch on almost all of your tasks, duties, and responsibilities. As the creators of the Handbook, we have done the best we know how to bring together the collective experiences of engineers, operators, and controllers like you from around the world. We have worked hard to be clear, well organized, and respectful. We now offer the Handbook to you and your management. It is our hope that you find it a valuable resource.

The handbook is large, containing many individual topic modules. Some contain old information, some new. Some very new and useful. There is a simple yet important reason for the size—your job as operator or controller is not simple. You have a lot on your plate! Your every shift hour involves observing, deciding, scheduling, and all manner of managing you do for a really expensive plant or facility. For a resource to be helpful, it must cover and respect your broad range of responsibility. If it is actually going to be of value for you, it needs to cover what you need.

The underlying goal of this handbook is singular: safe and reliable operations. Inside you will find explanations about the intended purpose of the wide range of your everyday tools and activities. There are introductions to new ones. There are discussions to help you understand and appreciate how human nature affects what goes on in control rooms and operation centers. You will learn about new ways to get help when help is needed—and to avoid continuing to operate when operational success is threatened by doing so. We hope that all of this enables you to be more skillful, more effective, and more comfortable sitting in the operator or controller chair. When all is said, understood, and done, the desired result will be for you to gain and maintain a higher level of operational, personal, and enterprise safety. Financial success and pride of operation will follow. Above all, you should recognize that, as a highly trained and ready operator, you are a *Professional*!

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PART 1
THE BASICS

Part 1 opens with the goals of the handbook and suggestions for how you might consider using it.

It continues with an explanation of the handbook's modular format, designed to help you find what you wish to use. Its several unique features are described.

Next the types of enterprises you operate are explored for: leadership, philosophies, and types of control room personnel.

It closes with characteristics and important components of safety.

PART 1 — THE BASICS

Module 1: Getting Started

Process Operators oversee and manage the full production process of a manufacturing plant or other industrial facility. They monitor equipment to ensure the quality, efficiency, and safety of the plant.... Process Operators are skilled professionals who often work as part of a team and provide leadership.

—JobHero.com

Welcome to your handbook. Up front, we admit that it is large. Lots of pages. Lots of individual topic modules. Some old material. Some new material. Some very new and quite useful material. The reason for the size: your job as operator or controller is not simple. You have a lot on your plate! Your every hour involves observing, deciding, scheduling, and managing a really expensive plant or facility. If any resource is going to be of help for you, it must cover and respect that broad range of responsibility. This one is for you to explore, test, and use.

When you venture inside this handbook, you will find a cornucopia of things you might need to know to help make your job as operator and controller work better for your enterprise and be more comfortable for you. Even if your enterprise has none of these tools and practices, and you are sure that will not change anytime soon, what you can find here will help you to do better with what you have available to you.

If you are new to being an operator, this can guide you into the position and help you get your arms around the job to become more comfortable. If you are a seasoned operator, you can discover many ideas that would be helpful and provide confirmation of what you already know and do.

1.1 Introduction

To our knowledge, this handbook is a first of its kind. The *Operators' Handbook* is compact but extensive. It is a ready reference, with tools, advice, experience, and examples. It explains how to gain and sustain a responsible level of control room operational effectiveness and safety. It reinforces the concept of you as a professional. The content is built upon material adapted from the groundbreaking engineering reference book *Situation Management for Process Control*, published by the International Society of Automation (ISA) in 2019. [1.1]

Your handbook is designed to explain, amplify, and supplement your existing knowledge and practices. The goal is to reinforce your background as you work in the control room. Your site-based training, experience, policies, and procedures, as well as the guidelines given to you and the expectations placed upon you by your plant or operation (called enterprise in this handbook) take precedence and are primary. This handbook is extra. It is intended to give you options, not to tell you what to do. Please use the material as an aid and hands-ready assistant to (a) recognize gaps,

small and potentially large, (b) assist filling in the gaps to keep things going right, and (c) provide new ways of meeting your job responsibility. What you find useful, review and discuss with your management. If you are new to operations, this material provides a supportive background and comprehensive introduction. Take the time to understand what is going on and what is needed to do your job well. If you are a seasoned operator, see how supportive this can also be for you. This material is not the only way to achieve effective situation management for good operation. If a particular idea, tool, or concept doesn't seem to work, skip it and use what already works. If you see gaps, ask your supervisor for advice.

> It is the sum total of the decisions and actions that the operator makes, within the capabilities of the enterprise, that determines whether or not the enterprise in his care operates safely and productively.

Situation management is the core message of this handbook. Recognize that the sum total of the decisions and actions that you make as operator, within the capabilities of your specific enterprise, determine whether or not the enterprise in your care operates safely and productively. It is your end-game mission.

Format

Parts

The material is presented in succinct modules that are grouped into seven parts. Each part is identified by a colored tab that is visible from the edge.

Part 1: The Basics—the basics of the handbook are explained with suggestions for reading. Cautions are given and special features are illustrated.

Part 2: Operations—discusses what goes on in a control room and who is there.

Part 3: Key Considerations—tools and ideas are covered, keeping the focus on what needs to happen in a well-run control room to avoid distraction and wrong turns.

Part 4: The Control Room—the control room is defined and described along with successful control room requirements and management. A module is included on the Human Machine Interface (HMI).

Part 5: Weak Signals—weak signals, a powerful and effective new way to discover early problems, is introduced and fully explained.

Part 6: Awareness—the tools and methods are provided to see what is going on in the enterprise and decide its importance.

Part 7: Managing Situations—how to keep things going properly and responding when and where they are not.

Additional Material: supporting material, appendices, glossary, and index

Dividers and Covers

There is a complete map of the contents in the very front of the book. Each module is identified, with the part in which it is included. This will easily aid you in finding the location of each module of interest. Each part is separated by a divider, with an overview of its contents (front side) and a complete listing of the included modules, with major sub-topics identified (reverse side). Each part is identified by an appropriately colored tab. All of this will help you easily and quickly find a topic.

PART 2
OPERATIONS

Your important role as control room operator is introduced. Discussion includes your functions and motivations, readiness and overload, what you use, and what supports your many varied activities.

The importance of successful communication is explained. Guidelines are given for safe and effective conversations in your control room setting, including ever-increasing virtual conversations.

The myth of multitasking is explained, and its dangers to operations are discussed.

Operator tools, including policies, procedures, and protocols are defined, and their benefits and uses are examined.

The functional aspects of operator training are covered, with a discussion of the enterprise responsibility to provide and maintain your full measure of qualification.

The benefits of understanding and using models are covered. The importance of interpreting and using data in context is explained.

Part 2 concludes with a brief discussion of the role of control room operator supervision.

PART 2 — OPERATIONS

Module 4: Operators

4.1 The Operator's Function

As the sitting *operator* of an industrial plant, or other operator-managed enterprise, you are entrusted with successful operational activity, second-by-second, minute-by-minute, hour-by-hour, day-in and day-out. You manage the real-time performance of an enterprise easily worth hundreds of millions of dollars. You are asked to accept responsibility for everything that happens during your watch; good, or heaven forbid, bad. You must be able to view and appropriately adjust every control loop, most sensors, all equipment, and supporting utilities within your area of responsibility and authority.

Yours is not an easy job. When it goes wrong, the inability to maintain situational awareness is a major loss. Loss of situational awareness directly contributed to almost every disaster event that was not the result of a complete and spontaneous surprise. No one wants an incident. But incidents and disasters do happen. We now know to a high degree of certainty why. They happen because those in charge of ensuring that they do not are not fully aware that they are happening. They are unaware of what is really going on. They are unaware of what is likely to happen. Or they think that what is not happening, actually is happening.

Successful operator performance centers directly on what is expected. What is expected of you is simple and yet profound: watch to make sure that the operations are properly progressing or whether they are not. When they are not, understand what is going wrong and take corrective action. This requires two skills: the cognitive skill of understanding whether or not something is going wrong, and the manual skill of performing the direct intervention necessary to make proper changes that work. The main thrust of your successful performance includes those cognitive skills as well as the resources for guiding intervention. The specifics of what intervention should be utilized must be left to experts in the enterprise as documented in all of your approved operating procedures and protocols. This handbook works to knit those resources together into an effective whole, supplementing missing structure and tools, where possible.

Definition of an Operator

An operator is defined as follows:

1. The person who operates equipment for its intended purpose. Note: The operator should have received training appropriate for this purpose. [4.1]
2. The person who initiates and monitors the operation of a process. [4.2]

4.2 Professional Operator

Even though intervention may be infrequent, your role is not babysitting. You are expected to fully understand your enterprise. You must keep fully abreast of what is going on through

active monitoring and testing. You are asked to initiate and follow through with any and all corrective actions required to keep things properly operating. And you are required to seek outside assistance for all situations that challenge your ability to sufficiently understand and properly manage. From the moment you assume operational control until the moment it is either ended or passed on to another, you are expected to do all in your power to ensure safe, effective, reliable, and responsible operation. You are an essential member of the enterprise team. You are a professional. [3.52]

Operator's Creed

A creed is a deeply held expression of dedication to a belief. It is a sign of professionalism. Among the better-known technical creeds are the Engineers' Creed (USA) and the Obligation (Canada). No operator's creed currently exists. So we propose one. In recognition of the responsibility society places upon the shoulders of *operators* and as an expression of and respect for this level of professionalism, this Operators' Creed is offered for your consideration as a professional operator.

> As the operator, I accept responsibility for the safe, reliable, effective, and responsible operation of the facility under my control. I arrive fit for duty. I take responsible charge. I properly utilize the resources and tools at my disposal. I place safe and responsible operation above all else. When duty is done, I effectively close operations or pass on responsibility to my relief. I leave duty in a responsible manner.

4.3 Qualified Operator

A *qualified operator* possesses the full kit of necessary knowledge and skill required to operate safely and effectively. Operating safely includes preventing injury and environmental exposure. Operating effectively includes meeting production schedules and quality standards. Management has set your qualifications, tailoring the requirements to your specific needs. They expect you to be fully qualified and possess the skills to operate effectively. By meeting these qualifications, you will be able to use the resources available to observe and correct for all abnormal operations including safety-related ones. Only qualified operators should be entrusted with the operation of an enterprise.

The best working definition of what constitutes qualification can be found in the Pipeline and Hazardous Materials Safety Administration (PHMSA) Regulations [4.3] for US pipeline operations. We have substituted the term "owner" in place of the PHMSA term "operator" below.

> "[The PHMSA rule] requires [owners] to document that certain employees have been adequately trained to recognize and react to abnormal operating conditions that may occur while performing specific tasks."

No other regulatory or compliance entity has provided alternate definitions. For our use, it would be the best available. Reliance upon this would be responsible.

PART 3
KEY CONSIDERATIONS

Part 3 covers key considerations that frame important concepts of control room operations—concepts that affect success or contribute to failure. It will help you to better understand what might get in your way as you work.

It begins by examining a critical resource: time. When you fully understand that time is your most valuable resource, it will guide your every activity. You must have enough of it available to manage problems. When it runs out, you cannot manage any more.

Different types of abnormal situations are defined. We show you how to see, understand, decide, and either act or defer action.

In the discussion on doubt, you are encouraged to embrace doubt and make it work for you.

Part 3 concludes with a module to recognize and understand the different types of biases and pitfalls we all confront. It then explains how the many ever-present but often unrecognized biases influence decision-making. It touches on differing norms and conventions of the many different cultures that may share the same control room.

PART 3 — KEY CONSIDERATIONS

Module 13: Power of Time

Time is the most valuable resource you have with you in the control room.

13.1 Time

Success or failure is always, every time, limited by how much time you have and how you are able to use it to manage a problem. If you ever run out of it, you have run out of options. So, while time is still available, your available options are to effectively and efficiently:

- identify potential problems early enough.
- work them properly.
- verify the effectiveness of your actions.
- modify those actions if needed.

Situation management is time management. So time management is everything. Time is *the* most important thing for successful control room activities. **No one and no action can intervene if there is not enough time for it to work!**

> If somehow, magically, one could stop time during an upset, all upsets could be successfully managed! If every disaster in the making could be paused, it would be possible to spend as much time as needed to understand what is going on, to assess potential damage if it continues, and to fix it if we wanted. Even if we could not reverse time, the mere ability to stop time or even slow it down would be the wonder tool. Alas, such daydreams cannot come true. Yet exploring this fantasy helps focus on your most valuable commodity during an upset: time

You are in charge of how you use time. Learn and use tools that work for you. Avoid multitasking [**M7**]. Use those countdown timers [**M8.4**]. Never run out of time before you stop the clock using *permission to operate* [**M35**].

13.2 See, Understand, Decide, and Act (SUDA)

How you *See, Understand, Decide,* and *Act (SUDA)* is the important operational reality of successful production management (Figure 13.2.1). There must be sufficient time to complete all remedial actions before damage occurs. The following definitions are useful:

Fault Tolerance Time

Fault tolerance time is the time for a given abnormal situation to mature and cause damage, injury, and all manner of other unwanted problems. Every abnormal situation that can lead to problems will have a fault tolerance time. Your job as operator is to understand what that time is and ensure that your actions can prevent problems whenever action can—or keep problems to a minimum when no reasonable action is available.

Process Safety Time

Process safety time, also called time to manage fault, is the amount of time an abnormal situation, once started, will be safe before the situation crosses the boundary into unsafe or other damaging situations. Once the process safety time has expired, bad things happen. Hence, the goal of good operation is to always strive to keep this time less than the fault tolerance time.

Cushion

No one can be comfortable in a situation where important actions must be taken where the remedial effort must be successful just in the "nick of time." That is too close for comfort. It gives no room for even the slightest error or delay. It is just too unforgiving to be counted on. A cushion is a pre-determined amount of time that an enterprise has declared must be incorporated into any activity where getting things right in time is vital. It is for this reason that the process safety time plus the cushion must be less than the fault tolerance time. Any intervention you would need to make would not be successful often enough without it.

Effects of Time

Take a closer look at the effects of time on your actions by viewing the timeline of an event from an operator-centric view illustrated in Figure 13.2.1. Note that to provide room for labels, the actual timing is not to scale.

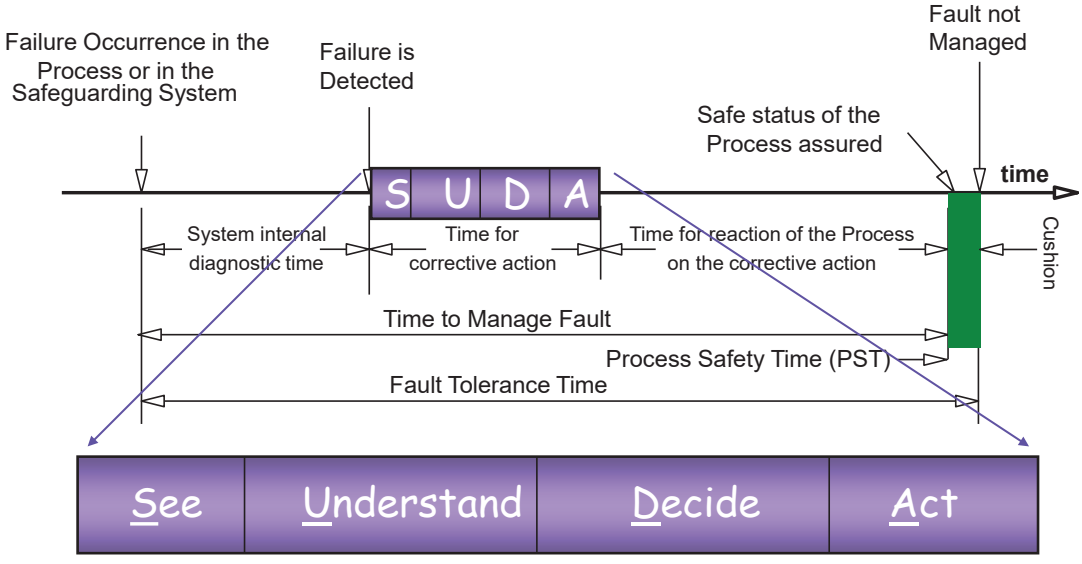


Figure 13.2.1. Process safety time and SUDA, illustrating that everything takes time (time axis illustration not to scale). It is only when the time required for proper operator management, i.e., "time to manage fault," is less than the time for the process to go into fault, i.e., fault tolerance time, that operator intervention is possible (and hopefully successful) **[Q5a]**.

PART 4
THE CONTROL ROOM

The control room is where it all happens. Part 4 examines the broad aspects of the control room as your major center of activity. It covers what a control room should look and feel like and what it should provide for you.

The key tools, activities, and components upon which you constantly rely are covered. Included is how a properly designed human-machine interface (HMI) and the alarm system assist you to monitor situations, to understand and successfully manage your enterprise's process automation features and installed technology.

Covered is the variety of components for managing the shift itself during everyday situations, plus additional activities necessary for maintaining sustained good operation.

Shift handovers are the most important and vulnerable communication events that you perform in daily shift operation. The entire spectrum of shift handover is explained along with recommendations on proper handover management, including coordination and interaction with maintenance and shift supervisory personnel.

PART 4 — THE CONTROL ROOM

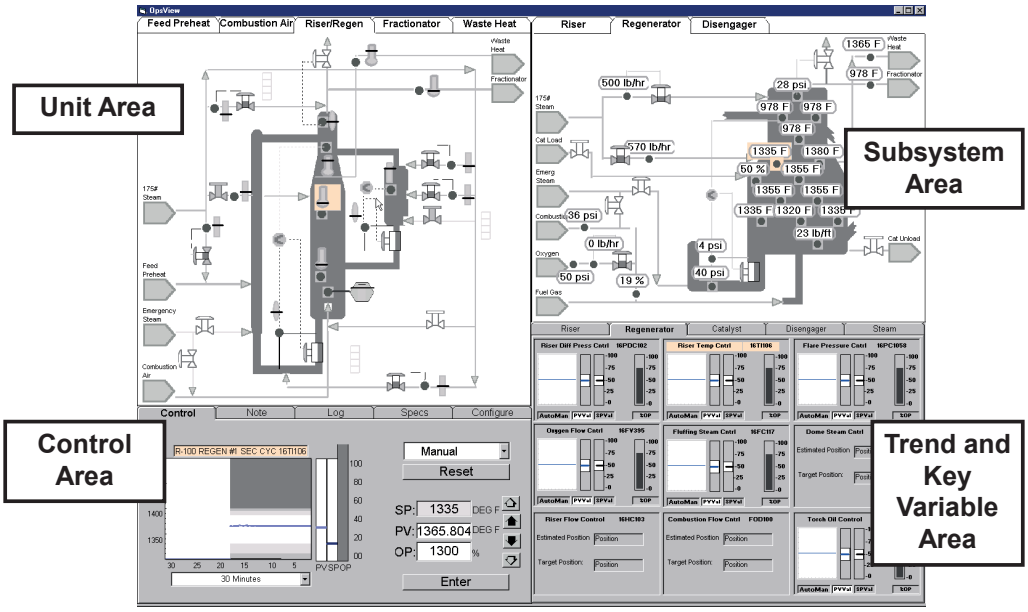


Figure 18.4.3. A situation-based secondary page that is pre-engineered to provide information to understand what the situation is and how to manage it. This display combines the window together with three additional windows to form a coherent view. It is constructed by the process of yoking (making a specific set of display screens or formats visible at the same time on one or more displays).

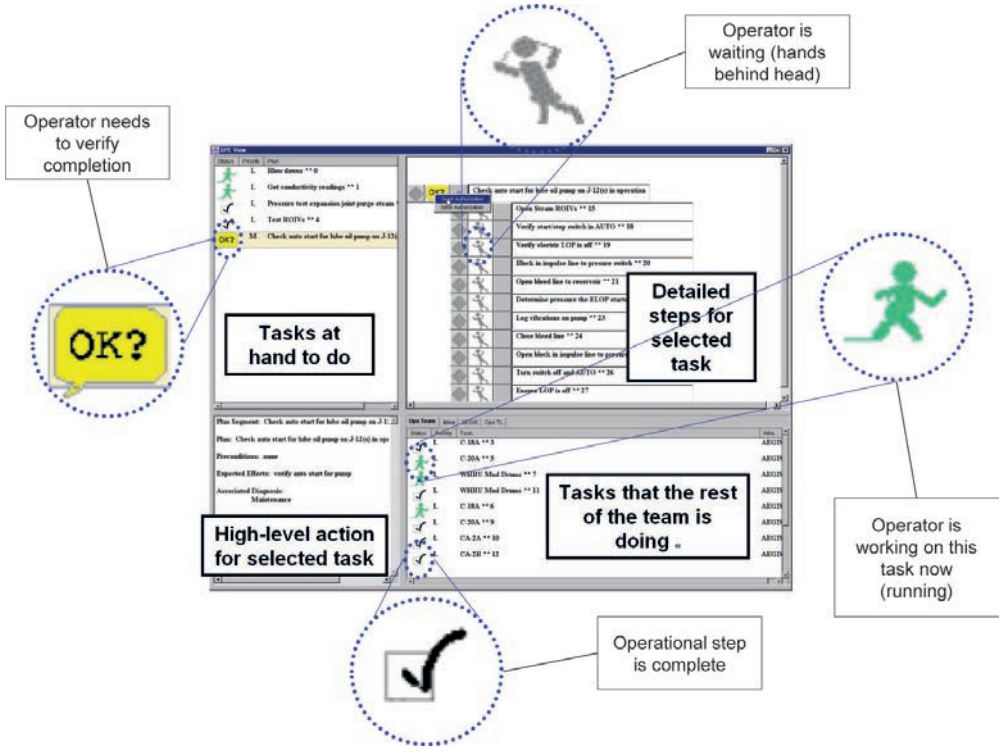


Figure 18.4.4. Procedure tracking is illustrated as a tertiary display screen. Each window depicts a different level of activity for the work being done.

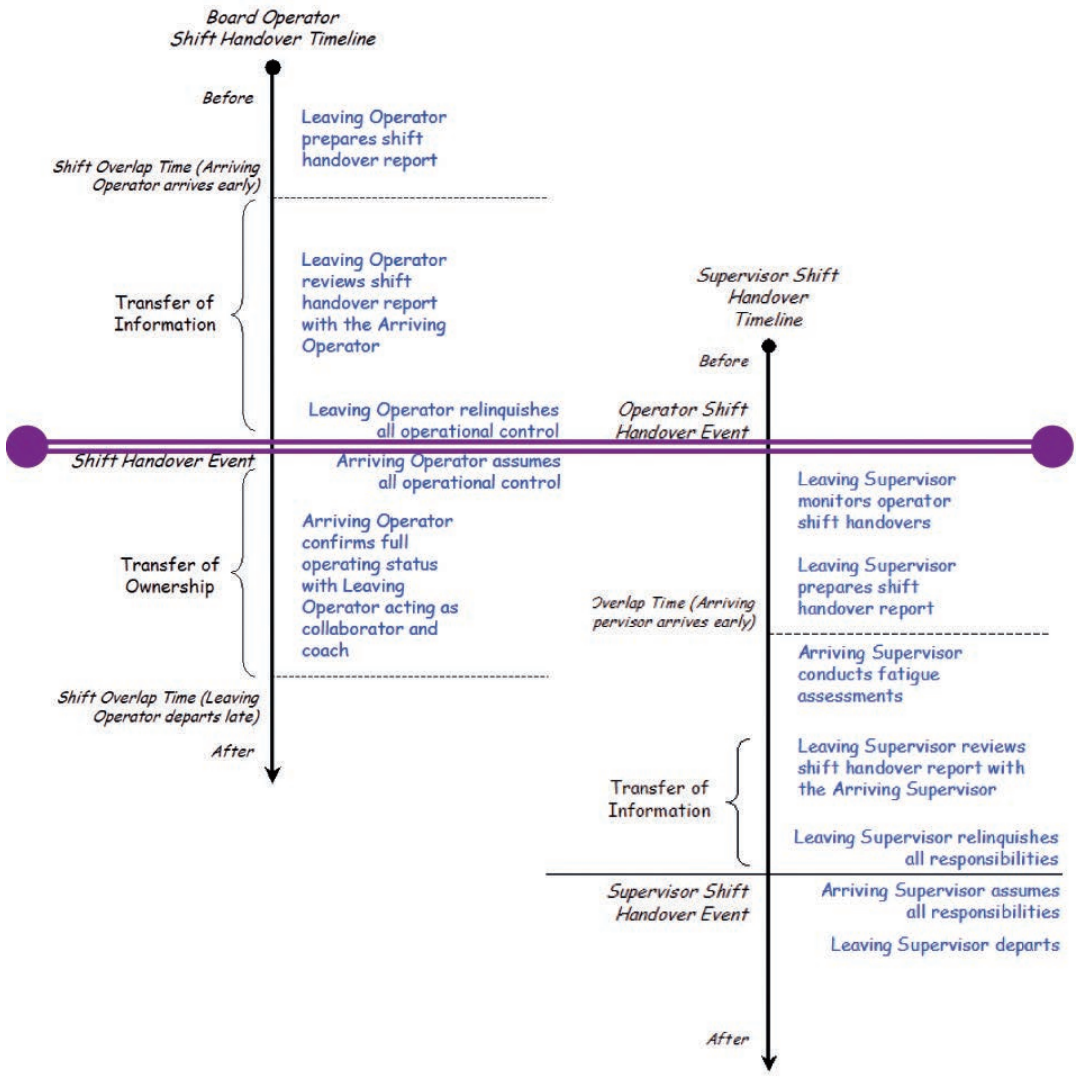


Figure 22.5.1. Combined timelines for both board operator and supervisor handovers. Purple (barbell) line depicts how the alignments of the individual handovers relate to each other. This arrangement allows the supervisors to monitor the joint operations phase of the control room handover, assess the fatigue levels of both operators, and assist the handover in case of problems.

PART 5
WEAK SIGNALS

An innovative new and powerful tool is introduced. The introductory module defines weak signals—small but important indications. It then describes how understanding and mastering them aids the operator to gain situation awareness.

The final three modules in this four-part series describe how to use weak signals, how to get more out of them, and how to troubleshoot problems that may arise with using them.

PART 5 — WEAK SIGNALS

Module 24: Using Weak Signals

24.1 Weak Signal Management

You now have a good starting idea of what weak signals look like from the previous module. It is time to learn how to use it. It does not take much imagination to see that lots of weak signals could be very easy to find anywhere you look. While they do need to be easy to find, you do not want to find more than are there. This is a skill, not an obsession or mission. This is why your HMI tools and views are carefully designed and implemented with useful clues. It is a major reason for style guides and consistent design.

Every chosen small indication requires processing. The single objective is to confirm there is sufficient evidence to reasonably know what the indication means. Weak signals involves forward extrapolation to potential significant implication and then backward projection to find confirming or disconfirming (denying) evidence. When you find evidence, you know either something is happening or, alternatively, not happening. When you do not find confirming evidence, you know nothing related to the small indication suggests a problem. At least for now.

The Work Process

The weak signals management work process is actually quite direct. It starts with the need for an effective way to see small indications. Once you select a small indication, you will follow this work process to examine it as a weak signal. It is a six-step procedure, illustrated by Figure 24.1.1.

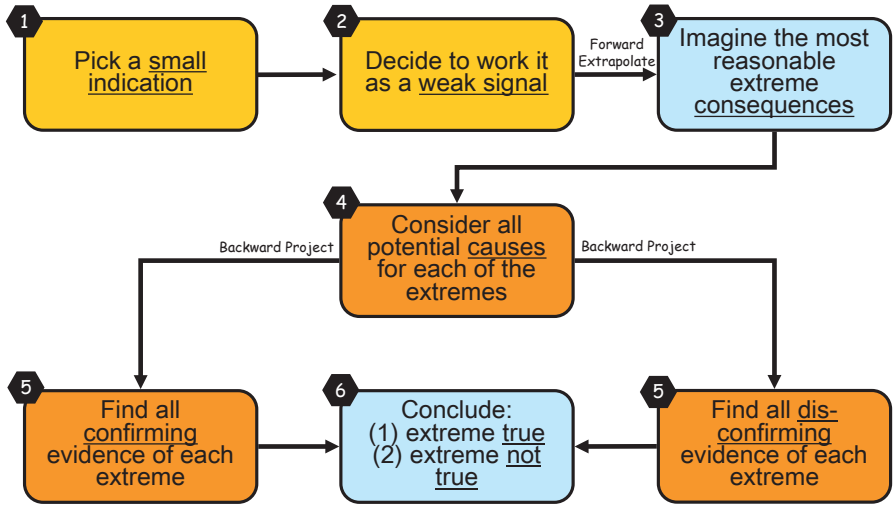


Figure 24.1.1. The *weak signal* six-step working process to prove or disprove whether a *small indication* means that there is something going on that needs attention. If neither, it is noise **[Q11a]**.

From the list of your small indications that you select to treat as a weak signal, do the following [**Q11b**]:

Selection

Step 1: Pick a small indication that you notice and decide might be useful to you.

You have seen something, thought something, or otherwise become concerned about something small (for now) and are curious about it.

Step 2: Decide that the selected small indication might be an indicator of something you want to know more about.

Take that small indication and consider it to be a "clue" of something important that is affecting your operational area. You now make it a weak signal, by definition.

Forward Extrapolation (to Find Significant Problem)

Step 3: Using the process model you have in your mind, imagine what is the reasonable but most significant concern that might be happening if this specific supposed weak signal is actually a true early warning.

Remember that you are looking for the significant thing (quite bad; really unwanted) that might be happening if it is not fixed or worked on.

If nothing can be imagined (identified), then you are probably forgetting something important about how the enterprise you are managing works and how it gets into trouble. Rethink things. Get help.

Backwards Projection (to Find Evidence)

Step 4: For each worst thing that might happen, make a list of all potential causes (possible things that go wrong) for that imagined bad thing to actually be happening.

In Steps 1 and 2, you have noticed something unusual. In Step 3, you were able to imagine something that your enterprise was heading for and is important to know. Now, you imagine all of the ways that that "something important" can go wrong and give itself away to show the bad thing actually happening. This list includes your best ideas for what could have started to go the wrong way earlier. And if they did, the situation would eventually materialize as the significant problem you envisioned. Make that list here.

Step 5: For each potential cause on your list from Step 4, look for everything that would confirm (or disconfirm) each supposed thing is actually happening now.

*Use the list from Step 4 above to tell you exactly **what** to look for. Now figure out **where** to look for specific evidence to prove or disprove whether or not each possibility exists.*

Confirm Problem

Step 6: For each "confirmed" weak signal in Step 5, you have identified a confirmed problem you will need to resolve. You have reached a conclusion.

Confirmed means that the weak signal was noticed, forward extrapolated to a worst bad thing, backwards projected to look for evidence, and actual evidence was found. So the original forward extrapolated problem is probably real. It will need attention and/or action. The weak signals part is complete. If there is no confirmation (or there is disconfirmation, which means that the bad thing really is not happening), then the weak signal that started this whole search is classified as immature (for the moment). Let it go for now. The activity to follow for a confirmed weak signal is covered in Situation Management [**M29**].

PART 6
AWARENESS

Part 6 introduces the concept of situation awareness: the ability to fully appreciate what the operation is up to at any given moment and where it is headed.

It covers the psychology of situation awareness and how it contributes to a proper situation assessment.

Also included is a discussion of additional information that comes to the operator in the form of alerts, messages, and notifications to assist in achieving situation awareness.

PART 6 — AWARENESS

PART 7
MANAGING SITUATIONS

Part 7 *Managing Situations* puts it all together. This final part dives into the many ways you will use all you have learned from the earlier parts of this handbook to properly and successfully manage everything under your charge.

It is here that you see how to identify and understand operational threats and then take response actions to reduce or eliminate them, both in everyday situations and in times of uncertainty. It is where the full force of procedures, training, protocols, expectations, and training all must fit snugly together.

Situation Management introduces specific control room conditions to help you maintain focus during abnormal situations. It discusses taking action, or not taking action (if success is not achievable) and how to get help when needed.

The requirements for good control room management are given to enable all players to perform effectively. The approach of *defensive operating* is added to the traditional aids of collaboration, escalation, and other situation management techniques. Included is guidance to successfully deploy and use them.

A module in the handbook covers *permission to operate*. This means that so long as you have time to be successful, you are empowered and expected to do all you can to keep and restore good operation. As soon as the situation becomes unfamiliar or you are on the verge of running out of time, you must stop everything and render things safe. From this point forward, you no longer have "permission" to continue operating.

PART 7 — MANAGING SITUATIONS

Module 30: Operational Boundaries

30.1 Boundaries and Responsibilities

To ensure effective *managing the control room* [**M31**], it is useful to understand that specific operational boundaries and responsibilities exist and how they are adversely challenged. This module contains important concepts and considerations not usually explicitly recognized. Operators and management should review existing procedures and processes to ensure that it is always clear who is in charge, what the limits of their activities must be, what and how any coordination will occur, and who will do what.

Your overall enterprise may have several operational areas, each with its own dedicated operator. It is taken for granted that you, as the operator, are charged with ensuring effectiveness in your operational area of responsibility. An operational area is the physical extent of equipment and activities for which a single operator is responsible. You. Figure 30.1.1 schematically depicts this. There is the interior portion (green) noted as the Operational Area. Only a single one, yours, is depicted for clarity. The operational area is contained within an enterprise or plant area (blue). The enterprise area is contained within the universe (light yellow), which is shorthand for everything else outside of the enterprise (community, etc.).

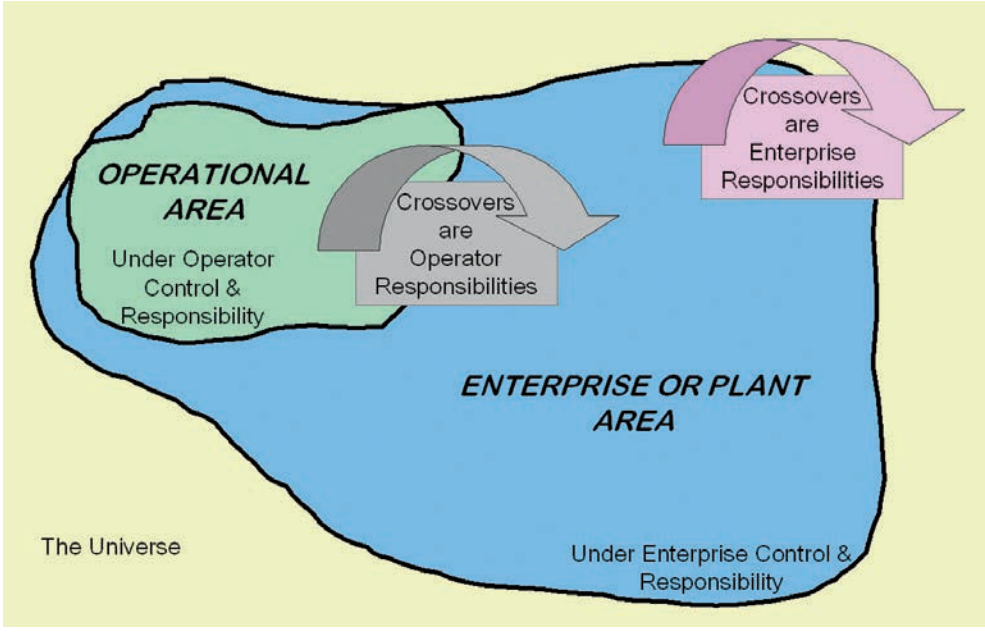


Figure 30.1.1. Boundaries and responsibilities that identify who is responsible for trying to prevent operational excursions from a particular region of operation and who is in charge once an excursion has occurred

A3: Cue Cards

A3.1 Introduction

Cue Cards are a special part of this handbook. This appendix contains copies of the Cue Cards that are provided separately. You can pull them out, and use the information on each one to keep a particular activity focused and on course. Later on, perhaps your first day back on a rotation, pick a few out and use them as a handy review. This way, you can both ease into the shift and brush up on what those cards cover. Cue Card material is pulled directly from the text, where it is explained in the context with the situation it covers. That specific handbook location is identified on each Cue Card using the same reference types used throughout the handbook. For example, Cue Card 4a [**Q4a**] material has been taken from Module 6 section 3; e.g., [**M6.3**]. A similar referencing is used to refer to other Cue Cards [**Qx**] where the "x" is the specific number of the Cue Card. The color used for the corner identification of each card is matched to the color of the relevant handbook part. Hence, the Cue Card 4 label would be in green since it came from Part 2.

A3.2 List of Cue Cards [Q1b]

Here is the list of all 20 cards.

Card Number	Description
1	*Handbook overviews* FRONT: Handbook Map BACK: List of cue cards
2	Long-arm-of-the-operator checklist
3	*Situation management* FRONT: Basic 4 situation management components BACK: Control the Situation Management Work Process
4	Safe communications FRONT: Safe Communications Set-up BACK: Steps for Safe Communications
5	SUDA (See, Understand, Decide, & Act) FRONT: SUDA Diagram BACK: SUDA in Everyday Situations SUDA in Alarm Situations
6	Managing uncertainty

Card Number	Description
7	HMI Navigation Checklist
8	*Alarm response* FRONT: Alarm response sheet BACK: 7 Steps for using alarm response sheet
9	Shift handover tasks and sequencing
10	*Maintenance handovers* FRONT: Maintenance handover BACK: Maintenance handback
11	*Weak signals* Front: Weak signals diagram Back: Weak signals 7-step procedure with brief explanation
12	*Control room conditions* FRONT: Restricted control room BACK: Sterile control room
13	Control room codes FRONT: Code Outside (emergency outside plant) BACK: Code Inside (emergency inside plant)
14	Defensive operating Front: Defensive Operating Behaviors Back: Defensive Operating Added Guidance
15	Collaboration
16	*Escalation* FRONT: Escalation flow diagram BACK: Escalation situation diagram
17	*Permission to operate* FRONT: Permission to operate flow diagram BACK: Permission to operate situation diagram
18	Weak Signal Flags
19	Triangulation Questions
20	Crew Resource Management

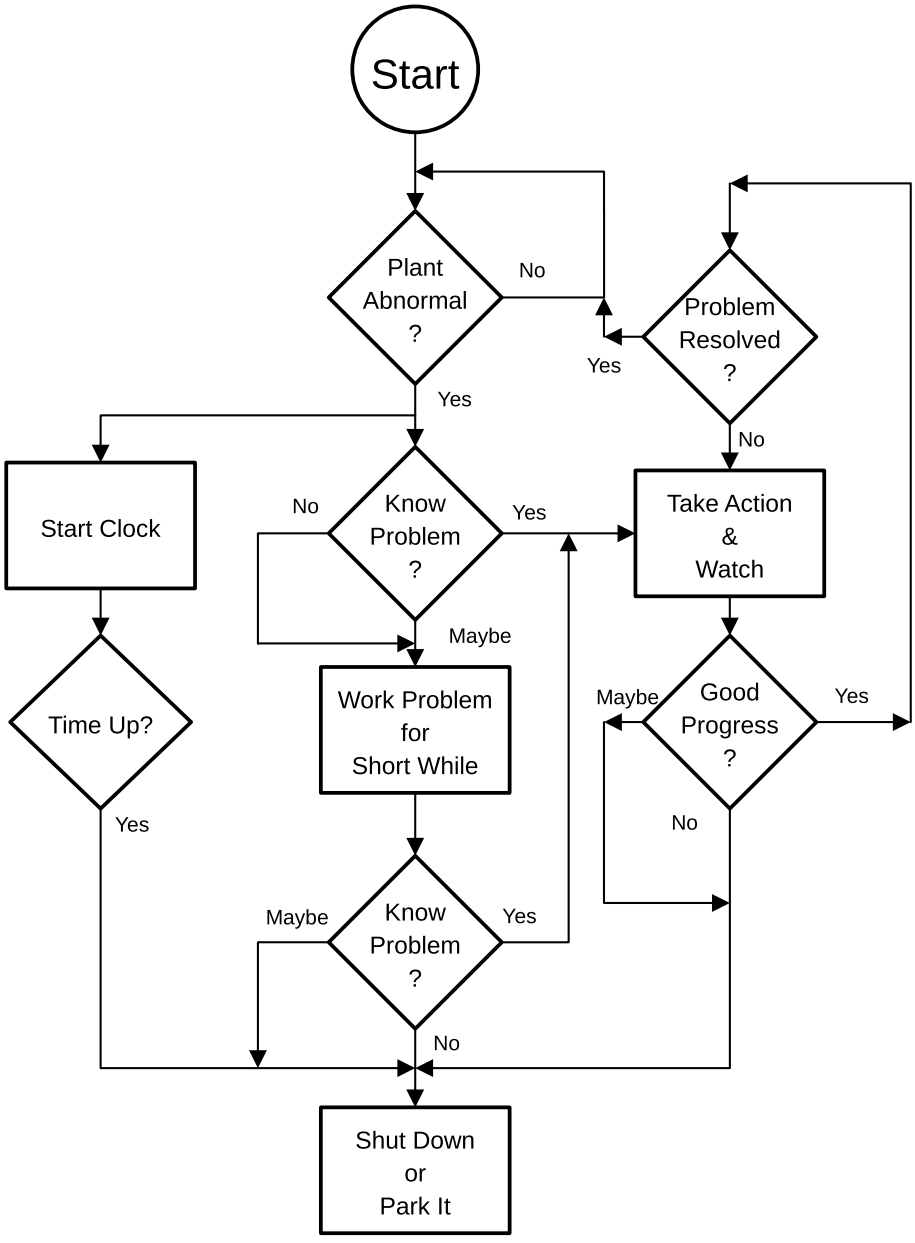
A3.3 Cue Cards

See next pages. Where the card is multi-sided, the front will be first followed by the remaining cards in order.

Cue Card **17a**

Control Room Operators' Handbook

PERMISSION-TO-OPERATE



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