UNIT-8 Developing a High Reliability Organization

Learning Outcomes

By the end of this unit the learner will be able to:

- ✓ Define the characteristics of a high reliability organization
- ✓ Define key concepts required for high reliability, including mindfulness and expectations
- ✓ Describe the five principles governing high reliability organizations: preoccupation with failure, resistance to simplification, sensitivity to operations, commitment to resilience, and deference to expertise
- ✓ Audit activities at all stages to assess the business' reliability
- ✓

Unit 8

What is a High Reliability Organization?

High Reliability Organizations

A high reliability organization (HRO for short) is one that operates at high performance levels despite the high risk level of their systems and/or environment.

Some examples of high reliability organizations include:

- Nuclear power plants
- Emergency medical response teams
- Wildland firefighting crews
- Aircraft carriers

If these organizations do not function reliably, serious disaster can result not only for the organization but also for those who depend on its services.

Even if your organization does not fall into one of these categories, you are still susceptible to crises and disasters. Applying the principles of these successful organizations can help your organization nip problems in the bud, reduce the occurrence and impact of negative events, and bounce back more quickly after a crisis.

Links in the Chain

Nearly all major disasters are the result of several sometimes minor events lining up in an unfortunate way. Often, if a single event had not occurred, the disaster would not have happened (or at least would have not had the impact that it did).

For example, consider the Deepwater Horizon oil rig disaster off of the United States coastline in 2010, which caused the worst accidental marine oil spill in the world to date as well as the sinking of the rig itself. At the time of the disaster, the rig was drilling an oil well at the Macondo Prospect in the Gulf of Mexico. Once the project was complete, the well would be sealed so that another rig could later hook up to it and extract the oil. The disaster occurred the day that the Deepwater Horizon was sealing the well so that they could unhook from it and move to the next drill site.

Executive Management

The following events all contributed to this disaster:

- No environmental assessment was done prior to drilling as parent company British Petroleum (BP) could not envision a scenario where a spill would occur and cause serious environmental damage.
- The rig's management team had an excellent safety record and described itself as the "pride of the Gulf."
- The well was 43 days behind schedule and millions of dollars over budget.
- Critical planning and engineering decisions were made at BP's head office, almost 500 miles away from the rig. A separate company, Halliburton, handled some additional engineering aspects (such as cement design).
- A BP engineer recommended 15 additional centralizers for the well (as only six were on board the rig), a key element to ensuring that the well would be able to be sealed.
- The engineer's supervisor was not in the office the day of this decision. However, the next day he reversed the recommendation as they would need to fly in all 21 centralizers as those currently on the rig differed in design from those available. As well, these additional centralizers would have taken about 10 hours to install, adding nearly a million dollars to the cost of the project.
- Transocean, BP, and Halliburton all disagreed on the method of cementing used to seal the well.
- The cement formula and method used to seal the well failed several stability tests at Halliburton, but they did not share these results with BP.
- The day after the well was cemented and sealed, a key pressure test on the oil well was performed. This test extended past the day shift and required a shift handover.
- A VIP tour for BP and Transocean, the rig owners, was taking place on the rig the day of the test.
- The operator from the day shift believed that the oil well was leaking, but the night operator did not agree with him.
- The night operator's team performed a second test that provided a false reading. Then, the well site leader supported the night operator and the well was declared ready to seal and abandon.
- This was the night operator's last shift on the rig: he had just been promoted and would be leaving the next day.
- No one was in the rig control room when the well began to blow out.
- The emergency disconnect system, which should have enabled rig workers to shut off the flow of oil at the sea floor and move the rig away from the blowout, did not work.
- This was later determined to be caused by cables connecting the system to the rig becoming severed during the first explosion. As well, the batteries powering the backup system (which should have triggered the disconnect when the system lost connection with the rig) were not charged.
- In previous industry tests, emergency disconnect systems failed in about 50% of simulated emergency situations. Based on this, some countries have mandated that other types of emergency systems be used.

Since no emergency response plan was in place and the well was left unsealed at the ocean floor, the oil spill continued for 86 days, pumping five million barrels of oil into the Gulf of Mexico.

HRO Principles

High reliability organizations have learned to focus on small signals of weakness so that problems are identified and resolved before they have a chance to grow. They use dynamic, complex processes and structures to manage a dynamic, complex environment. They know that you can never predict all possible outcomes, so they instead plan to be flexible and responsive so that they can manage a variety of scenarios.

This approach involves five key principles:

- Preoccupation with failure
- Resistance to simplification
- Sensitivity to operations
- Commitment to resilience
- Deference to expertise

These principles require a mindset of continual learning, flexible organizational structures, and mindfulness, in order to avoid complacency and constantly keep a watchful eye for potential problems.

Key Concepts

Expectations, Normalization, and Mindfulness

Expectations

We all have expectations about the world around us. We expect that our car will start when we turn it on. We expect that we will still have a job when we get to work. We expect that gravity and physics will keep our world in order. These expectations are normal and provide structure to our daily lives.

However, expectations can also create blind spots. If a construction team has never had an accident, they may begin to feel invincible, like an accident simply cannot occur. If a machine has always produced 100 widgets a day, the production team may not foresee the time when it fails and puts other operations in danger. When these expectations are not met, crisis can occur and lessons will be learned the hard way.

High reliability organizations are aware of these tendencies surrounding expectations. They constantly challenge themselves to stay alert, identify their expectations, and thereby expose weaknesses and blind spots.

Normalization

We often alter reality to support our expectations and normalize the world around us. Disaster expert Robert Bea puts it like this: “Frequently we think of things as we want it to be, not as it is. So if we want it to be OK, we find everything we can to support that thinking.” This tendency increases in times of crisis and pressure.

Another way that we normalize unexpected events is by comparing them to past events that we have coped with. We might think something like, “This reminds me of the time that…” For many people, this helps to give them a sense of control over the situation. However, both of these tendencies can create blind spots, particularly during a disaster.

Mindfulness

A high level of alertness to what is happening right now can help combat the blind spots caused by expectation and normalization. In "*Managing the Unexpected,"* Karl Weick and Kathleen Sutcliffe define mindfulness as an attitude that is "focused on clear and detailed comprehension of emerging threats and on factors that interfere with such comprehension."

The five principles of high reliability organizations (preoccupation with failure, resistance to simplification, sensitivity to operations, commitment to resilience, and deferring to expertise) provide strategies for being mindful and fully aware of the situation at hand.

Making Connections

The Deepwater Horizon Disaster

The Deepwater Horizon oil rig disaster off of the United States coastline in 2010 caused the worst accidental marine oil spill in the world to date as well as the sinking of the rig itself. At the time of the disaster, the rig was drilling an oil well at the Macondo Prospect in the Gulf of Mexico. Once the project was complete, the well would be sealed so that another rig could later hook up to it and extract the oil. The disaster occurred the day that the Deepwater Horizon was sealing the well so that they could unhook from it and move to the next drill site.

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Case Study

Describe how expectations contributed to this disaster.

Executive Management

Describe how normalization contributed to this disaster.

Describe how mindfulness (or a lack thereof) contributed to this disaster.

The Anticipation Principles

Preoccupation with Failure

The Three Anticipation Principles

The first three principles of high reliability organizations focus on preparing for unexpected events in order to slow their development and reduce their impact. The first of these principles is a **preoccupation with failure.**

Preoccupation with Failure

This principle is based around the notion that in order to avoid failure, you must embrace it. High reliability organizations know that catching problems early on is essential to preventing them from spiraling into a crisis. They encourage people to focus on their gut instincts and to investigate further when something just doesn't seem right. This principle focuses on high-level failures as well as small events that cumulate into larger disasters and early warning signals of potential problems.

In order for this to work, the following supports need to be in place:

- A culture where people feel comfortable looking at problems and pointing out possible failures or errors
- An understanding of how a single small event can affect many parts of a complex, interdependent system, and why preoccupation with failure is important
- An approach that makes problems a system issue rather than a blame game of pointing fingers
- A willingness to work with others and put your own ego aside
- A mindset that does not let success create blind spots and a feeling of invincibility
- An organizational structure that supports and considers input from all levels
- A focus on imagination and possibilities rather than pessimism

Case Study

Christiana Care Hospital, located in Delaware, United States, is one of many health organizations who have turned to the principles of high reliability in order to improve patient care and service delivery.

One of their areas of focus was the treatment of patients with sepsis (infection in the bloodstream). Although the average rate of death due to this condition was only slightly higher than average, hospital staff knew that they could do a better job of treating these patients.

They identified three major areas where failure could occur with sepsis cases:

- Misdiagnosis in the emergency room
- Timely access to appropriate antibiotics
- Lack of availability of intensive care beds, which was the only department equipped to handle these cases

Notice that the description of each of these issues focuses on the health system and its resources, not on specific departments or teams.

Then, solutions were developed to address each type of failure. This included portable stations with information on symptoms and treatment of sepsis as well as doses of the appropriate antibiotics. In-depth educational programs were also launched to train staff on the signs of sepsis and treatment options.

As a result of these programs, the average rate of death due to this condition at Christiana Care Hospital has declined by 46%. As well, the average length of intensive care stay has declined by about 22%, freeing up critical resources.

Making Connections

Describe how this principle could have helped prevent the Deepwater Horizon disaster.

Resistance to Simplification

Simplification and Categorization

High reliability organizations also **resist simplification**. Mindfulness helps these organizations pay attention to small details and the context of situations. This helps bring out details and expose potential issues.

Applying categories and labels to situations can help us understand them, but they can also create expectations and blind spots. For example, would you consider an empty or full barrel of gasoline to be more dangerous? The answer might surprise you: an empty barrel is more dangerous due to the vapor that builds up in it. The feeling of safety when using the label "empty" has caused more than one serious accident.

In-depth exploration of the issues at hand, with intelligent questioning and a diverse team of people breaking down systems, can help an organization resist simplification and get to the real issues at hand.

Case Study

On January 16, 2003, the space shuttle Columbia launched from the Kennedy Space Center in Florida on its 28th mission. Almost immediately after the launch, a piece of foam broke off and struck the left wing. This event was classified as "in-family" (an understood, reportable problem) rather than "out-of-family" (a problem that has not yet been experienced and is treated more seriously). This categorization, as well as numerous other failures, led to the decisions that ultimately saw Columbia break up upon re-entry, killing all seven crew members.

Making Connections

Describe how this principle could have helped prevent the Deepwater Horizon disaster.

Sensitivity to Operations

Sensitivity to Operations

The third and final anticipation principle is **sensitivity to operations**. This principle requires that the organization as a whole understands its systems, including their complexity, variability, and sometimes disorderly nature. It's about the actual work done in the organization and the hands-on involvement of every person at every level.

This principle encourages information gathering (including instinct and gut feelings) and reporting from all levels of the organization. A janitor's feeling that something just isn't right with a cooling system is given just as much regard as a formal report from a consultant. Interaction between diverse groups and levels of employees is encouraged to sniff out these risks and potential problems. Asking "What if?" is another way to become sensitive to operations.

In order for the organization to become sensitive to operations, information must be shared clearly and in real time. Face-to-face communication should be encouraged wherever possible, particularly between different departments and teams.

It can be easy for tasks to be classified as routine and for mindfulness to deteriorate. It can also be easy for us to applaud ourselves for a successful track record and to become complacent. Being aware of what is happening in the organization can help avoid these pitfalls and promote high reliability.

Case Study

Aircraft carriers are an excellent example of a high reliability organization that is very sensitive to operations. Consider this description of life on one of these vessels, as quoted in *"Collective Mind in Organizations"* by Karl Weick and Karlene Roberts:

"Imagine that it's a busy day, and you shrink San Francisco airport to only one short runway and one ramp and one gate. Make planes take off and land at the same time, at half the present time interval, rock the runway from side to side, and require that everyone who leaves in the morning returns the same day. Make sure the equipment is so close to the envelope that it's fragile. Then turn off the radar to avoid detection, impose strict controls on the radios, fuel the aircraft in place with their engines running, put an enemy in the air, and scatter live bombs and rockets around. Now wet the whole thing down with sea water and oil, and man it with 20 year olds, half of whom have never seen an airplane close-up. Oh, and by the way, try not to kill anyone."

Here are a few ways that sensitivity to operations helps safety and reliability in a complex environment like this:

- All crew are in continuous communication using voice channels as well as visual observation
- Anyone on the ship can stop operations at any time
- Small adjustments are continually made to ensure optimal performance

Making Connections

Describe how this principle could have helped prevent the Deepwater Horizon disaster.

Pre-Assignment Review, Part One

Review your pre-assignment information in light of that we just discussed. Summarize your findings below, as well as any new insights and ideas for improvement.

Principle	Things We Are Doing Well	Things We Could Do Better	Ideas for Improvement
Preoccupation w/Failure			
Resistance to Simplification			
Sensitivity to Operations			

The Containment Principles

Commitment to Resilience

The Two Containment Principles

By their very nature, errors, accidents, and unexpected events are hard to anticipate and prepare for. As geophysicist Richard Sears says, “You don’t manage these risks to zero. They are always there.”

Therefore, the final two principles of high reliability organizations focus on minimizing the impact of a negative event when it does occur. The principles of **resilience** and **deferring to expertise** will help organizations react quickly and appropriately, while retaining the attitude of mindfulness and being aware of expectations.

Commitment to Resilience

The first containment principle is a **commitment to resilience**. Resilience is about how a system continues to operate even when some of its parts are failing. It is also about how a system bounces back after failure and improves itself based on the lessons learned.

Case Study

Shipping company FedEx is an excellent example of this principle. FedEx is responsible for getting products to their destination safely and quickly. However, they are often faced with more shipments than anticipated. External factors such as weather and airport conditions can also impact their delivery targets.

To ensure that the system is not adversely affected by these factors, FedEx has what they call a “sweep network.” Each day, 20 to 25 FedEx planes across the United States depart for the central processing station in Memphis with 40% of cargo space still available. They can then stop and pick up excess cargo on the way if necessary, as long as they can still be in Memphis by the deadline of 1:30 a.m.

Making Connections

Describe how this principle could have helped prevent the Deepwater Horizon disaster.

Deference to Expertise

Deference to Expertise

The second containment principle is **deference to expertise**. This principle acknowledges that the front-line people are often those who see the early signs of problems first. High reliability organizations give these people the ability to report these problems, be heard, and make decisions to correct negative events early on. It's not just about knowledge and formal education; it's about hands-on experience and in-depth understanding of the systems at hand.

Note that we use the term "expertise" rather than "experts." This principle does not mean handing off a problem to a single person and then washing your hands of it. It's about leveraging the knowledge and experience of the right people and seeking help when it is needed.

Case Study

Wildland firefighting teams have learned the hard way to listen to the people on the ground who have hands-on experience with wildfires. In many wildland fire departments, each crew of firefighters has a leader who has complete control over the firefighting operation. Upper management respect their expertise and the expertise of the crew. Although they do maintain a hierarchy in supporting and supervising operations, crew leaders have autonomy and the ability to make real-time changes on the ground.

Making Connections

Describe how this principle could have helped prevent the Deepwater Horizon disaster.

Pre-Assignment Review, Part Two

Review your pre-assignment information in light of the information that we just discussed. Summarize your findings below, as well as any new insights and ideas for improvement.

Principle	Things We Are Doing Well	Things We Could Do Better	Ideas for Improvement
Commitment to Resilience			
Deference to Expertise			

Auditing for High Reliability

Auditing Techniques

The Importance of Audits

Mindfully, consciously looking at the organization and its systems is a key part of high reliability. Asking questions and assessing the current state of things helps promote mindfulness, weaken expectations, and expose possible problems.

Readiness Assessments

As you begin to consider implementing high reliability principles in your organization, it can be helpful to see where things currently stand. Karl Weick and Kathleen Sutcliffe recommend performing an audit for each of the five principles, as well as tendencies towards mindfulness and mindlessness. These audits can then be repeated to evaluate progress towards high reliability and to expose areas that require further work.

Churchill's Four Questions

Winston Churchill had a framework of four questions that he asked whenever anything went wrong. This simple structure can also help high reliability organizations look at how negative events unfold, identify missed opportunities, and close gaps for future events.

The four questions that Churchill asked were:

- Why didn't I know?
- Why didn't my advisors know?
- Why wasn't I told?
- Why didn't I ask?

Making Connections

Consider that you are the Deepwater Horizon well site leader and answer Churchill's four auditing questions in light of the disaster.

Why didn't I know?

Why didn't my advisors know?

Why wasn't I told?

Why didn't I ask?

Sample Audit Questions

The Auditing Scale

The types of questions that you will ask will depend on your organization. However, here are some sample questions that you can use as a starting point. Each question can be answered using a scale from one to three.

1. This statement does not describe our organization at all.
2. This statement partially describes our organization.
3. This statement completely describes our organization

Mindfulness

- People agree on what things could go wrong.
- Work is very routine.
- Front-line workers have the authority and skills that they need to address problems.
- Processes have little room for error.

Preoccupation with Failure

- People throughout the organization look for weaknesses in our systems.
- When a negative event occurs, a thorough examination is done so that we can learn from it.
- People are encouraged to report errors.
- We look at errors as system issues rather than assigning blame.

Resistance to Simplification

- We limit the use of categories and labels.
- People are encouraged to ask questions.
- We practice active listening and questioning.
- We encourage skepticism.
- People respect each other.

Sensitivity to Operations

- All levels of management pay attention to what is happening on the front lines.
- There is always someone available for support in case problems arise.
- People have the authority to make decisions and resolve problems.
- People throughout the organization constantly interact and communicate so that everyone has a detailed view of the current state of operations.

Commitment to Resilience

- There is a strong focus on training and education.
- People have the skills that they need to do their job.
- Systems are evaluated and adapted to become more resilient.
- People are encouraged to think outside the box and be creative.

Deference to Expertise

- People are willing to share information with each other.
- The management team frequently asks front-line workers for their opinion and input.
- There is a good depth of knowledge within the organization.
- People know who to turn to for help.

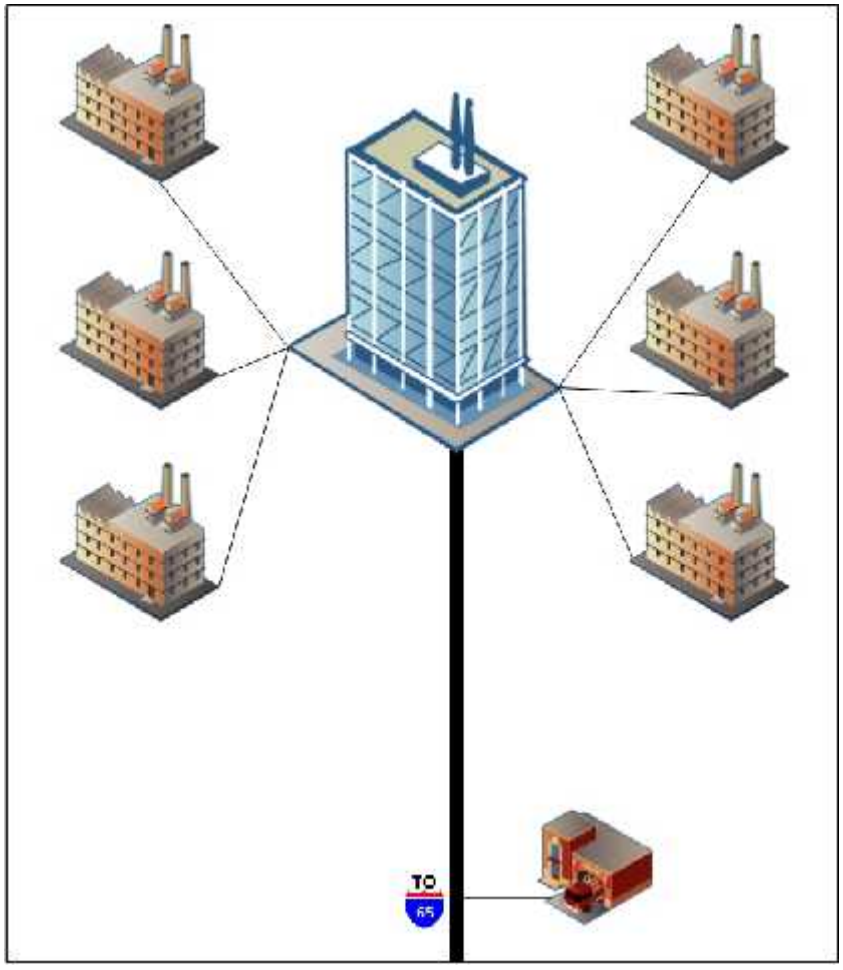
What other questions might you want to ask in your organization?

Test Driving

Case Study

Your team has been hired by the Asimov Nuclear Power Plant to improve its reliability and resilience. You have been given the following background information on the plant.

The construction of the plant was begun five years ago by the government in order to address power shortages. The plant was designed to house six nuclear reactors surrounding a central plant, like this:



Although engineers recommended that a newer type of reactor be built, it was deemed too expensive. Government consultants chosen an older design, even though other plants have had problems with this design overheating and de-stabilizing. Construction took two years longer than planned due to problems with the quality of the building materials and the construction itself. The plant has now been open for about a year.

Executive Management

The control center is the heart of the Asimov Nuclear Power Plant. It is staffed by four engineers as well as a chief operator. There are two chief operators on staff: one works from 7 a.m. to 7 p.m., while the other works 7 p.m. to 7 a.m. Each operator works four days on followed by three days off. During their off days, an engineer takes over their duties. Operators do carry a cell phone in case of emergency and will drive in to the plant if necessary.

Each reactor is staffed by a crew chief as well as six engineers. The shifts for the reactor crews are as follows: 7 a.m. to 3 p.m., 3 p.m. to 10 p.m., and 10 p.m. to 7 a.m. Each crew is permanently assigned to one reactor. Senior engineers have shift preference over junior engineers, meaning that overnight the reactors are manned by less experienced staff.

During a tour of the plant, your team makes the following observations:

- There have been four near misses since the plant opened. All of these incidents have been covered up and no discussion is permitted about the problems.
- Although there is a fire department near the plant entrance, it does not have a direct connection to the plant's control center or any of the reactors.
- The reactors are self-powered; that is, they rely on their own electricity for operation and do not have backup generators. If more than one reactor fails, all reactors must be shut down.
- The control center also relies on reactor power to operate.
- Reactor engineers can communicate with the control center but not each other.
- All decisions are made by the chief operator in the control center, neither of whom have never worked in any of the reactor buildings.
- Both operators live about 45 minutes from the plant.
- Safety drills are done at night, when power demand is lower.
- The reactors are about one mile from each other and half a mile to 1.5 miles from the control center. A shuttle runs from the control center to each building every half an hour. No other vehicles are available.
- At the end of each shift, crew chiefs are asked to fill out a form to rate the performance of the reactor during their time on duty. Green means excellent, yellow means acceptable, and red means underperformance. Crew chiefs can also report issues at this time through additional forms.
- Staff meetings are held every Friday at 8 a.m. The agenda covers staff changes (such as terminations and hiring), requests from the Board of Directors, and upcoming safety drills.
- Key decisions are made by the Asimov Board of Directors, who meet weekly at a conference center in a nearby city.

Task

Use the principles of high reliability organizations to improve the Asimov plant.

Executive Management

Preoccupation with failure

Resistance to simplification

Sensitivity to operations

Commitment to resilience

Deference to expertise

Debrief

Preoccupation with Failure

The Asimov Nuclear Power Plant should be conducting in-depth investigations into all near misses. They should also encourage all staff to report issues, not just the crew chief. Staff meetings for all shifts, with an open forum to discuss issues, could be a good starting point.

Resistance to Simplification

It appears that there is not enough detail in the crew chief's report. Categories should be replaced with in-depth questions that are immediately reviewed by and discussed with the chief operator. As well, all systems should have at least one backup generator to ensure that adequate power can be provided to the reactors and the control center.

Sensitivity to Operations

Decision making and information sharing at Asimov is fragmented. There is no physical or communication link between any of the reactors. As well, reactor crews have very little time for shift handoff and communicating important events.

We would recommend having a chief operator on duty at all times, building roads between the reactors, opening communication lines between the reactor buildings, and making vehicles available to move more freely in the plant. As well, an executive team should be present full-time in the control center with 24/7 availability to all staff.

Chief operators should have periodic shifts in the reactor buildings, as well as physical observation of the reactors during their supervisory shifts.

Commitment to Resilience

All systems should have at least one backup generator to ensure that adequate power can be provided to the reactors and the control center. Clear plans should be in place to address reactor failures, with flexibility given to staff to adjust these plans as needed.

The availability of fire crews should also be reviewed to ensure that coverage is adequate. Direct lines to the plant and automated monitoring systems could also improve response times in case of a disaster.

Finally, systems for recording near misses and implementing lessons learned should also be in place.

Deference to Expertise

Engineers, crew chiefs, and chief operators should be more involved in decision making. They should have more authority to make changes as they see fit and have more opportunities to share their knowledge with the executive team.

Siloing the reactor crews into permanent positions could create blind spots. Cross-training and flexible job assignments could improve mindfulness and the overall reliability of the power plant.

Further Reading:

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