Staying Competitive Through Operational Excellence

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Contents

Abstract

Unexpected events cost more than ever. Equipment damage, forced outages, startup delays, exceedances, injuries and near misses have direct costs. Investigations, corrective actions and stakeholder issues distract managers from strategic objectives. These events happen despite preventative programs, policies and procedures. They are "unforced errors." They are errors of communications, failures to set standards and failures to follow standards.

This case study describes the work done by the electric generation business unit of a North American utility and a process consulting firm to define and fix the problems that led to unforced errors. Operating practices were compared with existing procedures and industry best practices. Written and verbal communications (turnovers, logs, work notifications, night orders, etc.), plant monitoring and control (use of procedures, operator rounds, etc.), and leadership characteristics (process discipline, communications, incident management, roles and accountabilities, etc.) were assessed at several sites, large and small. A scope was created to achieve Operational Excellence: to reduce errors by 1) ensuring accurate and complete information exchange in operations, and 2) developing a process- and procedure-based culture.

A governance committee of plant managers was established to ensure fleet-wide consistency. A small but diverse design team quickly put together standards that were short, simple and realistic. Clear and consistent guidelines were developed for day-to-day operations. Methods were developed to sustain these practices by measuring their effectiveness and reinforcing them.

The procedures were implemented plant by plant. Operators assisted in tailoring them at each site. Training was held, and one-on-one coaching drove understanding and fast behavior changes. Supervisors began directly observing operators and providing feedback. Exceptions to the standards were reviewed with the governance committee. Following implementation, an audit was conducted at each plant. A human performance measure was developed as a lagging indicator to directly show the reduction of unforced errors.

Introduction and Background

Project background

The Power Generation business unit at WEC Energy Group (WEC) consists of dozens of generating units, natural gas storage, district heating and centralized support for training, maintenance and monitoring. The total generating capacity of over 7,300 megawatts (MW) is derived from coal, combined cycle, combustion turbine and hydro assets. Over 1,100 employees work in Power Generation, including approximately 780 represented by the International Union of Operating Engineers and the International Brotherhood of Electrical Workers. WEC Energy Group and its subsidiary companies have a long and proud tradition of innovation. For over a century they have built and operated plants that have provided reliable power for their customers.

Five years ago, WEC Energy Group began a sustained effort to improve performance across the company. The company had to respond to the cost pressures and reliability demands felt by all power

generators. The ambitious goal was to achieve top quartile results in key areas by 2020. In Power Generation the areas identified were outage management, maintenance work management, operational excellence, equipment reliability, and plant monitoring and diagnostics. This report describes the Operational Excellence project – an initiative that brought about a step change in how the vital work of day-to-day operations gets done.

In 2017, WEC partnered with the Reliability Management Group (RMG) to assess operations at six Power Generation facilities. The objectives were to identify strengths and opportunities at each site, to identify opportunities for fleetwide improvement through standardization of operations processes and procedures, and to provide recommended actions and a business case to support the actions. RMG has been in the business of helping organizations improve their work management processes since 1987. RMG's philosophy is that the root cause of process, system and equipment reliability is human reliability.

The driver behind WEC Energy Group's decision to broadly assess operations was the persistent occurrence of what one executive described as "unforced errors." These were events that appeared to be simple errors, which resulted in production losses, outage delays, equipment failures, environmental exceedances and safety hazards. They continued to occur despite broad efforts to improve training standards, operating procedures, equipment labeling and other key operational processes. However, both WEC Energy Group and RMG personnel understood from the beginning that these were not, in fact, simple errors. The question was: What needed to change to break the chains of events that led to these errors?

Operations challenges

Communications are the greatest challenge in an around-the-clock operation. The people who operate the facility spend 75 percent of their work time when day shift personnel are not at the plant. This creates a high potential for a communications gap between the on-shift operating staff and their leaders on day shift. Paradoxically, the technology that has done so much to enable communications often obscures the critical communications to and from the operating shifts. Operations supervisors returning to shift after a week off typically must sort through 50 or more emails from each day. It can be hard to tell at a glance which ones contain information that should be known before taking the shift. Communications and direction come from many sources, and the on-shift leaders must sort through them to ensure they are using the right guidance for decisions they make.

The next big challenge is deciding how things get done. In any 24/7 operation with rotating crews and multiple work disciplines, questions of how things should be done, who should do them, and when they should be done are daily challenges to coordination and decision-making. In the absence of formal guidance, informal practices develop. Each site develops its own culture that is handed from one operator to the next. Individuals can influence the culture based on their personality, knowledge, leadership skills or positional authority. A plant culture will often reflect the preferences of a strong leader who has been gone for years. In contrast, formal work practices can be used to guide operations as well. Informal work practices can be effective at reducing errors and the risk of error. However, it is entirely dependent on the individuals setting and maintaining the standards. Consistency, clarity and accountability are not built into the system and are often lacking. Creating procedures is a way to formalize good operating practices to ensure consistent performance and clear accountability.

The third challenge in operations is following established standards. While key safety processes, such as lockout/tagout, have an extremely high success rate, whether other processes and procedures are followed is dependent on the operating culture and the quality of the procedures and standards. Informal or poorly written procedures and standards lead to low commitment to use them. A reactive culture at a site can result in procedures and standards being set aside when production becomes the priority. It is not enough to have good procedures and standards. There must be a firm commitment to following them to reduce errors.

Analyses of unforced errors almost always implicate communications, unclear accountabilities, procedures or expectations as the true sources of the errors. It was these fundamental facets of operations that the Operational Excellence project addressed.

Methodology and Results

Assessment methodology

WEC Energy Group initially chose six generating plants for assessment: three multi-unit coal-fired generating plants, two natural gas-fueled combined cycle plants, and one cogeneration plant converted from coal to natural gas that supplies district heating steam. Two RMG senior consultants completed the assessments, led by a project manager. The assessment of each plant took one week, except for the largest site, which took two. The assessments consisted of reviews of current operations work processes and practices with two objectives: first, to identify strengths and opportunities for improvement at the site, and second, to develop improvement recommendations (e.g., process, training, tools and standardization) and identify the value of such recommendations.

Before any site visits took place, a combined team of Power Generation and RMG personnel reviewed fleetwide standards, the scope and progress of other improvement initiatives, and the assessment plan. Representatives from both unions participated in these discussions to ensure early buy-in. It was made clear from the outset that the assessment was about plant- and fleetwide process and performance improvement, not assessing headcount or judging individuals.

The assessment was done using an evaluation tool called the Operational Excellence grid. The grid is a framework for analyzing operations and communicating results of the analysis. RMG had developed and used the grid previously. Before the WEC assessment, a review was done to ensure it was up to date and included key processes for power generation. The grid consists of broad functions (e.g., monitoring and communication) and the key processes within that function. A set of specific criteria were used to evaluate the effectiveness of each process. The resulting numeric score for each process was represented on the grid as a color: green for best practice, blue for a functional process, yellow for results where standards were absent or the process not followed, and red where the process was absent or not functioning. Refer to Figure 1.

8	Work Culture	8.1 Leadership	8.2 Goals and Goal Translation	8.3 Health, Security, Safety,Environment	8.4 Teamwork Effectivness	8.5 Organizational Communication	8.6 Operational Discipline
7	Process Control Management	7.1 Operating Standards	7.2 Work Identification	7.3 Response to Abnormal Conditions	7.4 Business Plans Alignment	7.5 Issues Management	7.6 Prints and Drawings
6	Continuous Improvement	6.1 Incident Management	6.2 Training	6.3 Employee Feedback			
5	Documentation	5.1 Operator Rounds	5.2 Narrative Logs				
4	Inter-Department Coordination	4.1 Maintenance	4.2 Modifications	4.3 Testing	4.4 Work Control	4.5 Dispatch	
3	Emergency Operations	3.1 Emergency Planning	3.2 Emergency Operation Training	3.3 Emergency Response			
2	Routine Operations	2.1 Standard Operating Procedures	2.2 Monitor Critical Parameters	2.3 Startup, Shutdown, Ramping			
1	Operations Communication	1.1 Shift Turnover	1.2 Shift meetings	1.3 Pre-Task Briefings	1.4 Verbal Communication	1.5 Written Communication	1.6 Emergency Communication

Figure 1. Example of an Operational Excellence grid

The key to the assessment was the method used to evaluate the processes. RMG consultants reviewed written procedures, guidelines, reports and other documents to determine what standards were established. One-on-one interviews were conducted with the site leader, the operations leader, supervisors, control operators and plant operators. The interviewees were asked what standards or guidelines (written or unwritten) existed for each process. They were asked to describe the actual practices for each process as well. They were given a guarantee of confidentiality. The final step in the assessment was observation. RMG consultants sat in on shift turnover meetings, daily plant meetings, supervisor turnovers, control operator turnovers and plant operator turnovers. Each plant had four or five operating teams, and observations were made on at least three different teams for each assessment. Control room observations were conducted, and plant operators were observed completing rounds and performing other tasks. These observations were interactive and enabled the observers to compare written standards with expectations (from interviews) and actual performance. The observers were also able to evaluate the flow of communications from the off-shift organization to the operating teams on shift, and from one operating team to another.

The RMG team met to integrate and evaluate the collected documents, interviews and observations. Each of the criteria was discussed and scored. Each score was supported by multiple data points. Once the complete grid was scored, a presentation was developed for the site leadership that showed the grid and highlighted strengths and opportunities in each functional area. This presentation served two purposes. First, it gave local leadership the first look at the assessment results. Second, it gave local leaders an opportunity to object to any part of the assessment they felt RMG had gotten wrong before the results were passed to the business unit leaders.

Assessment results

Each site was assessed, and a consolidated assessment was developed from the site reports. Some of the key findings in the consolidated report:

- Areas of "best practices" existed throughout the organization.
- Emergency planning and response processes were generally best practice.
- Expectations and practices for using standards and procedures varied by site.
- Informal and incomplete communications were present in degrees at all sites (shift turnovers, shift meetings, logs, operational directives, etc.).
- Several key processes and procedures were missing or required improvement, such as: ✦ Shift turnover and shift meeting.
    - ✦ Verbal and written communications (e.g., operator aids, night orders, etc.).
    - ✦ Pre-task briefings.
    - ✦ Post-maintenance testing and off-normal testing.
    - ✦ Management of Change Process (MOC) – including process and procedure changes.
- Work identification and coordination practices were inconsistent between sites:
    - ✦ Use and quality of notifications to identify deficiencies.
    - ✦ Prioritization of work (for maintenance)
    - ✦ Performance of operator rounds checklists.
    - ✦ Performance of operations PMs
    - ✦ Maintenance work scheduling and completion
- No systemwide set of process metrics supporting operations was in place, other than plant performance such as Equivalent Forced Outage Rate, Equivalent Availability Lost Margin, etc. Not having metrics limits feedback on process use and effectiveness, limits identification of improvement opportunities, and leads to reduced process accountability.
- Flexibility to adapt procedures for operational needs was not incorporated into standards.
    - ✦ Procedures revised to incorporate human factor formats have removed asset and operational information that served as important reminders.
    - ✦ No standards exist for the format and use of off normal and alarm response procedures.
- Closeout of plant projects and modifications was often not completed (documentation, PM definition, training, procedures, prints, drawings, etc.).
- There was inconsistent structure, material and training quality across sites: ✦ The observed level of plant-specific knowledge varied.
    - ✦ Peer-to-peer training (on the job) and signoff of Qual books were resulting in inconsistent operator knowledge.
    - ✦ Instructional material updates were not managed for plant upgrades and changes.
    - ✦ The fundamentals training approach was inconsistent.
    - ✦ In some cases, there was no formal training program or administration.
- Level of site leadership involvement in plant operations varied between sites:
    - ✦ Greater operational discipline was observed where management was engaged daily.

- ✦ Better operations and maintenance coordination was observed where there was site leadership oversight.

- All sites were challenged with the pace of change initiatives; smaller sites were particularly impacted.
- Processes to manage procedure and process changes were incomplete or not used.

The Operational Excellence grid for each site was completed and shared with site leadership and executive leaders. Refer to Figures 2-7.

Site 1

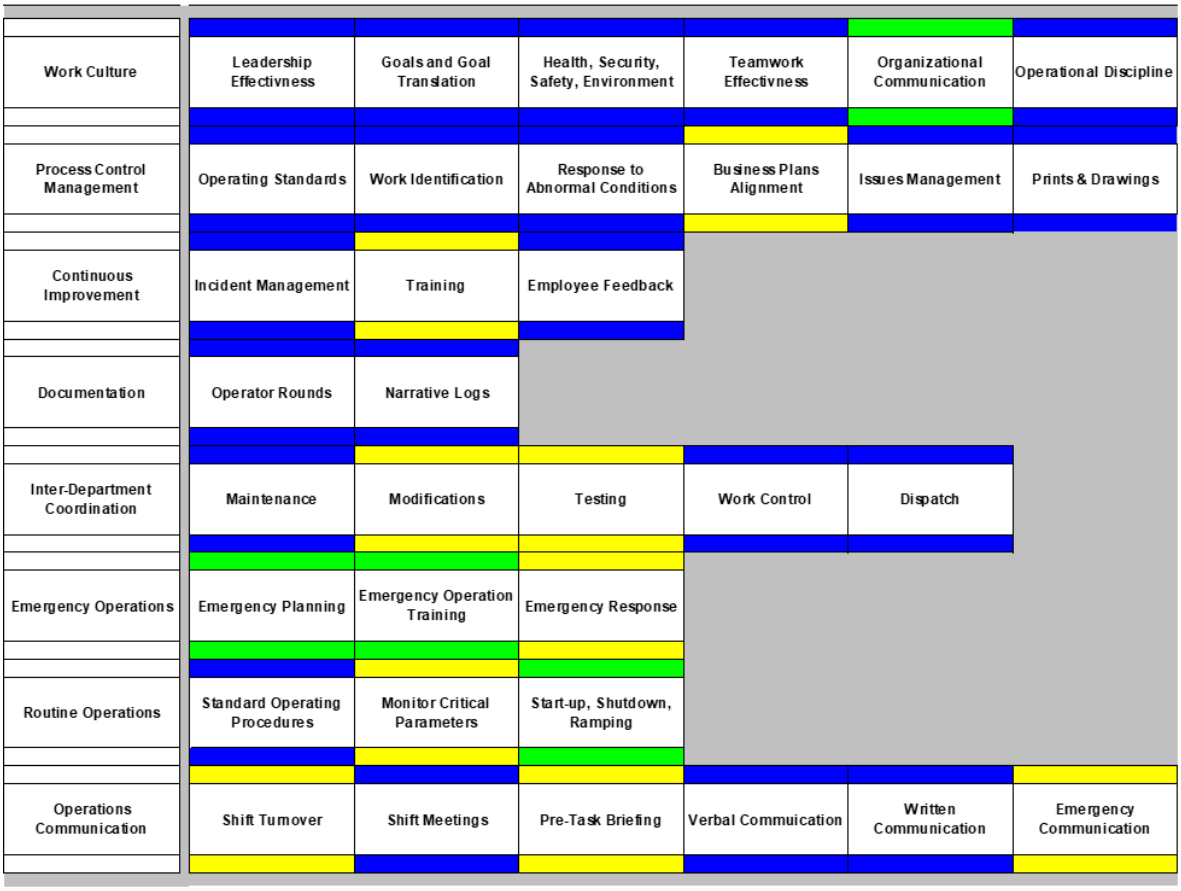

Figure 2. Site 1 Operational Excellence grid

Site 2

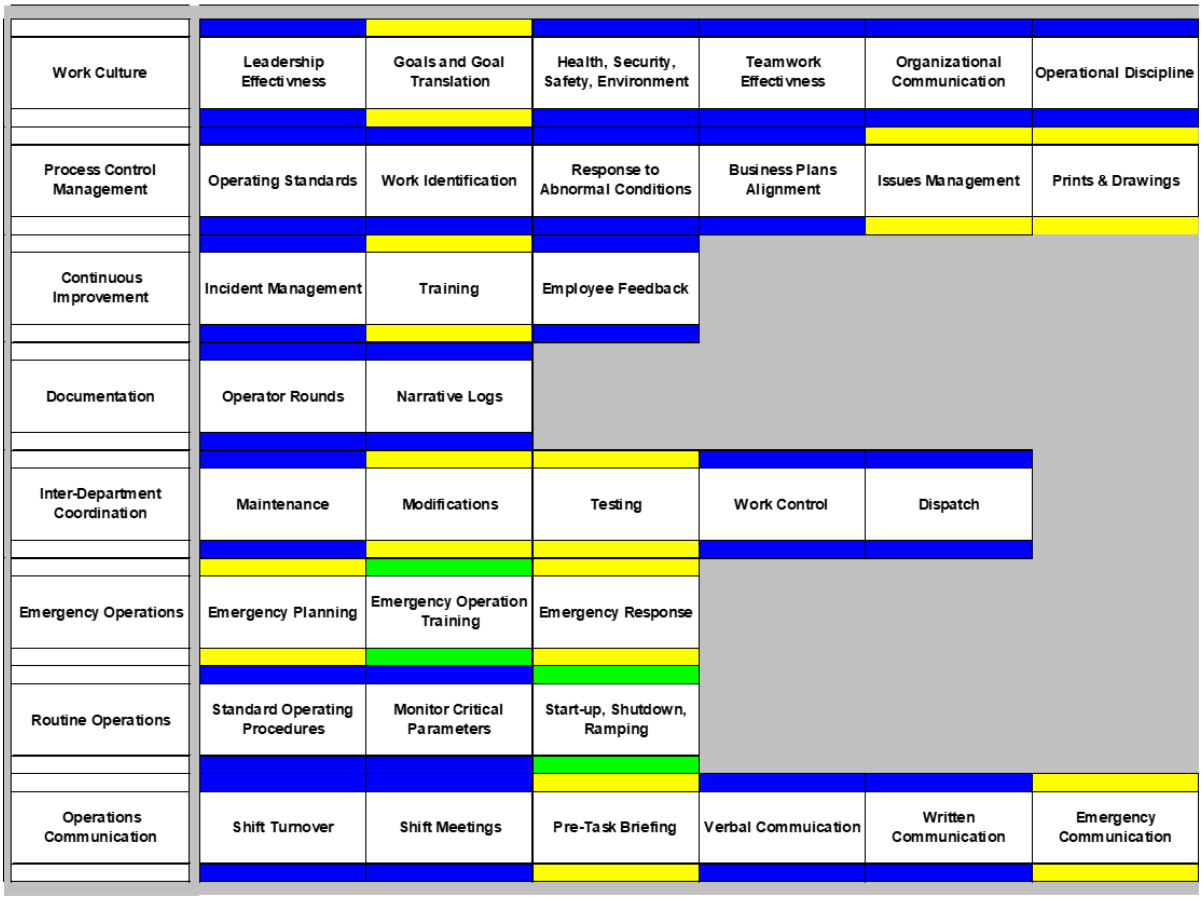

Figure 3. Site 2 Operational Excellence grid

Site 3

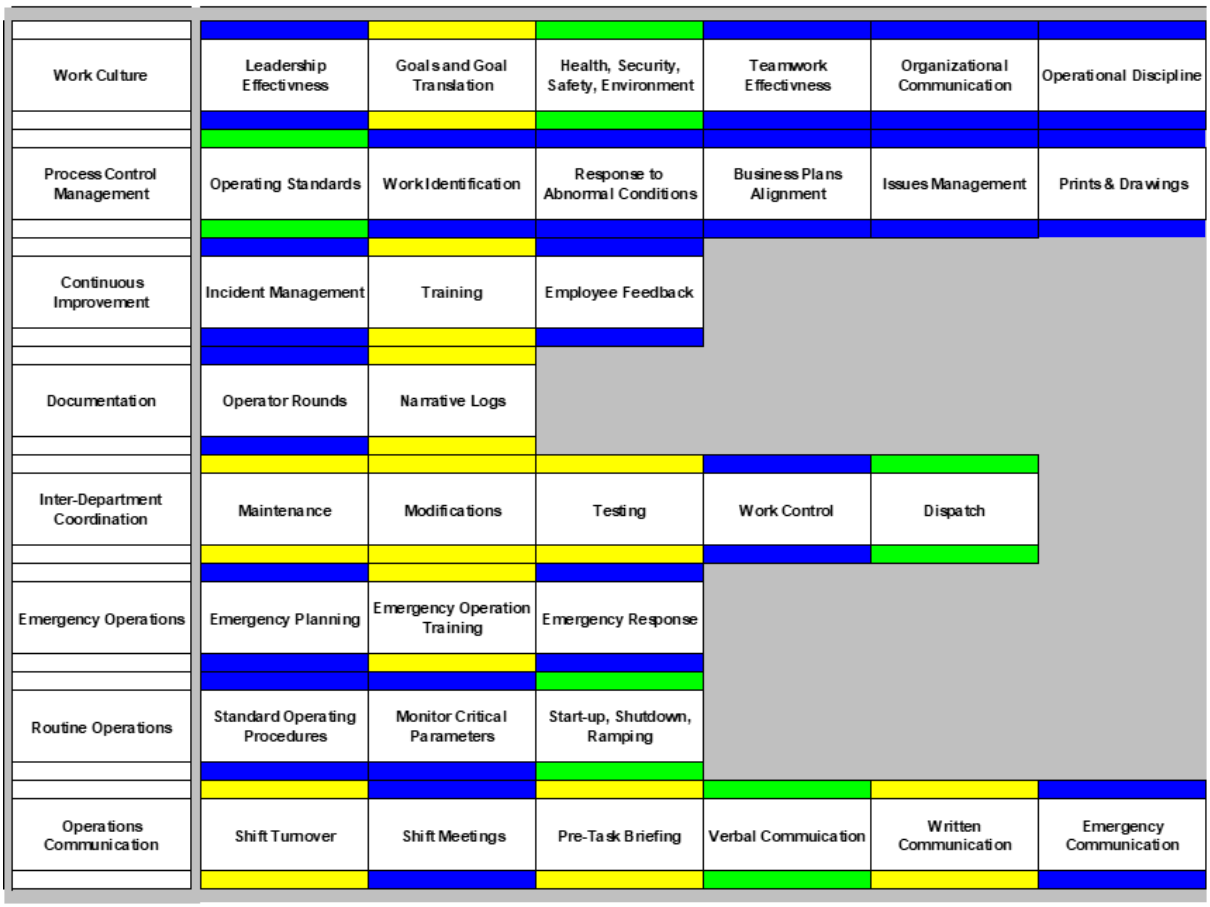

Figure 4. Site 3 Operational Excellence grid

Site 4

Figure 5. Site 4 Operational Excellence grid

Site 5

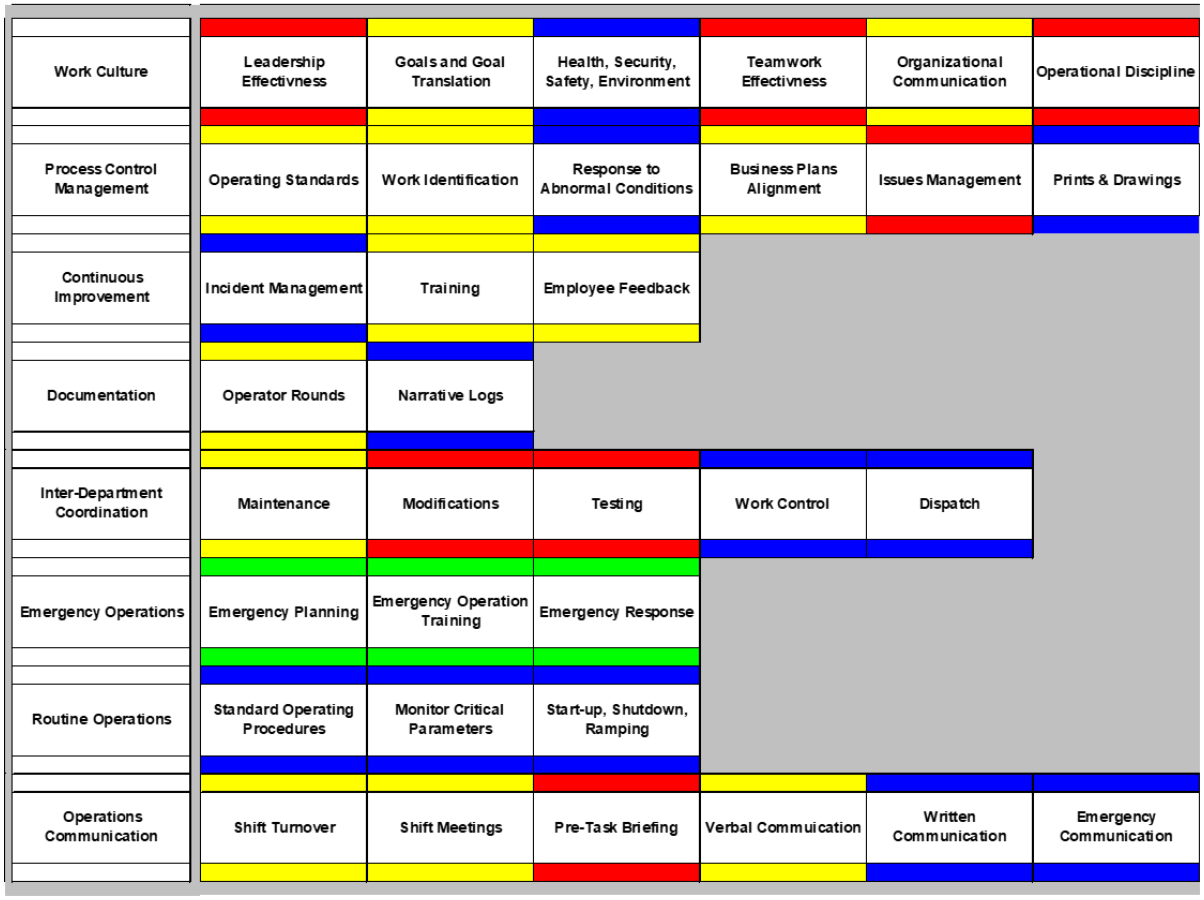

Figure 6. Site 5 Operational Excellence grid

Site 6

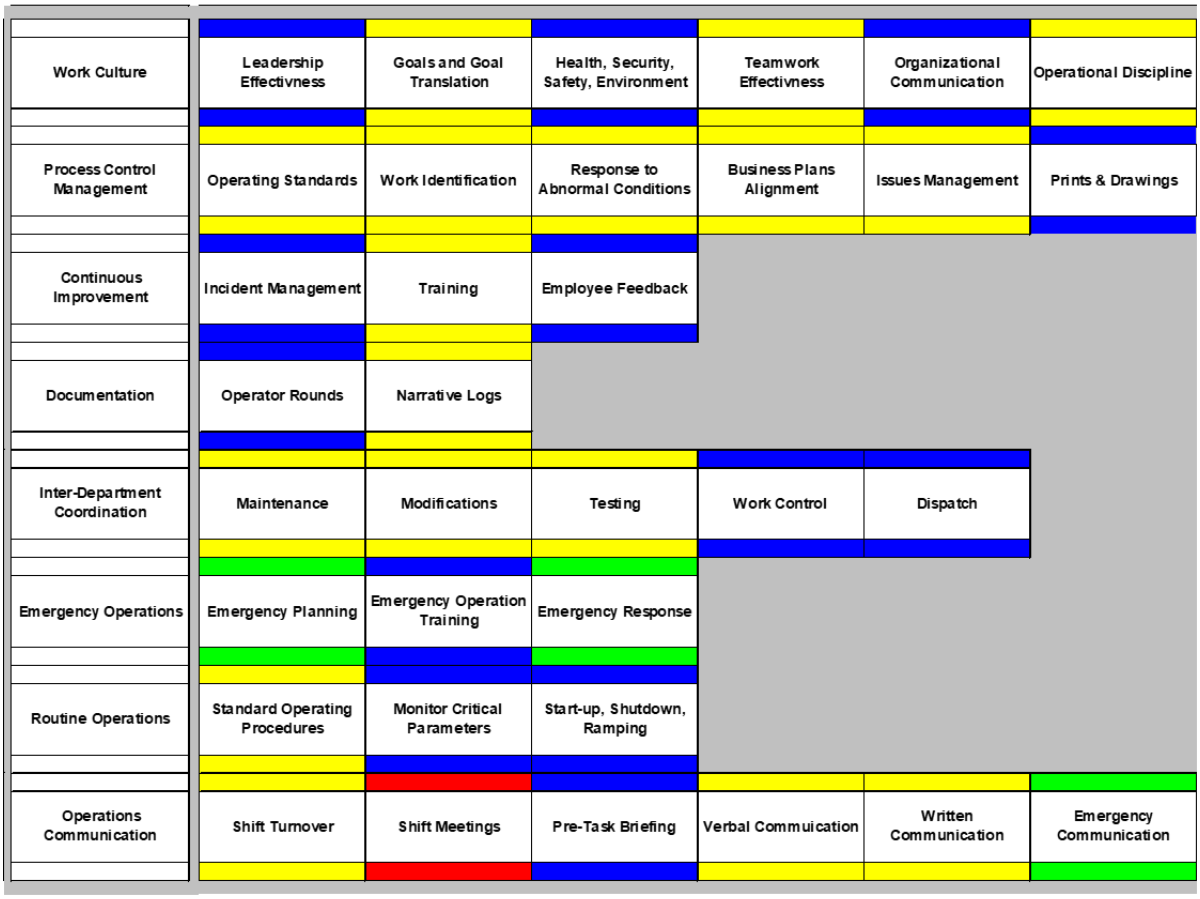

Figure 7. Site 6 Operational Excellence grid

A summary graphic was developed to illustrate the percentage of functional and fully implemented processes at each site. Refer to Figure 8.

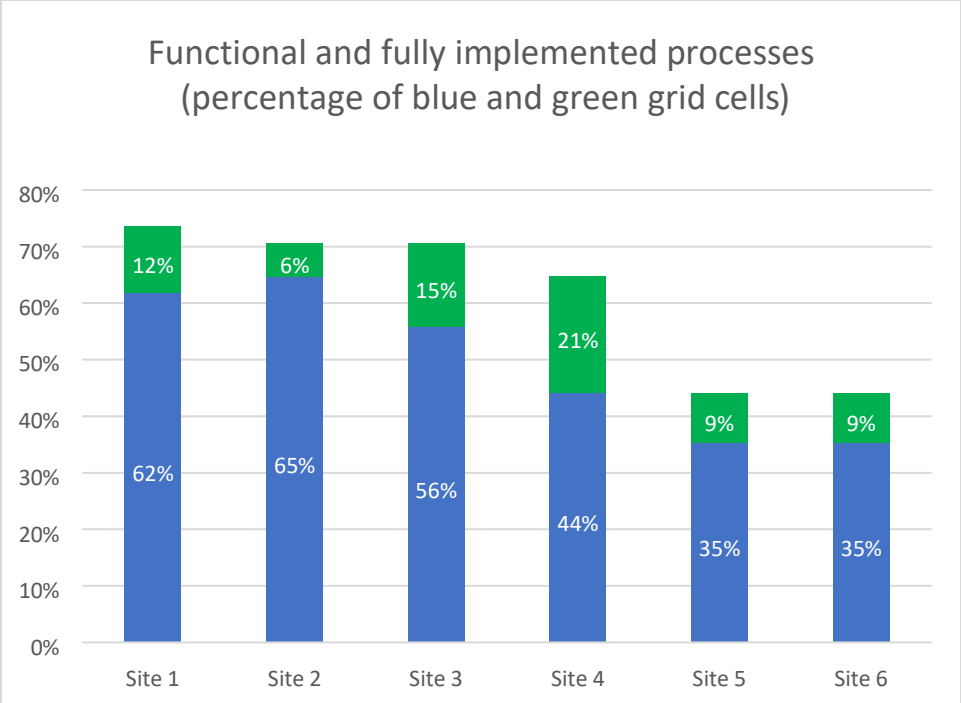

Figure 8. Functional and fully implemented processes at each site.

While the individual site grids provided a granular view of the processes at each location, a broader, overall picture was obtained by showing the "functional" and "fully implemented" processes as a percentage of all processes assessed. This showed there were improvement opportunities across all sites and that a couple of sites were at higher risk than the others.

Based on the assessments, several key recommendations were made to create a sustainable, standardized operating culture based on a uniform approach to critical operations processes:

- Develop, revise and implement Power Generation procedures and processes.
- Define overall operations excellence governance for long-term management and sustainability.

The benefits expected from implementing these recommendations were:

- Development of a process- and procedure-based culture.
- Ensuring accurate, complete information and data exchange.
- Reducing human errors to increase plant availability, lower equipment risk and improve lost opportunity.
- Sustained long-term improvement of operations practices.

Project scoping

The first step in scoping the Operational Excellence project after the assessments were completed was to clearly establish the expectations of the Power Generation executives. The following expectations were established:

- Operations standards, processes and procedures will be implemented and used at all Power Generation facilities.

- Sites would not modify operations standards, processes and procedures other than to reflect site organizations in determining roles and responsibilities; exceptions (for plant types such as hydro) to be reviewed and approved by the Operational Excellence Governance Committee.
- All previous versions will be removed; new or revised standards, processes and procedures will be implemented following change management practices.
- Standard operational excellence metrics will be used, reported and posted in each plant to ensure process use, improvement and sustainability.
- Changes to operations standards, processes and procedures will be controlled by the Operational Excellence Governance Committee.

Based on the assessment, the scope included review, revision and standardization of operating procedures in the areas of:

- Operations communications and information.
- Plant monitoring and control.
- Plant maintenance and modification.
- Operations management.

Clear roles and accountabilities were to be identified within each procedure. Metrics showing the use of procedures were to be developed and audits conducted following the implementation of the procedures. A process governing change management for all the Operational Excellence procedures was to be developed as well.

The first activity in scope was to develop the new procedures, which would be implemented in phases. Phases 1 and 2 included the sites that had been assessed. Phase 3 was planned for the remaining fleet assets.

A formal project plan was developed by the RMG project manager and approved by the project sponsor, the head of Power Generation support.

Governance

The establishment of a governance body was key to establishing and sustaining consistent fleetwide standards. As originally envisioned, the Operational Excellence Governance Committee's role was to:

- Oversee implementation of changes to Power Generation standards.
- Develop a process to identify, control and implement non-asset operational changes across the organization (processes, procedures, PMs, etc.).
- Identify and leverage "best practices."

The Governance Committee acted as the representatives of the Power Generation executives. The Governance Committee consisted of several plant managers representing a cross section of fuel types and geographies. It was chaired by the head of the support organization within Power Generation. A formal charter was put in place.

As the project progressed, additional accountabilities were given to the Governance Committee:

- Oversee operational process metrics management and review.

- Conduct regular process audits to ensure effectiveness of operational processes and procedures.

Governance Committee members met monthly and stayed engaged throughout the project. They influenced key decisions and provided guidance to the RMG project manager. Their support lent credibility to the project.

Weekly written project updates were provided to the project sponsor and a detailed discussion of the week's progress was held. Monthly written reports were provided to the project sponsor and the governance committee. Monthly update presentations were made to the operations vice presidents.

Stakeholder communications

A stakeholder analysis was completed as part of the project plan. The stakeholders included not only the operators and their leadership at the sites in the scope of the project but also other affected groups: maintenance, engineering and leadership groups at the sites in scope; the representatives of the unions at each of the sites; support personnel; and both maintenance and operations at sites not in the scope of the project. The results of this stakeholder analysis were used to identify potential risks and to form the basis for a communications plan.

The communications plan identified key messages, methods, timing and audiences. Site leaders teamed with RMG to deliver communications. An emphasis was placed on face-to-face communication over written or electronic communications. However, all available means, including electronic message boards located in all sites, were used. During the project planning, several standing forums consisting of management and hourly personnel were identified. These became important discussions as the project progressed to keep representatives of the broader organization informed and to hear concerns from the field.

Design Team

A key part of making the project successful was developing ownership by operations groups across the fleet of the revised standards and procedures. The plan was to put together a team to design these procedures that was small enough to work quickly but large enough to give a representative cross section of the affected sites. The Governance Committee and plant managers proposed a team of carefully chosen members who were respected within the organization and expected to be engaged and willing to contribute. The Design Team consisted of eight members – four hourly employees and four management. It included plant operators, equipment operators, control operators, supervisors and an operations manager. It represented both subsidiary companies that formed WEC Energy Group as well as natural gas-fired and coal-fired plants.

The logistics for the Design Team were carefully laid out. The members traveled to a location away from their normal work sites. While there were a few interruptions for each member, they were strongly encouraged to minimize them. The team worked together for three weeks, four days each week. On Friday of each week team members went back to their regular work sites and had an opportunity to discuss what they were working on with others at their sites.

The team was split in two to do the work, with RMG facilitators embedded with each team. Each half of the team worked on a procedure or standard and then presented their results to the other half. This quickly produced procedures that were simple, clear and designed for all sites to use. Accountabilities were unambiguously specified in each procedure. RMG had provided draft procedures so that the group would not start from zero. These drafts were based on industry best practices and RMG experience. It was made clear to the team, however, that nothing was off the table, and during the design process the team made substantial changes to most of the procedures.

The Governance Committee was provided drafts of the Design Team's procedures and came in to meet with the team three times during the development of the procedures. The discussions between the team and the committee were key in getting the committee's buy-in and ensuring Design Team members understood the committee members' expectations.

At the end of the three-week Design Team period, the team produced 20 procedures. Most of them were ready for Governance Committee approval. A few of the procedures required review and buy in from other groups. All the procedures were ready for implementation by the time they were needed.

Procedures

The Design Team developed 14 procedures that formed the core of the Operational Excellence system:

- **Three-way communication** – When and how three-way verbal communications are required to minimize errors.
- **Shift turnover** – Requirements for individual operator turnovers and beginning of shift meetings.
- **Procedure use** – Addresses when procedures must be present during use, use of place keepers, authority for deviations, and requirements for review.
- **Safety tailgates** – Conducting safety tailgates every shift, tailgates for frequently performed operations, and tailgates for infrequent or complicated evolutions.
- **Operator rounds** – Expectations for rounds, when rounds sheets must be used and reporting.
- **E-logs** – Guidelines for use of electronic logs, including required entries.
- **Daily orders** – Short-term (24 to72 hour) direction from the operations leader to the on-shift operations teams.
- **Standing orders** – Longer-term temporary direction from the operations leader to the unshift teams. These are often temporary workarounds. They always have criteria for termination.
- **Operator aids** – Controlling information aids posted in the plant for use by operations. These are distinct from equipment labels and signage.
- **Off-normal tests** – Requirements for operations and engineering reviews of unusual plant operations not covered in procedures.
- **Work management** – Requirements for when work should be identified and quality standards for writing the notification.

- **Operations PMs** – Process control document for routine tests and preventive maintenance performed by operators.
- **Post-maintenance testing** – Requirements for operations and maintenance working together to ensure equipment functions properly after maintenance is performed.
- **Operations process metrics** – Requirements for observations and reviews of field use of the Operational Excellence procedures in order to drive sustainment. A requirement was also established for periodic on-shift reviews of the Operational Excellence procedures.

Operations metrics and sustainability

One of the challenges given to the Design Team was to develop ways to measure the effectiveness of the new procedures. This was key to implementing a sustainable system of procedures. It was accomplished in two ways. First, for those processes that could be observed as they occurred, behavioral observation criteria were developed and added to an existing behavioral observation tool used for safety. These processes were shift turnovers, operator rounds, job briefings, use of procedures and verbal communications. Second, for those processes that would be difficult to observe as they occurred, reviews were incorporated into the procedure that specified when and by whom the procedure or documents would be reviewed. The reviewed processes were operator logs, daily orders, standing orders and work notifications.

Operations supervisors and managers were required to perform four operations process observations per month. The procedure stated the point of the observations was not to grade the operators being observed but to drive a conversation between the operator and observer about the operator's performance of the procedure. The metric derived from the observations was simply the number of observations done at each site. This metric was reviewed by the Governance Committee.

In addition to leading metrics derived from observations and reviews by supervisors, an effort was made during the project to develop a lagging metric to provide a direct measure of human performance. Actual safety, environmental and production events (including forced outages, derates and unexpected equipment failures) were evaluated and those determined to be primarily caused by human performance were added to the measurement. The events were totaled per site monthly and compared to a rolling 12-month average. A baseline was developed from the previous year and new data was tracked over a few months. After discussion of the indicator, the determination was made that it did not provide actionable information. The existing lagging metrics for safety, environmental and production results were more useful.

Implementation

There were significant differences between each site, primarily in the size of the organizations. An implementation of the Operational Excellence procedures designed for a staff of 300 would be different than one tailored to a staff of 30. The advantage with the smaller organizations was that communication was less complex. There were fewer people to keep informed and it was possible to get everyone on site together at the beginning of the day. The disadvantage for the smaller staffs was that all the accountabilities fell on fewer shoulders.

Each implementation plan was developed with a dedicated implementation team from the site. The team size ranged from one to four people. The leadership team was engaged at the outset and kept updated. The detailed implementation plan included:

- Who would receive training, and when and how it would be delivered?
- A coaching matrix defining who would receive coaching and on what topics.
- Any forms or guidelines to be developed.
- Directions on how documents would be maintained and controlled.
- Which procedures and documents would be superseded and removed?
- Communications about which changes were being made and when they would be effective.

For example, daily orders were implemented at each site, but at some they were included on the same form used for the beginning of shift meetings and at others they were issued as stand-alones. In all cases their content conformed to procedure requirements and they were approved by the operations manager, equivalent or designee.

The plan for each site was approved by the operations leader before implementation. Any deviations from the Operational Excellence procedures that the site decided to take were noted and presented to the Governance Committee with the site's justifications. The Governance Committee held the approval authority for deviations. Following the completion of the implementation at each site, an implementation report was developed and provided to site leadership and the Governance Committee to document the as-left status of the system of procedures. A punch list of open items was also provided to ensure follow-up and closeout of issues at each site.

Training and rollout

Training was conducted face-to-face with all operating teams, usually in the plant environment. Conducting training in a control room or ready room results in disruptions and distractions, but it promotes engagement and interaction. The operators are in their environment and the discussion of how things will be done in operations flows well. The training for the operators covered all the procedures and was broken into smaller time segments, typically 45 minutes to one hour. It was scheduled at a convenient time for the operators, after they were done with beginning of shift activities and rounds or right after lunch. The training included the rationale for the changes, the benefits expected for the organization and the benefit of the changes for the operators. An important step was to have the operations leader at the initial training session to present the rationale and benefits.

Training was tracked to ensure that everyone who needed it received it. The training was delivered quickly, with consultants working early and late to cover different shifts. Operations personnel on day shift were included as well. Training was also provided for affected groups: the site leadership team, maintenance leaders, engineers and project managers. The training material and attendees were customized for each site.

Communications at each site supplemented the training. Display boards provided key messages, and leaders provided communications by email, during leadership meetings, and during broader employee meetings.

Each site had an effective date for the procedures. Some of the processes were rolled out as they were ready, for example, daily and standing orders. All were functioning on the effective date, and superseded procedures, forms and guidelines were removed.

Coaching

One-on-one and small group coaching was a critically important part of the implementation. Consultants provided coaching to control operators on shift, plant operators in the plant, supervisors on and off shift, managers and directors. Coaching reinforced the training, provided an opportunity to discuss the rationale for the changes, and provided reinforcing and adjusting feedback. The objective of coaching was to drive commitment to the revised procedures and processes one person at a time. Each coaching session was tracked and evaluated. The results were used by RMG's consultants to determine where the coaching effort should be focused.

More hours were devoted to coaching than any other project activity, reflecting its importance. RMG emphasized the importance of this step based on its experience in process change. The coaching conversations provided opportunities to get feedback from the operators as well, resulting in issues quickly being identified so they could be managed. Coaching discussions led to course corrections during the implementation.

Coaching to supervisors and managers emphasized their roles in ensuring the revised procedures and processes were being performed as expected. Working with front-line supervision to ensure they were coaching operators was a key activity. The successful engagement of front-line supervisors in this activity was necessary to sustain the revised procedures and processes after the consultants were gone.

Regular updates on the progress of coaching were provided to the site leadership and the project sponsor. RMG kept individual coaching results confidential but described how well the coaching was progressing with different groups of operators. This confidentiality helped to establish the trusting relationships the consultants needed with the operators they were coaching.

Audits

Audits were conducted at each site three weeks to three months after implementation was completed. A customized audit tool was developed to produce consistent audit results; it was modified after the first audit and worked well for all of them. The audits were led by the RMG consultants but used two to four people on each audit team from other sites. This enhanced the credibility and effectiveness of the audits. It also provided valuable learnings for those who assisted in the audits.

Observations and reviews were conducted during the audit. Specific criteria were identified for each procedure. The evaluations showed whether the criteria were fully met, partly met or not met at all.

The results for all individual sites are shown in Table 1. In this table, the numbers show the total percentage of observations and reviews in which the criteria were partly or fully met. The average for these results is shown along with the percentage of best practice and functional processes from

the initial assessment. While these do not exactly overlap, they are comparable and illustrate the change effected at each site.

	Audit criteria fully and partly met					
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Three-way communication	57%	80%	100%	84%	38%	76%
Turnover	67%	100%	100%	90%	100%	100%
Procedure use	100%	86%	100%	93%	91%	86%
Safety tailgate	100%	86%	100%	76%	100%	86%
Operator rounds	100%	100%	100%	100%	100%	100%
E-log	67%	100%	100%	100%	67%	100%
Daily orders	100%	100%	100%	100%	100%	100%
Standing orders	100%	100%	97%	100%	86%	100%
Operator aids	100%	100%	98%	95%	80%	100%
Off-normal tests	0%	100%	100%	100%	100%	100%
Work management	100%	100%	95%	93%	100%	100%
Operations PMs	100%	83%	100%	100%	63%	83%
Post-maintenance testing Ops	100%	40%	62%	60%	10%	40%
process metrics	60%	100%	83%	100%	100%	100%
Average results	**82%**	**91%**	**95%**	**92%**	**81%**	**91%**
Functional and best practice processes (from assessment)	**74%**	**71%**	**71%**	**65%**	**44%**	**44%**

Table 1. Individual site audit results

A summary of audit results for all sites is shown in Table 2. In this illustration the results are fully broken out between fully met, partly met and not met at all.

	Fully Met	Partly Met	Did Not Meet
Three-way communication	67%	9%	25%
Turnover	68%	24%	8%
Procedure use	70%	25%	4%
Safety tailgate	84%	9%	8%
Operator rounds	93%	7%	0%
E-log	79%	12%	11%
Daily orders	100%	0%	0%
Standing orders	45%	55%	1%
Operator aids	87%	10%	4%
Off-normal tests	38%	63%	0%
Work management	56%	42%	2%
Operations PMs Post-maintenance testing	91%	6%	3%
Ops process metrics	15%	45%	40%
	45%	43%	11%
Average			
	67%	25%	8%

Table 2. Aggregate site audit results

Audit results for each site were reported to the site leadership and the Governance Committee. Aggregated audit results were reported to the Governance Committee. The site audit results provided insights for each site, and the aggregated results provided insights on the overall implementation results. Some processes were strongly adopted, and more work was needed on others. For example, daily orders, operator rounds, operator aids and safety tailgates followed the revised procedure a high percentage of the time. Where results were very low, such as on post maintenance testing, the result indicated the process and implementation needed to be reevaluated.

Project closeout

At the conclusion of the first two phases of the project, a report was provided, and a formal closeout held. Outstanding issues and recommended next steps were discussed. A third phase of the project, covering the remaining assets within Power Generation, was planned. While the initial implementation and audits were complete, the overall change process was not. That process was expected to continue to drive improvement. Additional audits will be conducted to verify this.

Discussion

Detailed standards for all sites vs. high-level standards that allow site-to-site variations.

As discussed in the methodology section, the decision was made to tailor implementation of high-level standards to each site rather than implement a set of detailed standards at all sites. This approach had advantages. Each site was able to develop an implementation that worked best for them. In most cases, good practices were preserved while making improvements. This approach led to higher ownership of the implementation at each site. There was a degree of autonomy while still ensuring benefits of the standardized processes would be realized. The disadvantages were that each site required development of a separate implementation and that the final set of all implementing guidelines was not as simple as it could have been. Either approach might suit an organization better. Which approach is best to take is a decision that should be based on an assessment of the changes to be made, the impacts on each of the sites affected, and the work cultures of the individual sites and of the broader organization.

Effectiveness of Design Team approach

In large organizations, development of common standards is often a painful and time-consuming task. An early challenge in the Operational Excellence project was to develop fleetwide standards quickly while still getting buy-in from stakeholders. The Design Team approach described in the methodology was able to achieve this. During a "lessons learned" review after the Design Team's work was completed, the following factors were identified as contributing to the team's success:

- Choosing team members respected within their site organization for their expertise and commitment to making improvements.
- Taking team members out of their normal work environment. Members had to attend a few meetings, but distractions were minimized.
- Choosing team members who represented a cross section of fuel types, geography and position. Management and hourly employees were balanced.
- Sticking to a structured schedule that provided enough time plus contingency to get the work done.
- Breaking work within the day into four daily sessions of 90 minutes. Total work time was limited to six hours daily to keep team members focused.
- Providing "straw dog" draft procedures at the start rather than beginning with a clean slate.
- Engaging the Governance Committee in face-to-face discussions during the process.

There were a few challenges resulting from this process:

- Procedures that involved stakeholders besides Operations had to be reviewed by those groups and any resulting changes run through the Design Team. This was an email process and subject to all the delays of a typical procedure review process.
- Stronger personalities tended to dominate the conversation in the Design Team. To try to minimize this, RMG facilitators broke the team in two and had each part of the team.

present their work to the other. The facilitators also provided one-on-one coaching to those who were dominating conversations.

Overall, the Design Team process was a major contributor to the success of the project.

Impact of the communications plan

Much of the upfront planning for the project was to develop a formal communications plan. The plan was based on the results of the stakeholder analysis. It included methods of communication, audiences, frequency and key messages.

Several aspects of the communications plan proved effective:

- The plan was written with an emphasis on recurring, face-to-face communications. These were always the most effective communications. A key part of these communications were the one-on-one and small group discussions that occurred after the formal communication session.
- The time taken to discuss the project and the coaching involved with union leaders was helpful. Throughout the project, there was no pushback at most sites on providing coaching to represented employees.
- The plan was adapted as needed. Key messages were adjusted after receiving feedback. The actual forums and audiences changed as it became clear which groups were more important to talk with. Even the best plan is not going to be exactly right, so it must be flexible.
- The most effective communications were always from site leadership, delivered face-to-face in an interactive session.

A few items stood out as opportunities for improvement in the communications plan.

- Email was generally ineffective. The plan de-emphasized email because it was known to be less effective, but still used it to convey some messages. The learning from this was that anything provided through email must go through other, more effective, channels as well.
- Electronic display boards are effective, but the messages go stale quickly. Leaving the messages up longer does not reinforce them. During the project, electronic signboard messages were posted for weeks. It would be more effective to leave them up, unchanged, for no more than a week or so.
- There was a gap in the communications during the months between the site assessments and the start of Design Team work and implementation. The decision was made by the Governance Committee to hold off on project communications during that period because they would add to many other communications related to other initiatives being done at that time. Further, the decision was made to communicate on a site-by-site basis during implementation and in selected fleetwide forums. The communications at each site were welcomed, but concern was expressed that there had been no communications since the assessment. The lesson learned was that communications can be taken out of the plan as needed, but an alternative must be developed to ensure the stakeholders are kept informed.

Overall, the communications plan was an important part of the success of the project. Considerable effort was put into it. There would have been benefits from doing even more.

Notable aspects of some of the procedures developed by the Design Team.

The procedures developed in this project are like other procedures developed in power plants and other industrial sites. There were some notable aspects to the ones developed in this project.

- A deliberate effort was made to minimize generating paper or electronic records.
    - Operators were not required to carry rounds once they were fully qualified, even though there were specific and detailed requirements for what should be accomplished and observed. The thought was that a qualified operator knows what to look at and would note abnormalities in the log or write a notification.
    - Readings were not taken by hand except when required for regulatory compliance. The rationale was that data systems existed to capture readings. ○ Likewise, operators were not required to write up a turnover sheet but were encouraged to use their shiftly electronic log entry during turnover.
    - Each operator was required to write a shift summary log. However, items were logged by exception. It was not intended to be a narrative of routine activities or events that were captured by data historians.

- A high degree of reliance was placed on the knowledge and judgement of fully qualified operators.
    - Operators were given the authority to change the order of procedure steps or mark steps as not applicable. This could only be done with the concurrence of the lead operator on shift. The reason had to be noted and management informed after the fact.
    - Operators made the decision of when to conduct a verbal pre-job brief and when a more formal, documented pre-job review was required. The criteria were specified in the procedure, and it was up to the operator to choose the right type.

These procedures empowered the operators. However, placing so much reliance explicitly on their knowledge and judgement can create risk. The observations and reviews required by the process metric procedure provided assurance that risk is minimized.

Solving the communications challenge

Feedback from operations personnel and audit results both showed the daily orders were fully adopted at all sites. The daily orders provided a clear channel of communications from the operations off-shift leader to the on-shift leader. If other groups requested support from operations, it had to be included in the daily orders. If other important information had to be passed along to the on-shift team, it went into the daily orders. The form and format of the daily orders was not the same at every site, but all had similar content – direction for the next 24 to 72 hours and information important to the on-shift operators. Equally important was the dramatic reduction in

"operating by email." By creating one authoritative source of direction and information, and ensuring it went from the leader of the off-shift organization to the leader of the on-shift team, communications were meaningfully simplified.

Standing orders provided another important piece of the solution to the communications challenge. They served several purposes. First, they ensured that the operations manager (or equivalent) approved a persistent work-around or unusual direction. Second, they served to keep operators from forgetting these workarounds and unusual conditions, a common occurrence when operating by email. Finally, the standing orders all had specific termination criteria, and were reviewed periodically to ensure the underlying condition is addressed.

The daily orders and standing orders were complemented by the shift meeting summary each on shift leader prepared for the next shift. This was the third major piece of the solution to the communications puzzle. This written summary, along with the daily orders, and changes to the standing orders, were intended to provide an oncoming on-shift leader all the direction and critical information needed for the next shift.

Electronic logs – a communications multiplier

To the maximum extent possible, the Operational Excellence procedures called for required documentation to be put into the electronic log system. The advantage of the e-log is that it can be written once and read immediately, many times, and from essentially anyplace. Just as there is a trend toward consolidating maintenance and reliability information from many systems into a consolidated database, so e-logs can become the repository of most operations information. Some of the implementations of the Operational Excellence procedures were innovative in this respect, putting the daily orders, shift meeting summaries and other documents directly into the e-logs.

The effectiveness of training and coaching in bringing about change.

One of the benefits expected from the Operational Excellence project was the development of a process- and procedure-based culture. This benefit relates directly to the operational challenges of deciding how things get done and ensuring that procedures are followed. In a process- and procedure-based culture, it is a given that processes and procedures will be followed, and that there are established methods for how things are done.

The method by which the transformation to a process- and procedure-based culture was to take place in this project consisted of many elements: The Design Team process, the Governance Committee's role, deliberate and targeted communications, built-in sustainment activities (observations, reviews and on-shift refresher training), audits, and training and coaching during the implementation.

As discussed in the methodology, training and coaching made up most of the actual work hours in the project. Several observations were made on the effectiveness of training and coaching:

- Providing training in small pieces, in the operators' environment, resulted in a high level of engagement. Sessions in control rooms and ready rooms, despite distractions, went better than sessions in the classroom.
- Where leaders were present and engaged, the training was more effective as evidenced by engagement of the trainees. This was especially so when the leader present was the operations manager or equivalent. The operations manager at the site that showed the most overall improvement from the assessment to the audit was present for *all* the training sessions and engaged in conversations about the implementation with plant operators daily.
- Training alone was not sufficient to ensure that operators had a good grasp of the revised procedures. One-on-one coaching included discussions that were like tutoring and helped reinforce the knowledge of the procedure.
- Almost all individuals were open to coaching. Some individuals were concerned until the consultants sat down with them and discussed the method and intent of coaching. Having discussed field coaching with union representatives helped allay concerns.
- Each individual was coached and observed multiple times for each process. The effectiveness of the coaching appeared to depend on several factors:
    - The engagement of the operations manager with the on-shift team, encouraging them to learn and make use of the new procedures.
    - The same with the on-shift leader (most often a supervisor). When supervisors provided feedback, behaviors always changed.
    - Peer pressure.
    - Individual motivation and distractions, but these were less than the impact of leader engagement.
- There was a point of diminishing returns noted in coaching. All operators benefited from the first coaching session. Most benefited from the second. Where needed (based on the observations from the previous coaching sessions) a third and fourth session were held. However, any further efforts were met with resistance. Once the individual understood the procedure and expectations, further coaching was not productive.
- Although the Operational Excellence procedures primarily concerned operations, training was provided to other affected groups at each site. The site leadership team was trained in each procedure. Engineers, project managers and maintenance supervisors also were trained on procedures applicable to them. During the lessons learned review of implementations, it was identified that some training should have been given to all site personnel to help them understand how the changes in operations could affect them.

The challenge of three-way communication

The aggregate audit results showed that the percentage of "criteria not met at all" for three-way communication was the highest of all commonly used and observed procedures. Operators use verbal communications many times daily to provide direction and plant information, but the commitment to this standard at most of the sites was low.

The purpose for requiring three-way communication was to reduce communication errors that could lead to significant hazards. All the operators recognized the usefulness of three-way communication

for critical operations. The rationale for requiring it during all plant operations was because it is not always evident when a communication is critical. Rather than putting the burden of deciding whether the communication is critical on the originator of the message, each verbal communication of plant direction or information was required to be delivered with a repeat-back and final acknowledgement. The Design Team incorporated this approach into the procedure and the Governance Committee approved it.

However, many operations leaders did not agree with the value of three-way communication for all plant communications and they did not make enforcement of the 100 percent adherence to three-way communication a priority. This was discussed with the Governance Committee during the project, and the decision was made to uphold the standard. The lesson learned is that it takes more than leadership endorsement to drive change. It takes active involvement and enforcement of expectations that the standard will be met.

The importance of the Governance Committee

One of the key recommendations made following the assessment was to define overall Operational Excellence governance for long-term management and sustainability. As discussed in the methodology, the Governance Committee was chartered, and members assigned. The Governance Committee quickly took a key role in the project.

The amount of time required of the asset leaders for involvement on the committee was modest – a few hours per month. However, the influence they had on the success of the project was substantial. Having the Governance Committee as a body to discuss issues, make decisions and provide guidance allowed for needed adjustments to the project and procedures to be made quickly.

During the development and early implementation phases of the project, the Governance Committee functioned as a steering committee for the project. After procedures became effective, the committees' function shifted to sustaining the Operational Excellence system of procedures. They monitored monthly process metrics, approved exceptions to procedures and reviewed audit results. When RMG completed its work on the project, the ongoing maintenance of the Governance Committee was taken over by Power Generation management. This strong development and sustainment of the Governance Committee is the single most important factor in the long-term sustainment of Operational Excellence.

Other complications during implementation

As with any large project, additional complications arose during the project that had to be managed. A few of these provided notable learnings:

- Concurrent initiatives added to the resistance to change. As described earlier, this project was one of several initiatives that were in progress to drive performance in Power Generation. It was common to receive feedback during communication sessions that this was simply one more initiative. The implication of this comment was that there was a capacity for change in the organization and that the Operational Excellence project was

more than could be managed. Several actions were taken in response to this. The project plans were re-evaluated to ensure each site's organization would have the capacity to manage the implementation. Also, the key messages were reformulated to emphasize the benefits the operators should realize from the revised procedures ("what's in it for me"). The lesson learned from this is that the organization's capacity to manage change must be considered as part of the stakeholder analysis in project planning.

- The Design Team's electronic log procedure was rolled out at the same time as a new e-log system. Like all large software implementations, there were some problems with the new system. This made the implementation of the new e-log procedure more difficult. Training sessions often turned into discussions of the problems with the software. Finding workarounds to the problems became as much a focus of implementation as developing templates and guidelines for use. The lesson learned from this is to avoid rolling the new tool and the new procedure out simultaneously if possible.

Sustainment plan

The plan to sustain Operational Excellence at Power Generation consists of a few simple elements:

- The Governance Committee's ongoing engagement is critical.
- The observations and reviews required of every supervisor and operations manager will drive one-on-one discussions about Operational Excellence between operators and their leaders.
- On-shift leaders are required to review four of the Operational Excellence procedures over the course of four weeks on shift. These short discussions are based on prepared messages provided to the leaders about the intent and details of the procedures. This recurrent training will ensure a high level of familiarity with the procedure requirements for all operators on shift.
- Audits will be conducted annually. Audits ensure the procedures are still effective at each site and provide important feedback for continuous improvement.

In addition to these core elements, the Governance Committee has considered other sustainment activities, such as formal annual training on portions of the Operational Excellence procedure and peer observations.

Conclusions

Several key conclusions were drawn from the assessment, planning and execution of the Operational Excellence project:

- The overall conclusion is that how business is done in operations can be addressed, standardized and improved. A process- and procedure-based culture can be developed.
- A well-planned and executed implementation is the first step. Treat process changes as projects.
- The site operations manager (or equivalent) must be closely engaged and visibly lead the implementation. This is the most important driver of success.

- The key to sustainment is a well-defined and active governance body.
- The procedures must be useable and useful to the operators. It is difficult to standardize processes across different sites and even different crews on the same site. It is impossible without simple, clear, useable procedures.
- The combination of training and one-on-one coaching is effective. Buy-in and participation by front-line supervisors are necessary to make the changes stick.
- Changes to operations affect everyone on site. Communications and training must reach all affected stakeholders.
- Finally, implementation of fundamental changes in operations processes is not a 90-day effort. Sustainment activities must become routine and management commitment to upholding the revised standards must be maintained.