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TRANSFORMING THE DUKE POWER WORK CONTROL PROCESS

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The Case for Change at Duke Power Company

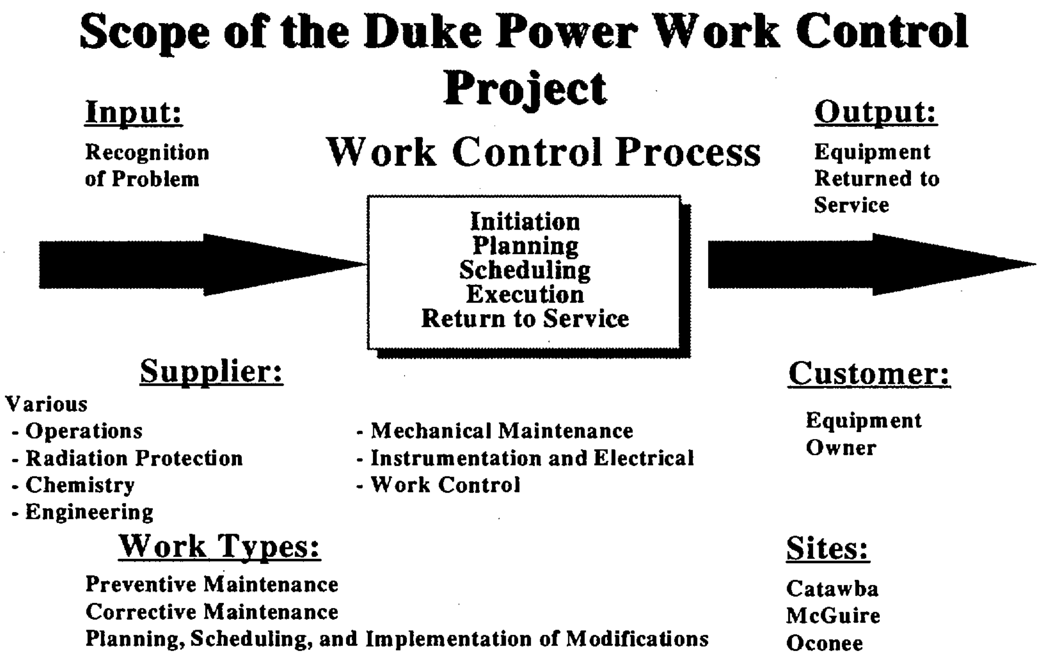
Duke Power Company, an investor owned electric utility headquartered in Charlotte, North Carolina, supplies electricity to more than 1.7 million residential, commercial and industrial customers in a 20,000-square-mile service area in North Carolina and South Carolina. Founded over 90 years ago, the company is one of the largest investor-owned electric utilities in the U.S. as measured by kilowatt-hour sales. Duke Power operates seven nuclear units on three separate sites, generating approximately 60% of the utility's electric load. The three sites are the Oconee Nuclear Station with three B&W Pressurized Water Reactors, the McGuire Nuclear Station with two Westinghouse Pressurized Water Reactors, and the Catawba Nuclear Station with two Westinghouse Pressurized Water Reactors. Duke Power played a relatively unique role in its nuclear program as the company served as the designer, constructor and operator of all of these units. With the skills and expertise available, the company not only continues to operate the plants, but supplies internally a significant portion of the skilled labor necessary to perform refueling outages for the units.

Through good management practices and good fortune, Duke was able to bring the nuclear units on line at costs significantly below average comparable units of their vintage. Although this has enabled the company to be competitive when compared with other utilities of the region, Duke management, in a 1992 study, realized the labor component for Duke nuclear operating and maintenance (O&M) costs appeared higher than some of the better performing plants. In addition, performance of the units, although good by 1992 standards, did not measure up to the best plants.

Beginning in 1991, Duke management had undertaken a programmatic approach to quality improvement throughout the corporation. This approach, termed Managing for Excellence, called on the various levels of management throughout the company to review their areas of operation and develop quality initiatives that would move the company forward on its strategic plan. In the Nuclear Generation Department, the strategic plan, formulated as a part of the overall strategic plan for Duke Power, focuses on three elements. These are plant capacity factor, O&M cost and a quality measure based on the evaluations of two key reviewers of the program, the Institute of Nuclear Power Operations (INPO) and the U. S. Nuclear Regulatory Commission (USNRC). In examining data comparing peer unit operations with Duke unit operation, department senior management, organized as a quality steering team (QST), determined that a project to improve the work control process would do the most to further the strategic goals of the department. At the time of this decision, the boundaries of such a process and the methodology for project implementation were not entirely clear. Duke, as a designer and builder, had clear ideas on how projects to construct power plants or perform plant modifications were developed. The definition of a project aimed at changes to human processes required iterative amendment to allow the project to be well managed and successful.

Project Scope and Description

The QST decided to define the work control process as shown in the following figure:



This definition of the process has helped focus the view of the department while accomplishing the process change. It is the highest level of work process flow, with the customer supplier relationship, work types and locations displayed. The work types include outage and non-outage maintenance and modifications. Equally important to the figure is what is not included. For instance, while the planning, scheduling and implementation of modifications is included, the design of those modifications, approval for performing the modifications and budgeting for those modifications is not part of the chosen scope. While the engineering area is impacted by the scope as defined (particularly in the modification area), it is not the major driver for this effort. The effort is primarily aimed at making the maintenance worker more effective in maintaining plant equipment.

In charging the team to move ahead, the QST established some high level objectives for the project team. The project objectives were:

- Do More Work with Improved Process Using Fewer Resources
- Enhance Quality of Work Package Delivered to Craft
- Improve Coordination Between Station Work Groups
- Simplify Documentation Requirements
- Increase Effectiveness and Utilization of Station Personnel
- Consistent Implementation Between Sites
- Reengineer the Work Control Process
    - Fundamental rethinking
    - Dramatic quality improvements
    - Dramatic reduction in inefficiencies

These objectives were developed in response to the perception of the state of work control as it existed at the three sites. The processes in use were highly resource intensive. Many personnel were involved with each work order. A planning package was required for all plant equipment work requests. The resulting work package was extensive, but might have little information of use to the crew actually performing the work. In many cases, the planner and crew attempting to plan and perform the work found that the initial problem statement was insufficient to enable them to proceed without extra work site visits. Coordination of activities was difficult. In many cases work was completed in spite of the process rather than because of it. Schedules for work were prepared, but were not credible due to items which routinely broke schedule and difficulties in coordination between work groups. There were some instances where multiple schedules existed, complicating work coordination.

With the multiple sites and available internal resources, Duke Power has developed a capability to move maintenance workers from its Electric System Support Department among the three sites to support the site outages. This has minimized the need for external outside contractors for outages. The lack of consistent work control process for the three sites caused confusion among these workers as they moved from site to site. In addition to these difficulties, the perception among the equipment owners was that plant equipment with even minor problems took too long to be repaired. Equipment problems identified on operator rounds remained uncorrected for weeks or months when that problem did not have sufficient priority to be placed on a work list. Personnel who wanted problems fixed quickly raised the priority on items so they would be added to the work list. The effect clogged the system with many items which did not warrant the priority indicated.

Challenges for the Project

Several major challenges existed for the project. The work control processes in place at the three sites were developed over many years. Very skilled, intelligent personnel had not deliberately made the processes complicated and inefficient. In many cases, the features of the process were placed there in response to perceptions on how to respond to USNRC or INPO criticism. Each site had its own set of directives to control the process, although these were embedded in other directives which obscured their purpose. In many cases individual groups at each site also had other directives. With views of the process that were limited to their individual group function, there was a resulting group function optimization. However in some cased this optimization of a particular limited functional area caused suboptimization of the process as a whole.

Nuclear & Personnel Safety

One paramount concern at the forefront of any change to a process as important and extensive as the work control process is the issue of nuclear safety. The project team and the management sponsors were clearly directed prior to beginning any changes resulting from the project that no compromise to plant safety was allowed. The process change, including the transition time, was required to cause no challenges to safety. Personnel safety concerns were also considered in planning of the project. The company had embarked on a campaign to eliminate employee safety incidents from the workplace and elements of the work planning were directly impacted by this focus.

Employee Involvement

One key element to success of a major change in a human process such as the nuclear work control process is the involvement and support of all employees. Jobs which have been performed by personnel for many years are impacted by the change to a new and different process. The project team was challenged to capture the collective thinking of the thousands of employees who worked in the process and to use this to help focus the changes to produce a high quality, efficient, new work control process.

Nuclear Capacity Factors

When the project began in September 1992, one of the requirements of the sponsoring executives was that nuclear plant capacity factors remain stable. Lifetime capacity factors for the three nuclear plants were in the range of 68-74%. However, with hard work, a good focus on equipment problem resolution and a mature operating staff in place, recent history for the system showed capacity factors near 80%. Because of this improvement, one key driver for the project team was to cause no reduction in the capacity factor of the nuclear system.

O&M Cost Reductions

As mentioned previously, the corporate strategic plan demanded significant O&M cost reductions from the nuclear program. On beginning the Work Control Project, none of the executives had quantitative information on what such a project would allow as cost reduction. It was clear, however, that non-fuel O&M costs were driven by labor costs. Approximately 70% of the non-fuel O&M costs were directly attributable to labor costs. A project to make processes more efficient should have direct results on these costs, but only if the efficiencies gained were actually captured by removing excess labor from the process. The executives had grown skeptical of projects justified only on labor savings, because much of this "saved" labor was reabsorbed into other tasks. Therefore, a strategy to withdraw excess labor due to the project's success was also formulated.

Project Scope Definition

The project scope as defined by the figure on page 2 did not emerge full blown as a major change project. The work was very much a step function with executive management understanding, control and endorsement. Quantitative cost/benefit analyses were a fundamental step in gaining this endorsement.

Project Phases

The project advanced through a series of phases. Each had its own particular objectives, with the overall objective being a major leap forward in the efficiency and effectiveness of the work control process.

Phase I--Feasibility & Planning

The initial phase of the project was launched in September 1992, with the naming of a project manager. Initial core team staffing was in place in October 1992 and this team of approximately 16 people were together until mid-December 1992, when their final report was presented to the QST. The team included personnel from each of the three sites, the nuclear general office and the electric system support department. Helping guide the team through this initial project phase were consultants from Ernst & Young's management consulting service. The areas explored by this team included:

High Level Assessment

The assessment of the existing process consisted of interviews with many key personnel in the process at the three sites. These personnel were asked a structured series of questions to determine the true issues with the process. Information was also gathered on activity levels, volumes and functional groups performing the activities.

Benchmarking

Benchmarking was performed both on industry leaders and on industries having similar characteristics. The characteristics of similar industries included industries where large numbers of people, tasks and work types were scheduled and where quality and timeliness were critical. This subteam did not concentrate on raw numbers, but on best practices from these benchmarking partners.

Technology Assessment

Technology assessment was performed both during the benchmarking and independently to determine process enabling technology which could potentially be deployed. The team also considered the state of technology that existed in the company. An early decision of the project team concerned the electronic work management tool. Duke Power had just completed implementation of an electronic work management tool at all nuclear and fossil sites. While the team found shortcomings in the implementation, the tool was seen as reliable and was viewed as a definite part of the future work control process.

Future Process Design

The project team, using the information from benchmarking and knowledge of the existing process, proceeded with high level design of a new work control process. This design developed the subprocess level, that below the overall process level. Due to the care required, the team recommended that before proceeding with any implementation, a carefully constructed process design phase be undertaken. The team also struggled with matching of the organization to the new design. They recognized that organizational design would need to be considered carefully during the design phase to allow the new process to properly function.

Risk Assessment

The project team brought the risk of implementation to the executives. These risks included not only the need to carefully construct the process design to avoid incident, but also the risks inherent in moving into a large change project with the existing organizational culture. These risks were not always obvious. Organizational restructuring was, and continues to be, a methodology used to address apparently malfunctioning or inefficient organizations. The team recognized that the "obvious" solution of restructuring needed guidance from a well designed process. Thus the team emphasized that any organization restructure must be thought through with the major process as a benefactor. Another risk concerned past failures to implement large change initiatives. In many cases project teams had developed lists of recommendations, handed in a three ring binder, received thanks for their good work and walked away; leaving the binder to gather dust while only parts of the project were fully implemented. The Phase I project team recognized that there was a case for action and their report did not in itself represent that action.

Cost/Benefit Analysis and Management Approval

One difference in the Work Control Project and other less successful projects which preceded it was a strong tie to executive management. In keeping with the needs of the project sponsors, detailed project cost benefit projections were produced for the project. In essence, the costs defined the next steps in the project. The business case, even given the gross assumptions of the initial feasibility phase, was overwhelming. Executive management felt the compelling need to move forward with the project to meet the needs expressed to them by the corporate strategic plan.

Phase II--Detailed Analysis and Design

The detailed analysis and design phase of the project was launched in January 1993. Personnel from all three of the nuclear sites, the nuclear general office, the information technology department and the electric system support department were named to the core team. A management consulting firm, Ernst and Young, was made part of the team to participate and help guide the team through the reengineering process. The team worked at the Oconee Nuclear Station from January 1993 to July 1993. To insure that the process was applicable at all sites, portions of the process mapping exercises were also completed at the Catawba Nuclear Station, from July through September, and McGuire Nuclear Station, from October through November. During this phase of the project, extensive communications efforts were planned and implemented to keep all potentially affected personnel informed of project purpose and developments.

Assessment of State of the Process

The assessment of the state of the process was termed "current state mapping." The process used involved facilitated sessions with personnel who worked in the process. The project team took care to bring in personnel who were generally informal leaders in their areas. The sessions were designed to walk through the process by gleaning information from personnel who were internal customers and suppliers to each other in the process. Once the outline of the process was mapped, estimates of the time to perform each of the activities were provided. Not only did this have the effect of exacting useful information, it also provided a pathway for information to those who might be affected by the changes to the process. This helped create significant buy-in for the project.

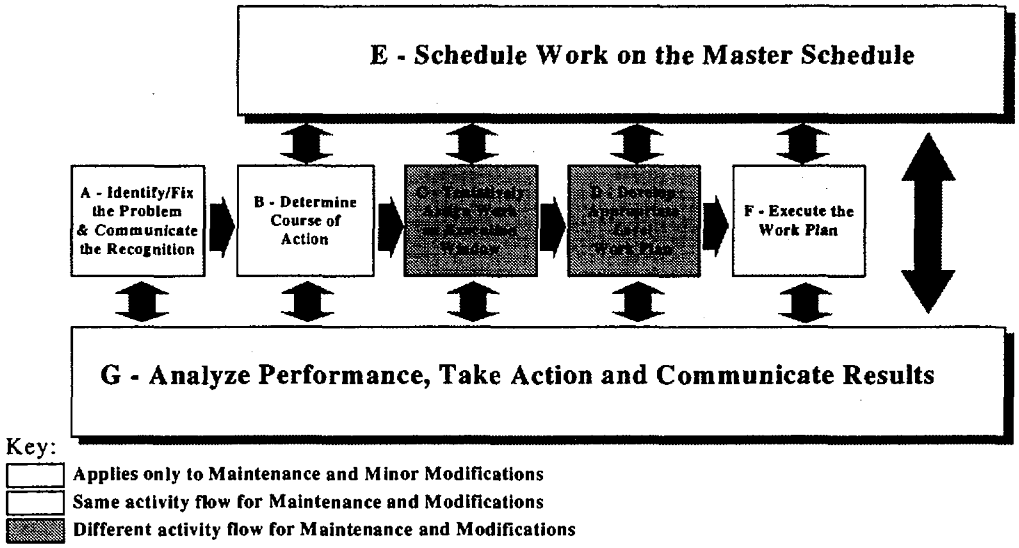
Technology Assessment

Concurrent with the current state mapping, detailed assessment of the technology enablers and information technology infrastructure was performed. Assessments were made of the feasibility of the enablers discovered during Phase I and new applications were also reviewed. Designs for infrastructure changes necessary to provide for the higher probability technology enablers were also considered. The major change to the human process could also require major changes to infrastructure. Major shortcomings were found in the handling and use of data concerning plant equipment. Data ownership and cleanup were discussed as topics under the technology assessment area. Also discussed were other enablers such as on line procedures and drawings. The ultimate vision for the process was information technology intensive. Several of the items related to the ultimate vision were discarded by the technology subteam at this stage. They either had little basis in reality or had no chance of being cost effective. Additionally, the length of total implementation was a concern. The technology subteam purposely limited the vision of new technology to that which could be implemented in a two year time frame.

Process Design

The detailed process design drew additional people from the three sites to supplement the core Phase II project team. In facilitated sessions, the process design subteam mapped the process, subprocess by subprocess. Each step of the process was detailed, questioned and redetailed. Once the entire process was mapped the subteam refined each activity and detailed a list of attributes for each of the activities. On completion of this step, the time for each of the activities was estimated by personnel knowledgeable in the type of work being performed. A high level view of the final process, with the subprocesses in time perspective is shown in the following figure.

New Work Control Subprocess Flow



Organization Design

Design of the organization was heavily influenced by the managers of the three nuclear stations. These individuals were highly experienced in the workings of the station and the interactions with the regulators. While the higher levels of the organization were defined during phase II, the actual definition of the first and second level management requirements were deferred to the implementation phase. The process definition also described several roles to implement functions in the activity level process design. During phase II of the project, the definition and decisions on multiskill teams were made. Sessions were held with knowledgeable individuals to define which areas would benefit from eliminating coordination difficulties with multiple hand-offs between teams of differing craft disciplines. While many areas appeared to be candidates, at the task level the areas where a multiskilled/multidiscipline approach were most feasible were reduced to six. These areas represented job functions where the natural unit of work revolved not around a craft discipline, but around maintenance for a particular type of equipment or plant function. The detailed organization design to implement these multiskilled teams was left to the implementation phase.

Projects Design

The project team had described an end point and had mapped various enablers and organizational features to help the process achieve its intended result. The question then remained as to how to move the organization from its existing state to that envisioned by the project team. The method chosen was an array of individual projects. The projects were interdependent with each other and with other ongoing initiatives within the company. Each was designed to move the overall project forward toward the ultimate vision for the process.

With feedback from the executive sponsors, the implementation projects were oriented toward putting the new process and its organization in place with only minor changes to technology. Then, as personnel became more accustomed to operating in the new process, technology changes were to be introduced as they could be delivered. Each project had a written charter and set of deliverables. Within the charter, the cost of implementation was estimated in standard format, with definition of the types of individuals needed to make the project successful. Portions of the benefits that would be accrued when the new process was in place were allocated to each of the projects. Some of the projects, especially those dealing with infrastructure, showed no positive benefit when taken individually, but were necessary to enable the entire project benefit to be achieved. Twenty discrete projects were formulated.

Cost/Benefit Analysis and Management Approval

Economic benefits of the project were primarily related to reductions in workforce as defined in full time equivalents (FTEs). There were also some cost savings associated with computer software tool changeouts due to license costs. The cost savings as well as the cost from each of the individual projects were analyzed using a net present value analysis that invoked the standard Duke Power methodology for project cost/benefit analysis and approval. A period of seven years was chosen for the analysis model. This was viewed as a reasonable time to implement the project (approximately two years), and live with the results (approximately five years), and also let the full capital costs of all equipment not only be considered once, but also allow for a replacement cycle. The net present value of accomplishing the project was conservatively estimated at $88 million. This analysis, the scopes of all individual projects and a proposed schedule was presented to and approved by the executive management of the Duke nuclear generation department in July 1993. This approval officially started the implementation phase of the project, Phase III. The initial projects of Phase III were simultaneously at all stations. It should be noted that this phase did overlap with the ongoing assessments of Phase II at the Catawba and McGuire stations.

Phase III--Implementation of Projects

Planning for the initial implementation of the work control project began in July 1993 with initial team staffing in September. As with Phase I and II, personnel were assigned to the project on a full time basis. Due to the fact that many of the initial projects had common elements, the projects were co-located and were given focus by a core team including the overall project director. Implementation of the initial projects, which were focused around work control subprocesses, was targeted at a window in early 1994 which coincided with a time during which none of the nuclear stations were scheduled to conduct a refueling outage.

Process Documentation

The quality program for nuclear power requires that processes and procedures for control of all phases of operation of nuclear power plants be documented and that this documentation be followed consistently. Over the years of operation of the Duke Power nuclear stations, significant quantities of documentation which affected the work control process had been written and implemented. A common element of the initial projects was to determine where all this documentation was located, how it should be changed to eliminate its control of the process and to perform this revision to the individual station documentation.

Simultaneously, a work process manual (WPM) was compiled. The manual was constructed to provide control of the work control process for all sites. Final approval and the effective date of the WPM sections were coordinated to coincide with the implementation of the initial process changes at each site. Due to varying conditions at each site, site specific implementation planning required temporary documentation be included on a site specific basis to control the differences in each sites process. These temporary documents were phased out as the implementation of various elements of the process were completed. The department now performs the work control process from a common work process manual.

Organization Design & Staffing

Organizational design and staffing were also common features of the initial projects. Project teams, in close coordination with the applicable management, designed the detailed organization, defining roles and responsibilities for all management roles below that of the superintendent level, determining staffing levels and types of personnel needed to fill the roles defined. Several new position types were evaluated to determine their proper salary structure versus responsibility. Management approved the organization through a series of interactive meetings and, during the two month period prior to initiating the new process, selected specific individuals to fill the positions for the organization. Through the projects' efforts, the organization of each of the three nuclear stations became consistent.

Training Development & Delivery

A large effort of the initial projects concerned the need to train individuals to perform their jobs in the new process and educate all site employees in how the process worked for them. Detailed training plans were prepared and instructors worked closely with the project teams actually detailing the process and preparing written documentation. All site employees within the work control process were given a one day course in how the process was to operate. Areas which only interacted with the work control process were given a shorter overview training. Areas which were newly designed required specific training for their workers in how they were to function. In total, over 4,000 personnel were trained in order to implement the new process.

Change Management

Change management received specific attention in the implementation of the new process. All management received specific instruction regarding the types of reactions such a massive change would elicit. Communications were planned and carried out to inform all personnel of the changes that would take place. Interaction of the project team with executive and line management was planned and carried out to enable management buy-in to the changes and solicit management input to the project outcomes.

Technology Changes for Initial Implementation

Prior to the establishment of the work control project, Duke Power had implemented an electronic work management system. In large part, this system did not require extensive modification to enable the process to be implemented initially. Several features were needed and the software was changed to accommodate the process. The key feature for initial implementation was the programming of a screen to allow simple entry of corrective problems. Other features were changed later to allow the implementation of the new scheduling tool. In some cases existing tables in the software were reformatted to allow data to be collected consistently. Measures for the work process were developed and agreed upon by the project team and site management. These measures were set up to be extracted from the work management database and displayed over site local area networks. Thus, site managers were able to monitor the progress of the process as it was fully implemented.

Technology Changes for Scheduling Implementation

A major change implemented after the initial projects were in place was the implementation of the new scheduling tool. The tool in use at the Duke plants was nearly ten years old, and required a fair degree of technical sophistication to use. For this reason, less detailed scheduling was used and little detail was actually in place for non-outage scheduling. The team selected a new scheduling tool to fill the need for a user friendly tool that would allow detailed scheduling with potential to also use resource loading. The team selected Artemis Prestige. This tool was then linked through a gateway to the electronic work management tool. Each of the three sites was equipped with a Unix server to run the scheduling tool as a client server application. As implemented, an additional update screen was added to the electronic work management tool. On this screen the work status is updated by the crew. Each evening, the information which has been updated is downloaded to the scheduling data base. The schedule is run by the schedulers in the work control organization and uploaded to the electronic work management system, which provides updated information to the work crews on a daily basis.

Key Changes Brought About by the Work Control Project

Over the course of the project, the evidence of project success rests in the key changes which the project, in conjunction with line management and staff, have implemented.

Improved Corrective Work Origination

A key improvement in the process concerned identification of work required to correct equipment problems. The new process allowed individuals to identify work in three ways. With a work control center (WCC) staffed full time, an individual can enter the WCC and convey a problem in person. A common site phone number was established to allow the individual to phone in the problem to the WCC, or the simplified computer input screen allows the individual to enter all the information in a few keystrokes from terminals widely available throughout the site. The entry to the simplified screen is the key to allowing the trouble-shooting teams to attack the problem. When a problem is called or brought in, this information is fed to the simplified screen at that time.

Single Point of Contact (SPOC)

The improved work origination features noted above are facilitated by having a single point of contact in place for all corrective work. This SPOC function is housed in the work control center. Managed by the Shift Work Manager, the personnel staffing the SPOC are dedicated to correcting emergent work items and keeping them from influencing the work already on schedule. There are several elements to the SPOC function.

Trouble-Shooting Teams

Trouble shooting teams are the on shift teams which are the first line of defense on all emergent work identified at the site. These teams consist of skilled technicians who work around the clock and have as their primary charge the correction or diagnosis of all emergent work items. If a problem arises, these technicians review the problem, determine if it meets the criteria for minor maintenance, determine if plant conditions allow the problem to be worked and if it is within their skills and qualifications to work the problem. Whenever possible, the technicians correct the problem on the spot. If development of a workplan is necessary, the trouble-shooting team, which is one of the multiskilled teams, performs the planning for the work and then performs this work plan. When not occupied by emergent work items, the trouble-shooting teams perform scheduled preventive maintenance work.

WCC Senior Reactor Operator (SRO)

The WCC SRO is assigned to the work control center to coordinate the Operations interface for the work process. This SRO provides the initial contact with the operations shift for problems related to clearance to begin work, tagging of systems, draining of components. Through this role, this SRO is the maintenance interface for Operations and provides tagging interface, approval of work, issues keys, fire barrier tags and ensures control of containment access.

Work Window Manger (WWM)

The work window manager serves in the WCC during his assigned work window, normally a week for non-outage operation. The WWM is the focal point for problems that arise during the preparations for and execution of work and is responsible for successful completion of all work activities within the assigned window. Any problem that potentially affects the scheduled work is brought to the attention of the WWM. This person, who is intimately familiar with the schedule of work for the window is in position to remove barriers to work completion. When the WWM is not in an execution window, he carries out critique of and planning for his work window on a predetermined activity sequence.

Multiskilled/Multicraft Teams

Multiskilled teams have been formed to reduce the coordination of work between craft crews of differing skills. Several areas lend themselves to organization different from that which might be in place when organizing the work from a discipline basis. The intent in installing multiskill teams was to organize around natural units of work, eliminating an unwise division of labor. The project team, using input from personnel involved in the work, decided upon six areas where multiskilled teams would be most effective. What was formed initially was actually a multicraft approach to the work. Training and procedures already in place did not allow easy mixing of skills within one individual. The ultimate goal of the effort is to use a multiskill approach where feasible. This lets one individual perform tasks from several disciplines which are specific to the type of work that is being performed. An example of the approach is in motor-operated valve work. Here the work crews perform job planning, lift electrical leads, perform rigging, valve repairs and reassembly, all within the same team and without assistance from other crews for the base work. If scaffolds above a critical height, asbestos insulation removal or radiation protection support is needed, other work crews are coordinated on the schedule. Many hand-offs and complications to the schedule are eliminated by this approach.

Planning

Planning of work has been moved from the central planning organization into the field work crews. Technicians have been trained in the planning of work to allow this function to be moved. A central planning organization also exists, under the control of the maintenance organization. This central function performs planning for outage work and maintains all of the model work orders when changes are necessary. These work orders represent work of a repetitive nature such as preventive maintenance work orders and repetitive corrective work orders. In order to better prepare technicians to take on the work of planning, a structured field planner training course has been prepared and is being offered to technicians as management and the plant work load will allow. The ultimate goal is to have sufficient planning resources on each work team to enable that team to be self sufficient in work planning.

Scheduling

Operations Matrix SRO

If the problem is not within the skill set of the trouble-shooting team, or plant conditions will not allow work at that time, the problem is referred to the operations matrix SRO, who, with the diagnosis of the problem received from the trouble shooting technicians, tentatively places the work into an appropriate work window for the schedule. This individual is responsible to insure that proposed plant alignments meet requirements of technical specifications and the plant risk matrix, that mode changes and plant evolutions are appropriately considered and items such as containment integrity, tagging requirements and grouping of similar work are performed.

Detailed Scheduling

Scheduling effectiveness and efficiency is one ultimate goal of the new work control process. The scheduling process has been refined and now one schedule controls activities at the station. All parties who are affected by the station schedule attend to this single schedule and through a series of coordination meetings agree on their commitment to work the schedule as published. This commitment is established two weeks prior to the actual execution of the work. All affected parties receive scheduling information for review weekly and are updated on the development of the schedule by the work window managers as they work with the unit schedulers to develop the schedule for their work windows. By linking the scheduling tool to the electronic work management tool, information for parts, tools and materials are also made available. A link to inventory management is in the final stages and will be implemented in 1996. This will allow ordering of materials for predefined and other work to be automated in the Duke procurement system.

Performance Measures

Performance measures for the process are extracted from the work management data base and displayed on the site local area network. The measures are consistent across the three sites. Each of the measures can be traced to the work groups responsible. Because scheduling is central to the operation of the process, items which do not complete as scheduled are discussed as part of each weekly critique and are the subject of attention by site management. These performance measures serve as sub-tier measures to the site performance report card, which is tracked for each station.

Other Ongoing Projects from the Work Control Project

Certified Equipment Database

One of the needs of the process identified by the project team in Phase II was the need for a consolidated, certified equipment database. This information will serve the planning function for population of the library of work plans with equipment information. The information technology work for this database has been completed. A project is now underway to review and certify the data for this database. This project is estimated to take two years to complete. A permanent responsibility for data maintenance has been established at each site. The owners of the data have been established and the duties of each have been defined. A software and data quality assurance plan has been implemented for this database.

Electronic Library

An additional project underway to meet the identified needs of the process is the electronic library project. This certified electronic repository will contain all procedures and drawings needed for the work control process. This information will be viewable on line throughout the site. This tool also allows revision and approval of procedures on line. This application has also implemented a software and data quality assurance plan.

Results from the Project

The Work Control Quality Improvement Project has been a great success for the Duke Power's nuclear generation department. In the aftermath of the initial implementation, the SPOC efforts on the front end of the process showed quick success. As the process implementation has progressed, other key changes such as the multiskilled teams, focused field planning and the unified risk-based scheduling approach have come to also be regarded as project successes. All of this has been monitored by the performance measures established by the project.

The SPOC efforts have resulted in a significant reduction to the burden of planning and scheduling and have resulted in greatly decreased turnaround time for problem resolution. All corrective problems are reviewed by the trouble-shooting teams upon notification. The team maintains as one of their prime directions, the rapid disposition of problems. Thus, within one shift, all corrective problems have been dispositioned by correction of the problem, determination that a problem does not exist, or assignment of the problem to a work window. Due to the excellent work of the trouble-shooting teams, 40-70% of all problems identified with a week are corrected within that week, most within 24 hours.

The new process has also had quantifiable results in dealing with maintenance backlogs. Backlogs of work have generally been halved at the stations, with many long term problems that had existed because of low priority being corrected. All station material conditions have improved through use of the process. The improved state of station maintenance has resulted in fewer operator work-arounds, leading to a decreased burden on the operators and decreased chance for error.

Work effort required, and consequently station staffing, has declined as a direct result of the work control project. Total station staffing is now 25% lower than at the beginning of the project, while the same or more work has been accomplished through the process. Statistics show that the number of corrective work requests processed through the system actually increased 25% during the first full year of the process. This is due to the increased confidence by station personnel that the process would actually allow the problem to be corrected.

The overall results from the Duke nuclear system during this time frame have been outstanding. Overall system capacity factors increased to 82.4% in 1994 and 88% in 1995. Outage durations have decreased dramatically. Each of the last seven refueling outages have been short outages for the unit, with outstanding results in work quality. Nuclear safety as evidenced by USNRC violations have decreased significantly and personnel safety has dramatically improved. The Duke Power nuclear generation department is positioned to help lead the utility into the competitive future with low cost nuclear power, produced through outstanding operations and maintenance of the nuclear system. The executive and line management, station staffs and project team are all to be credited with bringing about these rapid and dramatic changes.