NUREG/CR-6122
PNL-8428
BHARC-700/92/047

Staffing Decision Processes and Issues

Case Studies of Seven U.S. Nuclear Power Plants

Prepared by
B. Melber, A. Roussel, K. Baker, N. Durbin, P. Hunt, J. Hauth, C. Forslund, E. Terrill/BHARC
B. Gore/PNL

Pacific Northwest Laboratory

Battelle Human Affairs Research Centers

Prepared for
U.S. Nuclear Regulatory Commission

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Manuscript Completed: December 1993
Date Published: March 1994

Prepared by
B. Melber, A. Roussel, K. Baker, N. Durbin, P. Hunt, J. Hauth, C. Forslund, E. Terrill,
Battelle Human Affairs Research Centers
B. Gore, Pacific Northwest Laboratory

Pacific Northwest Laboratory
Richland, WA 99352

Battelle Human Affairs Research Centers
Seattle, WA 98105

Prepared for
Division of Systems Research
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
NRC FIN B5696

Abstract

The objective of this report is to identify how decisions are made regarding staffing levels and positions for a sample of U.S. nuclear power plants. In this report, a framework is provided for understanding the major forces driving staffing and the implications of staffing decisions for plant safety. The focus of this report is on driving forces that have led to changes in staffing levels and to the establishment of new positions between the mid-1980s and the early 1990s. Processes used at utilities and nuclear power plants to make and implement these staffing decisions are also discussed in the report. While general trends affecting the plant as a whole are presented, the major emphasis of this report is on staffing changes and practices in the operations department, including the operations shift crew. The findings in this report are based on interviews conducted at seven nuclear power plants and their parent utilities. A discussion of the key findings is followed by a summary of the implications of staffing issues for plant safety.

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Executive Summary

The objective of this report is to identify how decisions are made regarding staffing levels and positions for U.S. nuclear power plants. In this report, a framework is provided for understanding the major forces driving staffing and the implications of staffing decisions for plant safety. The focus of this report is on driving forces that have led to changes in staffing levels and to the establishment of new positions between the mid-1980s and the early 1990s. Processes used at utilities and nuclear power plants to make and implement these staffing decisions are also discussed in the report. While general trends affecting the plant as a whole are presented, the major emphasis of this report is on staffing changes and practices in the operations department, including the operations shift crew.

The findings in this report are based on interviews conducted at seven nuclear power plants and their parent utilities. A discussion of the key findings is followed by a summary of the implications of staffing issues for plant safety.

Changes in Staffing Levels and Positions

Plant-wide, the most significant staffing changes are:

- an increase in overall staffing levels at all seven plants;
- increases in operations, maintenance and engineering staffing at all seven plants;
- increases in training staffing at six of seven plants.

Departmental decreases in staff size were not typical.

In the operations department, the major trends seen in staffing are:

- addition of a sixth shift crew in six of seven plants;
- addition of coordination positions in five of seven plants;
- addition of administrative positions in four of seven plants;
- addition of licensed operators on shift in three of seven plants; and
- addition of supervisory staff on shift in two of seven plants.

Driving Forces

The general forces driving staffing changes are pressures from external organizations, economics, and performance issues.

External pressures include regulations and requirements. Plant staff reported feeling pressures not only from the Nuclear Regulatory Commission (NRC), but from the Institute for Nuclear Power Operations (INPO), the Nuclear Management and Resources Council (NUMARC), and the Public Utilities Commissions (PUCs) as well. Specific examples of these pressures include increased training requirements, the maintenance rule, design basis reviews, and the NUMARC procurement initiative. In most instances, new requirements or regulatory pressures lead to new work initiatives that drive staffing needs upward.

Economic factors tend to constrain staffing growth. Pressures toward cost-effectiveness and increased efficiency were cited by respondents at six of seven plants as curbing staff growth.

Major performance issues include specific performance concerns identified by the NRC or INPO and continuous increases in performance standards in general. These factors also tend to drive staffing levels upwards.

Impact of Driving Forces on the Operations Department

The general forces of external pressures, economics, and performance issues affect the operations department in several specific ways. The external pressure that affects operations staffing the most is the initiative to improve operator training programs. Other external pressures affecting operations staffing include design basis reviews of plant systems and reviews of procedure upgrades. Because a high level of regulatory attention is paid to licensed operator staffing and to the centrality of operations to plant safety, economic pressures appear to have less of an impact on operations staffing than on staffing in other departments. Finally, plant performance concerns have led to additional administrative and coordination demands on operations staff. For example, operations input into other departments' planning and work activities is increasing.

Processes for Staffing Decisions

Management at most plants in this study rely on periodic efforts to assess their departmental organization and staffing patterns. These assessments result in a recommended organizational structure and staffing levels that are retained for several years.

The most common justifications given for the addition of new positions are increased workload due to new programs or regulatory requirements, backlogs of work, and overtime use.

Plant Staffing Mechanisms

A variety of staffing policies and mechanisms are used at plants to meet regulatory and performance expectations while curtailing the expansion of economic costs. The most common mechanisms seen in the site visits were sometimes conflicting:

- reorganization of functional groups, usually based on a utility-wide initiative aimed at increasing efficiency and reducing costs;
- contractor use, including both reliance on contractors to augment authorized staffing levels and replacement of contractors with permanent staff to reduce costs;
- hiring freezes or caps on hiring; and
- overtime policies, including the use of overtime to meet workload demands and constraints on overtime use to reduce costs.

Shift Staffing Mechanisms

Mechanisms for staffing the operations shift crew include retention programs, recruitment practices, and career paths.

In general, turnover in operations staff at the plants that were visited is relatively low, with rates estimated at around 5-13% for 1991. At some plants, shift scheduling policies are viewed as a mechanism for addressing turnover issues, with the 12-hour shift being offered as a way to retain staff.

In terms of recruitment practices, recruits for operator positions are sought from a variety of sources, including the Nuclear Navy, regional technical schools, and community colleges.

The most significant concern mentioned in terms of career paths is limited opportunity for advancement. In general, operators at the plants in this study face fewer promotion opportunities and a longer time between promotions than five years ago.

Staffing Issues and Plant Safety

The findings presented in this report suggest several implications for plant safety. The following four issues are addressed:

- the potential conflict between economic pressures and safe operations;
- the increasing workload demands on the operations shift crew;
- the effort to maintain an appropriate number of licensed operators; and
- the impact of performance evaluations by the NRC and industry review groups on staffing.

The tension between economic constraints and increased workload demands has been central to staffing decisions at the nuclear power plants in this study. To the extent that economic constraints limit the plants' ability to meet increased work demands, there is the potential for an adverse effect on the safe operation of nuclear power plants. However, at this time, there is no evidence to indicate that economic constraints faced by utilities have taken precedence over meeting safety-related workload demands, particularly within nuclear divisions of utilities and within the operations departments of plants. Continued attention by the NRC to utility responses to economic pressures is important to ensure that economic constraints do not lead to inadequate staffing in the future.

The involvement of operators in special initiatives such as training program improvement and design basis reviews has increased the responsibilities of the operations shift crew. Increased participation of operators in a broader set of tasks has the potential to negatively affect safe operations if these new demands interfere with plant operations. However, operator involvement in these tasks also has the potential to enhance plant safety if staffing levels are sufficient to carry out plant operations and if operator expertise on these tasks results in improved plant functioning.

In staffing licensed operator positions, management at plants face the difficulty of maintaining enough licensed staff to cover unexpected needs for operators (e.g., due to examination failures or illness), while not establishing an oversupply of "back up" licensed staff. Insufficient numbers of licensed staff can lead to heavy use of overtime to cover shift staffing when regular shift operators are not available. However, as the number of licensed operators increases, there is a decrease in the time these operators are assigned on shift with responsibility for running the plant. Considerable experience with on-shift responsibility is important for ensuring safe operations, and a very large pool of licensed operators can reduce individual experience levels.

Plant performance reviews carried out by the NRC and INPO have had a significant impact on staffing decisions at the plants in this study. These reviews can serve as an important mechanism for ensuring that plant management continues to emphasize safety-related needs as a basis for staffing decisions.

Conclusion

The results of this study of seven nuclear power plants indicate that there are strong and opposing pressures on staffing decisions. Pressures to reduce staffing levels to be economically efficient are countered by regulatory and industry pressures for new safety-related initiatives and higher performance standards that add to workload and increase staffing levels.

The identification of the major forces driving staffing decisions is useful for anticipating where imbalances between workload and staffing levels are likely to occur in the future. The ability of staff in operations departments to assume many additional responsibilities is limited. Regulatory attention that focuses on the extent to which new activities are undertaken, the approaches to carrying out these new activities, and the bases for changes made in staffing levels can contribute to early identification of potential safety concerns.

Acknowledgements

Many individuals and organizations contributed to the work on which this report is based. The managers and staff of corporate headquarters and nuclear power plants of one Canadian and seven U.S. utilities generously provided their time, information and insights. This work would not have been possible without their cooperation.

We acknowledge Dolores Morisseau of the NRC Office of Nuclear Regulatory Research, who served as technical monitor for this work, for her valuable assistance throughout all phases of this project, including study design, site visit arrangements, and report preparation. We also thank J.J. Persensky of the Office of Regulatory Research for his support and insights which contributed to the study design and preparation of this report.

For production support, we acknowledge with thanks the excellent work of Sharon Baldigo. A number of our colleagues provided insights and comments at various stages of this work. We acknowledge the special contributions of Jody Toquam, Tim Mitts, and John Bumgardner.

1 Introduction

The objective of this report is to identify how staffing decisions are made for U.S. nuclear power plants. A framework for understanding the major forces driving staffing and the implications of staffing decisions for plant safety are presented in this report.

The focus of this report is on the major forces that have led to changes in staffing levels and to the establishment of new positions between the mid-1980s and the early 1990s. The processes used at utilities and nuclear power plants to make and implement these staffing decisions are discussed, and general trends affecting plants as a whole are presented. The emphasis of this report is on staffing changes in operations departments including operations shift crews. A discussion of safety issues related to forces driving staffing decisions concludes the report.

In the early 1980s, the Nuclear Regulatory Commission (NRC) issued both regulations and policy guidance addressing the staffing of nuclear power plants, primarily in response to the event at Three Mile Island (TMI) Unit 2 nuclear plant. These issuances included requirements for the number of licensed operators and senior operators on shift and policy guidance on the establishment of a Shift Technical Advisor (STA) position. Regulatory changes for the purpose of enhancing the safe operation of nuclear power plants were a major force driving the staffing decisions of nuclear power plants during the post-TMI period. Staffing decisions made between the mid-1980s and early 1990s are addressed in this report in order to understand the forces affecting nuclear power plant staffing in recent years. Site visits at seven U.S. nuclear power plants were conducted to gather information on decision-making processes for staffing. In addition, a more limited site visit was made to a Canadian utility and one of its nuclear power plants to provide a comparative perspective on decision-making processes and issues for staffing.

In Chapter 2 of this report, the methods and sample selection strategy used for data collection and analysis are presented. The changes reported by staff at the nuclear power plants studied is documented in Chapter 3.

The forces driving these staffing changes are addressed in Chapter 4. The specific ways the forces driving staffing changes have affected operations department staffing are discussed in Chapter 5. In Chapter 6 the organizational processes used for staffing decisions are presented; the specific policies and mechanisms used for staffing the plant as a whole and for operations shift crews are discussed in Chapters 7 and 8, respectively. In Chapter 9 a summary of major findings and a discussion of safety issues related to staffing decision-making concludes this report.

2 Approach and Methods

A series of structured interviews at seven U.S. nuclear power plants and their parent utilities was conducted in order to review staffing practices and decision-making policies in the U.S. nuclear power industry. In addition, interviews were conducted at a Canadian utility and one of its nuclear power plants in order to provide a comparative perspective on decision-making processes and issues for staffing.

Detailed in this chapter are the methods used in selecting plants for the study, developing the interview protocols, carrying out site visits, and conducting the analyses that are presented in subsequent chapters.

2.1 Sample Design and Selection

The sampling strategy, developed in consultation with the NRC, was designed to capture the range of U.S. nuclear power plants. Because the goal of the site visits was to determine staffing practices and decision-making processes at operating plants, the sample was restricted to plants that were operational when the sample was selected.

The sample was stratified by two factors that were expected to be related to staffing levels and positions at plants: the age of the plant and the size of the parent utility's nuclear operations (i.e., the number of plants and sites). This second factor is referred to as complexity.

In classifying plants by age, the key factor was whether the plant was operational before the TMI incident in 1979. A number of manpower and staffing issues as well as several regulatory and industry initiatives related to staffing, arose from the analysis of the incident at TMI. Thus, plants that were operational before TMI had to make staffing changes in response to new requirements, while those that became operational in the post-TMI era began operations with a staffing complement that fulfilled these requirements.

The sample used in this study includes both older (operational before 1979, pre-TMI) and newer (operational after 1982, post-TMI) plants. This definition permits a clear separation between pre-TMI and post-TMI plants. Nine plants that came on-line in the four-year period from 1979 to 1982 were omitted because this was a transitional period after TMI but before implementation of some post-TMI staffing regulations.

A second factor expected to affect staffing levels and positions was the number of nuclear power plants and sites under utility responsibility. Four categories were used to allow for variation in both the number of units on a particular site and the number of sites operated by a utility:

- one site, one unit;
- one site, multiple units;
- two sites, multiple units; and
- three or more sites, multiple units.

The sampling universe was obtained from the U.S. NRC listing of licensed nuclear power plants (NUREG-1350, 1989). There were 101 operational plants that began operation prior to 1979 or after 1982. As shown in Table 2.1, plants were stratified into eight groups by the factors of age and utility complexity. Within each of these eight groups, plants were randomly selected for participation in this study.

In two cases, when the first randomly selected plant in a group did not participate in this project, alternate randomly selected plants were requested to participate. In Table 2.2, the site visit sample is summarized and a coded plant number is assigned to each cell in the table. Seven plants were selected to represent the eight cells. One plant represents two cells: it operated as a single unit, single site plant before being absorbed into a larger utility management structure which operated at multiple sites.

The plants selected for site visits can be summarized as follows:

- Plant 1 is an older, single unit, single site plant;
- Plant 2 is an older, multiple-unit, single site plant;
- Plant 3 is an older, multiple-unit plant whose parent utility operates plants on two sites;
- Plant 4 is an older, multiple-unit plant whose parent utility operates plants on three or more sites;
- Plant 5 is a newer, multiple-unit, single site plant;
- Plant 6 is a newer, multiple-unit plant whose parent utility operates plants on two sites; and

Table 2.1 Number of operational plants by age and utility complexity

Utility Complexity	AGE Pre-TMI	Post-TMI	Number of Plants by Utility Complexity
One Site One Unit	15	7	22
One Site Multiple Units	14	16	30
Two Sites Multiple Units	19	5	24
Three or more Sites Multiple Units	15	10	25
Number of Plants by Age	63	38	--
Total Number of Plants	--	--	101

Table 2.2 Final site visit sample

Utility Complexity	AGE Pre-TMI	Post-TMI
One Site One Unit	Plant 1	See Note*
One Site Multiple Units	Plant 2	Plant 5
Two Sites Multiple Units	Plant 3	Plant 6
Three or more Sites Multiple Units	Plant 4	Plant 7

*Note: This cell is represented by information from Plant 7's operating experience as a single unit, single site plant, prior to its absorption into a utility management structure which operated at least three sites.

- Plant 7 is a newer plant whose parent utility operates plants on three or more sites. (At the time of selection, Plant 7 was a newer single-unit, single-site plant, but it became part of a larger utility management structure prior to the site visit to the plant.)

2.2 Interview Protocol Development

A structured interview guide was prepared consisting of open-ended questions concerning key staffing and decision-making issues. Questions covered the following categories:

- staffing changes in terms of numbers and types of positions;
- processes for making staffing decisions;
- workload;
- inter-departmental coordination;
- operations shift crew composition; and
- shift crew recruitment, retention, and career progression.

The interview protocol was tailored for each set of interviewees: headquarters staff, human resources staff, plant managers, operations managers, other plant department managers, and operations shift crew supervisors and staff. The same questions were asked of several respondents at each plant. Multiple accounts were used to verify key issues; when discrepancies occurred, they were noted in the analysis.

2.3 Data Collection Methods

At each of the seven plants selected for a site visit, information on policies and practices for staffing was obtained through interviews with key staff using the structured interview protocols described earlier. Interviewees included headquarters staff and plant staff.

Respondents at utility headquarters typically included the vice president of nuclear operations or an equivalent position, the director of human resources, and other managerial staff as appropriate. At the plant, respondents included the plant manager; managers of operations, engineering, maintenance, quality assurance and training; the human resources manager; and two unlicensed operators or auxiliary operators (AOs), two reactor operators (ROs), two senior reactor operators (SROs), two shift supervisors (SSs), and one shift technical advisor (STA). The total number of individuals interviewed at a particular site ranged from 18 to 27, with an average of 21 interviews conducted at each site.

2.4 Analysis

Analysis of the results of all seven site visits consisted of systematic qualitative content analysis of responses in key issue areas. The interview responses were first compiled into a single master file for each site. The key issues included changes in staffing levels and types of positions; reasons for staffing changes, processes used to make staffing decisions, workload, and operations shift crew composition and staffing practices. Content analysis within each area focused on common themes across plants and issues related to plant safety.

The emphasis in the analysis was on cross-case comparisons, rather than individual case studies. The focus was on bases and processes for decision making with regard to staffing to identify both what appeared to be industry-wide approaches--those common across the range of plants visited--and approaches that appeared to be linked to the age of the plant or the number of sites and units operated by the parent utility. Site-specific circumstances were identified for use as examples of specific plant approaches to staffing issues.

2.5 Comparison Case: Canada

A major Canadian utility was also selected for a site visit. A cross-section of staff and managers was interviewed regarding staffing practices. The information from this visit is used throughout this report to provide illustrative material in comparison to the U.S. cases. The Canadian nuclear industry was selected because it is subject to many of the same post-TMI pressures as the U.S. industry, including economic pressures, yet it operates within a different political and regulatory framework.

3 Trends in Staffing Levels and Positions

3.1 Staffing Changes in Numbers and Types of Positions

The first step toward the objective of understanding staffing practices in the U.S. nuclear power industry is an examination of staffing patterns and recent changes in staffing levels and composition.

In this chapter the changes in staffing levels experienced by seven nuclear power plants in the five-year period prior to this study are described. A summary of plant-wide staffing changes is followed by a discussion of changes in various functional units. The discussion of staffing in operations includes a description of current staffing practices as well as an analysis of changes over the past five years. The factors influencing the changes described here will be discussed in subsequent chapters.

3.2 Overall Staffing Changes

In exploring staffing patterns and practices in nuclear power plants in the period from 1987 to 1992, the first striking finding is that all plants in the sample increased their staff size during that period. Quantitative data on staffing changes was received at all plants; however, since plants differ in their methods of accounting and the time periods reported, the data are not comparable across all seven plants.

While the overall permanent plant staff increased in all of the plants, the level of staff increases varied considerably. For example, staffing at Plant 5 (a newer plant within a utility that operates two units on a single site) increased from 1194 employees in 1987 to 1279 in 1992, a 7% increase, while staff at Plant 1 (an older plant that is the only nuclear station operated by its parent utility) increased 46%, from 233 to 341 employees during this period. Significant further growth was planned at Plant 1 for the next two years as part of an overall staffing plan, which includes contractor replacement.

Staff increases were reported for all seven plants in the areas of operations, maintenance, and engineering, and in training for six of the seven plants. In three plants, increases in chemistry department staff were reported. Increases in other areas were reported for only one or two plants. In Table 3.1, a summary of staff increases and decreases in particular departments at the seven sites visited is provided.

Respondents were asked whether staffing levels had changed in particular departments. Responses were grouped by functional area, and are reported as departmental increases (though department names may vary from plant to plant).

The general pattern apparent in Table 3.1 is one in which increases in departmental staff size far outpace decreases. Decreases in staff size were reported for departments in three plants (Plants 3, 4, and 7). Staff numbers decreased in the quality assurance (QA) department in Plant 3, in middle management positions in Plant 4, and in several areas in Plant 7 (quality assurance, licensing, operations assessment, administration, and corporate staff).

The case of Plant 7 is particularly interesting because it is the only site that had a significant number of departments with staffing decreases. While the overall staffing level at Plant 7 was increasing, it was the only plant with decreases in several specific functional areas. Most of the staffing decreases were due to a reorganization that occurred just prior to the site visit. What had been a single-unit, single-site plant was incorporated into a larger management structure that operates plants on three separate sites. As a consequence, some functions were centralized to the new management headquarters, and plant departments like licensing, quality assurance, and administration lost staff.

At the other end of the spectrum is Plant 1, which experienced the most significant staff increase of the seven sites visited. Plant 1 is a smaller, older unit whose parent utility had instituted a three-year hiring freeze in the mid-1980s. By the end of the decade, it became apparent that the plant was significantly understaffed as compared with other plants of similar age and capacity at other utilities. The utility began a systematic process of increasing staffing levels across the board. At the time of the site visit in 1991, the staffing increases were continuing, with plans to bring in 150 additional staff in the next several years.

Overall, the pattern of staffing changes is one of increases in department size in the major functional areas, with very few exceptions. In the next section, the expansion of the operations department is explored in greater detail.

3.3 Operations

Staffing changes in operations take two forms: non-shift crew operations staffing changes and changes in the operations shift crew composition. Each will be examined in turn.

Table 3.1 Staffing level changes

	Operational Pre-TMI				Operational Post-TMI		
Department	**Plant 1**	**Plant 2**	**Plant 3**	**Plant 4**	**Plant 5**	**Plant 6**	**Plant 7**
Overall	**Increased**	**Increased**	**Increased**	**Increased**	**Increased**	**Increased**	**Increased**
Operations	Increased	Increased	Increased	Increased	Increased	Increased	Increased
Maintenance	Increased	Increased	Increased	Increased	Increased	Increased	Increased
Engineering	Increased	Increased	Increased	Increased	Increased	Increased	Increased
Training	Increased	Increased	Increased	Increased		Increased	Increased
Water Chemistry	Increased			Increased	Increased		
Human Resources	Increased	Increased					
Licensing	Increased						*Decreased*
Quality Assurance	Increased		*Decreased*				*Decreased*
Planning/Scheduling		Increased	Increased	Increased		Increased	
Health Physics		Increased			Increased	Increased	
Radiation Protection			Increased	Increased			
Middle Management				*Decreased*			
Operations Assessment							*Decreased*
Administration							*Decreased*

Note: Blank cells are those for which no information was provided.

Table 3.2 Non-shift crew operati

Operation Staffing Change	Plant 1	Plant 2	Plant 3	
Administrative	New Administrative position	New Shift Admin. Asst. (in Ops. Support)	New Senior Clerk	Ne
Coordination	Two new positions (SROs)	New Ops. Support Coord. position (in Ops. Support) New Maintenance Coord. during outages (in Ops. Support)	New Training Liaison New Engineer Coord. New Radwaste Liaison New Maintenance Coord. New Spent Fuel Coord. New Procedure Coord.	Ne
Oversight		New Ops. Assessment Group (in Ops. Support)	New Operator oversight position (reports to Plant Mgr.) New Clearance Order Review Committee Revamped Corporate VP structure for better Ops. oversight	
Dedicated Positions				
Created Operations Support Group		New separate Ops. Support Group	New separate Ops. Support Group	
Moved Functions OUT of Ops.	Moved Water Chemistry to Chemistry Dept.		Moved I&C to Maintenance	
Moved Functions INTO Ops.	Moved Training into Ops.			Ne Up
				Mo En int

ons staffing changes

Plant 4	Plant 5	Plant 6	Plant 7
v Admin. position			New Admin. shift
v Planning Coord.		New Training Liaison (SRO) New Work Control Support (SRO) New Procedures Coord. (SRO)	New Ops. Coord. (SRO)
		New Asst. Ops. Mgr.	New Event Analysis Reporting Response Mgr.
		Special person to do fire watch	Possible: Admin. STA to handle testing
Procedures rade Group	Moved STA into Ops.		
ed Reactor neering position Ops.			

3.3.1 Operations Department Staffing

The operations department at all seven plants has increased in size since the mid-1980s. As illustrated in Table 3.2, most of these staffing changes occurred in administrative, coordination, or oversight positions. Administrative increases accounted for some staffing changes in all four older plants in the sample, while recent staffing configuration changes due to administrative tasks were reported at only one of the three newer plants. While respondents across all seven plants reported that their administrative burden had increased over time, it is possible that these increased administrative demands at the newer plants had been built into the initial staffing plans, while positions at older plants were added to meet the administrative workload.

At Plant 7, the approach used to meet these administrative staffing needs was different from the approach used at the other plants. Rather than add dedicated administrative staff positions in operations, an administrative rotation for the shift crew was created at Plant 7 in order to handle administrative work (including paperwork and procedures review). The reasoning was that as the administrative workload increases in size and complexity, the need for specialized administrative expertise increases. The operations administrative crew is a day-shift team of experienced operators who rotate every 12 to 18 months. This time frame allows the operators to become proficient with the administrative paperwork and provides a long period of a day-shift schedule, away from the usual shift rotation schedule.

Positions were added to operations at five plants to assume coordination or liaison tasks. At Plants 6 and 7, these coordination positions are filled by licensed SROs, which indicates the level of expertise required to carry out coordination tasks. At Plant 3, the most staff was added to deal with coordination: in total, six staff were added--one each for coordination with training, engineering, radioactive waste, maintenance, spent fuel, and procedures.

The third contributor to staffing changes in operations was the addition of supervisory positions or oversight structures, as seen at four plants.

Another trend seen in operations department staffing was moving collateral support functions such as fire protection or spent fuel coordination out of the department, so that operations was able to focus more on operating the reactor. This occurred in three of the four older plants, but was not reported at any of the newer plants. A distinct operations support department was created at two older plants to take collateral functions out of operations, while at a third plant the water chemistry function was moved out of operations and into chemistry. Of the three newer plants, one had a separate operations support and assessment group, while another had a plant services group. The third newer plant had no clearly defined operations support group, but the operations department included only shift operators. This indicates that the newer plants were created with operations departments focusing on operating the plant, while older plants had to reorganize to achieve that focus.

This trend of moving collateral functions out of operations was countered by an opposite trend observed at three units (two older plants and one newer plant) of moving other functions into the operations department. At Plant 1, operations training was moved out of corporate training and into operations, for increased attention to training needs and in recognition of the key role operators were already providing within training. At Plant 4, a procedures upgrade group was created, and at Plant 5 the STA (who used to be in another plant organization) was moved into operations, so that the STAs would be closer to personnel whom they support.

In summary, the general trend in operations outside the shift crew was the addition of full-time day positions for paperwork, coordination, and oversight of operations.

3.4 Shift Crew Composition

In this section the operations shift crew staffing levels and recent changes in the numbers and types of positions on shift are presented.

3.4.1 Changes in Staff Levels

The greatest single change in shift crew staffing was that in the past five years a sixth crew was added to the operations shift staff at six of the seven plants. Reasons cited for adding a sixth crew included training requirements at three plants, high levels of overtime use at two plants, increased use of vacation time at three plants, and increased operations workload in general at two plants.

3.4.2 Operations Shift Crew Staff Numbers

There is some variation in how crews are staffed. In Table 3.3, the staffing composition of shift crews at the seven plants that were visited are presented. All plants meet or exceed the minimum requirements contained in 10 CFR 50.54(m). As indicated in Table 3.3, the two-unit sites have about one fewer staff member per unit crew staff; they have an average of about 9.6 crew members per unit, while one-unit plants have an average of 10.75 crew members per unit. This difference exists in spite of the fact that the two-unit sites have all recently added shift crew positions to assist in paperwork or to train entry-level people who have not yet become AOs.

There are differences in staff numbers by plant age. The older plants have an average of 9.1 staff per unit. The new plants have an average of 11.8 staff per unit. However, these averages are affected by extreme values; for example, Plant 1 (an older plant) has six staff on shift, which appears unusually small compared to all other plants, older or newer. At the other extreme, Plant 6 (a newer plant) has 13-14 staff on shift. Thus, plant age in this sample is related to staff size; new plants have more staff per unit.

3.4.3 Senior Reactor Operators (SRO)

Three of seven plants have two SROs on shift, of which one is also the control room supervisor. Generally, there are two SROs per unit; however, in two of the three newer plants, there are more SROs than in the older plants, with up to five SROs for two units. Plants that have fewer SROs on shift usually have a larger number of ROs; thus the total number of licensed shift crew members generally remains the same. Two of seven plants license their STA as an SRO and use the STA in a dual role of SRO/STA.

3.4.4 Shift Technical Advisor (STA)

At four plants an on-shift dedicated STA is used, while at one newer and one older plant mentioned above, a dual role SRO/STA is used. At Plant 1 an on-call STA is currently used; however, this position was to change to an on-shift STA in 1992.

3.4.5 Changes in Crew Composition

Changes in crew composition are presented in Table 3.4. Two of the seven plants have added another level of supervision in the form of an SRO who serves as assistant to the control room supervisor. In addition, three of the seven plants surveyed added a licensed operator to the shift crew sometime in the 1980s. These increases in licensed operators are over and above the staffing levels mandated in 10 CFR 50.54(m). Three plants added AOs in recent years.

3.5 Summary

In this section, the staffing increases seen in all the plants in the sample have been described. Increases in the main functional units of operations, maintenance, engineering, and training were discussed. The major trends seen in operations staffing in the past five years are as follows:

- addition of coordination positions in five of seven plants;
- addition of administrative positions in four of seven plants;
- addition of a sixth shift crew in six of seven plants;
- addition of supervisory staff on shift in two of seven plants; and
- addition of licensed operators on shift in three of seven plants.

In the following chapter, some of the driving forces behind these staffing changes are described.

PLANT	Plant 1	Plant 2	Plant 3	Pla
No. Units staffed for:	1 unit	1 unit	2 units	2 u
No. Crews	6 crews	6 crews	5 crews	6 c
SROs:	2 SROs • 1 Shift Super. • 1 CRS	2 SROs • 1 Shift Super. • 1 Foreman	4 SROs • 1 Shift Super. • 3 SROs	4-5 SROs • 1 Shift Engi • 2 Shift Supe • 1-2 Dual Ro
STAs:	on-call	1 STA	1 STA	1-2 STA (Note as SRO)
ROs:	2 ROs	4 ROs	4-6 ROs	4 ROs
AOs:	2 AOs (1 NAO, 1 TAO)	4 AOs (NOs)	6-10 AOs	8-9 AOs
Other:			1 Shift Clerk	1 Engineering
No. Staff Per Unit:	6	11	8-11	9-1

Key:

SRO: Senior Reactor Operator
CRS: Control Room Supervisor (SRO license)
STA: Shift Technical Advisor
RO: Reactor Operator
AO: Auxiliary Operator, also called Nuclear Auxiliary Operator (NAO), Nuclear Operator (NO), Equipment Operator (EO
Turbine) Auxiliary Operator (TAO), and Nuclear Plant Operator (NPO).

Table 3.3 1992 crew composition

nt 4	Plant 5	Plant 6	Plant 7
nits	2 units	1 unit	1 unit
ews	6 crews	5 crews (Adding 6th)	6 crews (one administrative - day shift only)
neer rs. le STA d above	5 SROs • 1 Shift Super. • 2 Unit Supers. • 2 Asst. Unit Supers.	4 SROs • 1 Shift Mgr. • 1 CRS • 1 Shift Support Super. • 1 Dual Role STA/SRO	2 SROs • 1 Shift Super. • 1 CRS
	1 STA	1 STA	1 STA
	4 ROs	3 ROs	2 ROs
Asst.	8 AOs (5 NPOs, 3 AOs)	5-6 AOs (EOs)	4-7 AOs (A - outside control room; B - turbine operator; C - everything outside protected area)
	1 AO (Operator) Helper	Trying to staff for 6th crew	2 Trainees
0.5	9.5	13-14	11-14

). Technical (or

Table 3.4 Changes in crew composition

Plant	Changes in Composition by Plant
1	1982: Added extra SRO (CRS) 1987: Added 6th crew 1992: To add STA to shift crew
2	1988: Added 6th crew
3	Mid-1980s: Added 5th crew 1989: Added 3rd SRO and 1 AO
4	1986: Removed 1 RO 1987: Added AO Mid-1980s: Moved STA on shift crew; added 1 Shift Supervisor 1988: Added RO back to crew
5	1985: Added AO helper Late '80s: Added utility shift operator (RO)
6	Recently added RO and AO to crew
7	Recently added two Class "C" AOs and will lose two Class "B" AOs

<u>Key</u>:

SRO: Senior Reactor Operator
CRS: Control Room Supervisor (SRO license)
STA: Shift Technical Advisor
RO: Reactor Operator
AO: Auxiliary Operator, also called Nuclear Auxiliary Operator (NAO), Nuclear Operator (NO), Equipment Operator (EO), Technical (or Turbine) Auxiliary Operator (TAO), and Nuclear Plant Operator (NPO).

4 Forces Driving Staffing Changes

The general pattern of staffing changes observed at the seven operating nuclear power plants visited for this study was outlined in Chapter 3. Staffing levels are increasing overall. Key staffing changes in operations include the addition of a sixth shift crew, increased administrative positions, increases in the number of licensed operators on shift, and increased supervisory staff. In the following chapters, the driving forces behind those staffing changes are explored. The general forces at play in driving overall staffing increases are discussed in this chapter. In Chapter 5, how these forces specifically affect staffing changes within operations is discussed.

Staff at the seven plants mentioned several areas as affecting staffing changes. The overall driving forces behind staffing changes can be grouped under three general headings: external pressures, economics, and performance issues. In Table 4.1, the forces affecting staffing changes derived from interviews with utility staff are summarized.

4.1 Regulations and Requirements

At all seven plants, respondents discussed the external pressures of regulations or requirements as a driving force in staffing increases. Individuals interviewed often used the terms "regulation" and "requirement" interchangeably; they did not always precisely differentiate between these terms. To ensure clarity in discussing these issues, the following convention has been adopted. *Regulation* will be used to refer to NRC rules in the Federal Code of Regulations, such as 10 CFR 50.54(m). *Requirement* will be used to refer to commitments made by utility management to follow any other NRC guidance and directives, and commitments made by utility management to follow any standards, specifications or expectations established by organizations other than NRC, such as the Institute for Nuclear Power Operations (INPO) or Nuclear Management and Resources Council (NUMARC).

Examples of external pressures that were cited include increased training requirements; the maintenance rule; design basis reviews; pressure to adopt a systems engineering perspective; a NUMARC procurement initiative; and increased INPO and NRC requirements regarding testing, procedures, and procedure reviews.

Several of the examples cited above are not regulatory requirements in the same way that the control room staffing levels designated in 10 CFR 50.54(m) are regulations. Rather, they are commitments on the part of the plants, which, once made, have the force of a requirement for the plants. It is important to note that most interviewees did not refer only to NRC regulations when discussing expanding requirements. For example, INPO and NRC requirements were often discussed together, indicating that the plant staff consider NRC, INPO, and in some cases NUMARC and the Public Utilities Commission (PUCs) all as sources of increasing requirements.

In most of these instances, new requirements or regulatory pressures lead to new work initiatives that drive staffing needs upward. For example, increased training requirements (cited by respondents at all seven plants) have led to an increase in training staff, as there is a need for increased staff to provide additional training. Increases in operations staff also have been attributed to increased training requirements. For example, as operators are required to spend more time in training and, at some plants, to contribute to the training process through activities such as developing question banks, additional operators are needed to meet shift staffing requirements.

Another example of external pressures driving staffing changes occurs in the area of systems engineering. The new NRC safety system functional inspections have led to increased emphasis on a systems engineering approach. Some plants have added engineering staff as a response, while others have reorganized their engineering groups.

A NUMARC procurement initiative provides an example of how voluntary commitments affect staffing. In this case, industry efforts to provide assurance that spare and replacement parts are suitable for plant safety and reliability have driven staffing increases in purchasing, maintenance, and quality assurance.

By contrast, in the Canadian case regulatory pressures are experienced differently. The Atomic Energy Control Board (AECB), the Canadian regulatory body, generally does not mandate generic regulatory requirements as the NRC does, for example, with 10 CFR 50.54(m). Rather, regulatory pressures are applied largely through requirements made in the licensing process. Canadian plant licenses are subject to review and renewal as frequently as every two years, and a plant can lose its license if it fails to comply with commitments. The commitments made in the course of Canadian licensing and renewal have the force of a federal regulation. To date, AECB has focused less than the U.S. NRC has on

Table 4.1 Summary of forces driving staffing levels

	Operational Pre-TMI				Operational Post-TMI		
	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Plant 7
Regulations & Requirements	X	X	X	X	X	X	X
Economics		X	X	X	X	X	X
Performance Issues:							
Performance Concerns	X		X			X	
Rising Standards	X	X					
Oversight		X	X		X		
Technological Change				X		X	
Aging				X			

specific staffing issues like training or shift complements. AECB initiatives tend to focus on design or equipment issues; staffing changes that occur as a result are generally the product of the utility's determination of staffing needs.

The Canadian case differs in one other aspect: the impact of organizations like INPO, NUMARC, and PUCs is far less in Canada than it is in the U.S. This may be due to the relatively small size of the Canadian nuclear industry.

4.2 Economics

Staff at six of the seven plants visited discussed economic factors as having influenced staffing changes at their plants. Economic factors were not mentioned by the interviewees at Plant 1, perhaps reflecting this plant's recovery from the conditions leading to a hiring freeze in the mid-1980s. In general, economic pressures toward cost-effectiveness were cited as curbing growth. That is, staff sizes would have grown even faster were it not for the economic pressures.

The market in which utilities operate is a highly regulated and constrained one. PUCs place controls on utilities' ability to raise rates to offset increased costs, and capacity factors are limited, so there is tremendous pressure to operate as cost-effectively as possible. Respondents, especially those in managerial roles, were acutely aware of the economic pressures facing their utilities. At one plant, a manager noted that "the money required to support staffing level increases would make [the utility] non-competitive. We need to become more efficient if [we are] to survive." The vice president of nuclear operations at that plant's parent utility spoke of the "overriding pressure to balance the need for continued measured improvement in operations [against] the practical limits of cost."

Economic pressures and the regulatory pressures tend to work in opposing directions. That is, the effect of regulatory changes is generally to increase staffing levels. Economic pressures toward cost-effectiveness, however, usually act to suppress some of those increases. As one plant manager pointed out, "the opportunities for excellence are there--resource limitations are the biggest obstacle to improvement."

At two sites, half the respondents who reported needing staff additions in their department did not expect to receive them. At one plant, a manager referring to future staff additions said, "they're not expected, but they're needed." When asked about future staffing increases, the utility's human resources director pointed out the need for "on-going sensitivity to operating costs and budget issues. Any time a person leaves a position, management will make an assessment: Do we need to replace this person?" At the second plant, a supervisor pointed out the need for more staff because of increasing maintenance work activities, but expected the staff level to stay the same because of budget constraints. At another plant, a manager pointed out the need to "resist staffing increases to aid each problem." Instead, he suggested efficiency studies. That utility's vice president of nuclear operations spoke of the need to limit the headcount and to increase efficiency as a way of reducing staff levels, thereby holding down operations and maintenance (O&M) costs and maintaining economic competitiveness.

Economic pressures toward efficiency were seen in the Canadian case as well. The plant manager identified the single biggest staffing issue as follows: "How are we going to do all the work we want to do without hiring more staff? The challenge is not bringing in more people, it's meeting the increased workload and increasing productivity." Several other Canadian managers discussed finances as constraining staff growth.

While economic constraints usually limit staff increases, there was one example of economic pressures leading to the creation of new positions in the expansion of the planning and scheduling function. Several respondents noted increases in the planning department or additions of staff to handle planning duties. These respondents said that the need to increase coordination and to function more efficiently were the reasons for the changes.

Another mechanism through which economic pressures lead to staffing increases, in contrast to the usual effect of limiting staff additions, is through replacing contractors with permanent employees. In most cases, replacing contractors with utility staff adds to the headcount of permanent staff but decreases overall costs. One respondent at a plant undergoing significant staffing increases due to contractor replacements pointed out that the average cost of a contractor used on a full-time year-round basis was calculated to be 1.8 times the cost of a plant employee.

4.3 Performance Issues

The third general category of factors driving staffing changes includes a number of performance issues, including operational performance concerns, continually rising performance standards, the need for managerial oversight, technological changes, and plant aging.

4.3.1 Performance Concerns

Respondents at several plants attributed staffing increases to particular performance concerns. Training performance was an issue at two plants: in one case, poor operator requalification performance prompted staffing increases in operations and training, while at another plant problems with training and anticipated problems in operator exams were observed; therefore, training staff was reorganized and increased at this plant.

General operational performance was an issue at two plants with a history of poor performance, both of which added staff at the suggestion of NRC and INPO reviewers.

At one of these plants, both INPO and NRC evaluations indicated performance problems. Utility management responded by enhancing communications and coordination in its nuclear operations division. Recognizing that planning was a particular problem, a supervisory layer in operations was added at the plant to reduce the span of control for the operations superintendent and to improve long-term planning. In addition, a new department was created to do work planning and outage management. Finally, in response to an INPO suggestion, an operations oversight position was created.

At the second plant, which was also having training problems, poor Systematic Assessment of License Performance (SALP) scores contributed to staff additions in several plant evaluation areas. In particular, quality assurance and root-cause analysis were highlighted by INPO and the NRC. Work planning was another identified problem area, and staff were added to the work control group to improve planning and coordination.

These performance concerns involved three plants altogether. One newer plant had performance problems with training as well as with general operational performance. The other two cases both involved older plants.

4.3.2 Continually Rising Performance Standards

Over time, the performance expectations for nuclear power plants have increased. As one plant manager put it, "the whole industry has increased the standards." Practices that were once acceptable are no longer adequate, and staffing levels that were once sufficient may not be adequate to carry out work needed to meet higher performance standards. Some of this pressure is attributed to the NRC and INPO, but some comes from the utilities themselves, as they push for continuous improvement. In the words of one respondent, "If you stay the same, you fall behind."

Combined with the movement upward of performance standards is the recent practice of benchmarking. It is common for plants to look at comparable plants to assess the appropriateness of their staffing levels. For example, plant management at Plant 1 observed "sister" plants going through major staff additions, in part due to NRC performance pressures. They wanted to improve their performance in advance of NRC pressure, and they requested additional staff partly based on the experiences of other comparable plants. The emphasis in the mid-1980's to "move pre-TMI plants to meet newer industry standards" was also noted by management at Plant 1.

4.3.3 Managerial Oversight

Staff at three sites mentioned adding staff to provide more oversight of day-to-day operations. In some cases, an additional layer of supervision was added to the management structure; in other cases, positions were specifically created with an oversight function. Such additions can be either active (aimed at preventing problems from occurring in the first place) or reactive (responding to past problems that could be averted with more oversight).

At one plant, the creation of an operations assessment group provided an example of an active addition. Management pointed out that "there are no new accidents," so they created a group to learn from operating experience and prevent future accidents. At another plant, the addition of supervisory and oversight positions was more reactive, resulting from a utility-wide reorganization that coincided with a response to NRC performance concerns about the plant due to a series of problems that led to a lengthy outage. In the third case, the manager responsible for event analysis, reporting, and response was given greater independence from the operations shift supervisor as part of a general restructuring.

4.3.4 Technological Changes

Respondents at two sites discussed technological changes as contributing to staffing increases. In the case of an older plant, the addition of computerized systems created the need for staff to service them. In the case of a newer plant, respondents referred to technological changes in general as driving staffing upward. Technological change was viewed as having only a minor impact on staffing changes at most of the seven plants.

4.3.5 Plant Aging

Plant aging was cited as leading to staffing increases by respondents at only one plant, an older one. Staff were added in engineering and construction reportedly to accommodate the increased workload of an aging plant. This staffing increase is related to maintaining performance as more staff and more work are needed to keep an older plant running at an acceptable level. Respondents at all sites were asked about the effects of plant aging on staffing. In general, their responses indicated that aging had had an effect on workload for older plants, but that for the most part, staff levels had not changed as a consequence. At one newer plant, staff indicated that the workload had decreased as the plant matured. No effects on staffing were noted.

4.4 Summary

The general forces driving staffing changes are increasing regulations or requirements, economic constraints, and a focus on improving performance. The effects of those forces on the operations departments are explored in the following section.

5 Effects of Driving Forces on Operations Department Staffing

How factors driving nuclear power plant staffing decisions specifically affect staffing decisions in the operations departments is examined in this chapter. Although operations staffing is influenced by the same factors that affect nuclear power plant staffing as a whole, the importance and consequences of these factors may differ for operations departments as compared to other departments. The significance of each of the general driving forces on operations staffing is reviewed. Then variation in plants' responses to these forces is discussed.

The general driving forces affecting changes in the numbers and composition of plant staff were categorized as involving the following:

- regulations and requirements;
- economic pressures; and
- performance issues.

Regulations and requirements were shown in Chapter 4 to have a strong influence on staffing decisions. While regulations and requirements usually drive staffing up, economic pressures tend to suppress staffing increases. These forces have similar effects on operations staffing decisions; however, there is some evidence that regulations and requirements have an even stronger effect on operations staffing, and that the effect of economic pressures appear to be somewhat less for operations department staffing, especially control room staffing.

While economic constraints have somewhat less effect on operations staffing decisions, they have had a significant indirect effect on operations staffing needs. Efforts to improve plant efficiency have increased the workload demands on operations departments and have led to the creation of several new positions. The overall increase in workload demands on the operations department has, in turn, produced a growing concern for the need to buffer operations departments, and particularly the control room staff, from these demands. Thus, general performance concerns to enhance efficiency have created a new performance concern over increasing workload for operations departments.

5.1 Regulations and Requirements

There are several reasons why regulations and requirements tend to have a particularly strong effect on operations staffing. Due to the centrality of the operations department to plant safety, this department has always been a major focus of NRC oversight. During the decade following the TMI accident, several regulatory actions were directed at operations staffing practices. A second SRO was required in 10 CFR 50.54(m). The STA position was also created in the post-TMI period. In addition, overtime guidelines for operators and other key safety-related staff have had an effect on the number of shift-crew staff necessary to stay within these guidelines (NUREG-0737, 1980; Eisenhut, 1982a; Eisenhut, 1982b).

Although these actions occurred prior to the period covered by this study, they continue to affect operations staffing decisions. As discussed in Chapter 3, staff at two plants have recently changed or are planning to change how they implement the STA position, and at two other plants, staff mentioned overtime issues as factors that continue to affect operations staffing decisions.

According to interviewees at these plants, staying within overtime limits continues to be a challenge because of (1) an ever-increasing workload, and (2) a greater need for vacation coverage due to increased vacation accrual on the part of older operators.

The actions currently having the strongest effect on operations staffing practices involve efforts to enhance operator training programs. More comprehensive requirements for operator license examination and INPO criteria for training accreditation have significantly influenced operations staffing decisions at all of the plants visited. According to interviewees at all plants that have added, or are in the process of adding, a sixth crew, the primary reason for the addition was to dedicate a full week in the rotation schedule to training. The addition of a 7th crew is currently being considered at Plant 6 because many people at the plant believe that one week of training may not be sufficient, given past training deficiencies.

In addition to the amount of time operations staff spend in training, upgrading training programs has increased the workload demands on operations staff in other ways. At six plants, operators were being called on to help meet the workload demands of the training department by performing functions such as teaching classes or writing examination questions. At one plant, the operator training group was moved into the operations department in order to maximize the level of attention and assistance provided by operations to training functions. Because of the increased workload demands on the operations department, this arrangement was expected to be temporary; plant management indicated that the training group would move out of operations as soon as the training program was sufficiently developed and adequately staffed.

In addition to the regulations and requirements directed at operations, external pressures directed at other departments tend to have an indirect effect on operations staff because operations workload is extremely sensitive to the amount of work being conducted at the plant as a whole. A clear example of this indirect effect is evidenced by the pressure to improve training programs; as discussed above, operators are not only affected in terms of the amount of training required of them, but also by the need of training departments for operations input and assistance in improving training programs.

Another frequently cited indirect requirement involved design basis reconstitution of plant systems. Although this initiative is primarily directed at the engineering function, interviewees at two plants mentioned the impact of this requirement on operations workload, particularly in terms of operations staff conducting design change reviews (DCRs) and providing assistance in upgrading the training required by engineering staff to review and modify plant systems. The implementation of each design modification will require further operations input as well as updated training on the part of all operators.

Regulations and requirements affecting plant operations and processes as a whole, such as the degree of documentation of operational events and work procedures, often require a high level of operations input. For example, staff in operations are primarily responsible for developing many plant procedures as well as reviewing procedure updates made by other functional groups. At three plants, developing emergency operating procedures and conducting reviews of procedure updates for other departments were mentioned as requiring a significant amount of operations time. Members of operations departments, far more than interviewees in other departments, mentioned an increase in the amount of paperwork and a need for additional administrative positions in their department.

Finally, auxiliary functions, such as fire brigade, which have been imposed by regulatory requirements, are often assumed by operations staff. At one plant a fire marshal position was filled by an SRO who was taken off the shift crew, while at another plant the responsibility for fire brigade became one more task assigned to the shift crew staff.

These case studies reveal the extent and range of external pressures on operations staff. Regulations and regulatory requirements have both directly and indirectly affected operations staffing needs by

- affecting the workload of operations departments;
- adding responsibilities which are met by creating new positions that are filled by operators recruited from the shift crews; and
- limiting the amount of overtime worked.

Pressure to enhance operator training both increased workload of the operations staff and drew off staff from operations to fill training positions.

5.2 Economic Pressures

In contrast to the greater impact of external pressures on operations departments, economic pressures may have somewhat less influence on operations staffing decisions compared to staffing decisions in other departments. Because operations staff, particularly the control room staff, are the primary focus for plant operational and safety performance, operations staffing receives considerable regulatory oversight. This high level of regulatory attention tends to make operations staffing more immune to the impacts of economic constraints than staffing of other areas.

Other reasons also contribute to operations staffing being relatively immune to economic constraints. The centrality of operations with respect to input into and oversight of much of the work done at the plant means that the size of the operations staff tends to function as a limiting force on the number of other plant staff and on the amount of work that can be supported and maintained. Control room staff and shift crew members not only continuously monitor existing plant conditions and conduct the day-to-day reactor operations, but are responsible for tasks related to the work of other departments, such as responding to maintenance work requests by tagging out equipment and bringing equipment back on-line. At all seven plants there was a general consensus that maintenance work was especially dependent on operations input.

In addition, most operations work does not lend itself to being handled by temporary contractors. Very few contractors were used in the operations departments at any of the plants visited. The few specialized activities that were contracted out involved operations procedure writing and refueling activities.

The critical nature of operations work combined with the fact that most of the work cannot be contracted out are compelling reasons to expect operations staffing decisions to be more immune to economic pressures than staffing decisions in other departments. A review of staffing decisions and changes reported by the plants provides some support for this contention, but also indicates that operations staffing decisions that do not involve control room or shift crew staffing may not be as protected from economic pressures.

Not only have increases in operations staff been quite widespread, but these increases have been fairly substantial. As indicated in Chapter 3, a sixth shift crew has been added at six plants within the past five years, and adding a seventh crew is being considered at Plant 6, in spite of a high level of concern regarding the plant's economic situation. Adding an entire crew complement represents a substantial cost increase for the plant.

In addition to increases in the number of crews, several plants increased the number of positions per crew. Across these seven plants, thirteen new or proposed increases in the number of positions were mentioned; ten of the thirteen positions increased the number of staff in the control room (see Table 5.1). Only three of these new positions involved persons outside the control room. An AO was added at Plants 3 and 6. An auxiliary operator helper was added at Plant 5. In spite of the relatively few increases in the number of AOs, there was a basic consensus among interviewees across plants that AOs had the greatest individual workloads. AOs were also reported to work more hours of overtime than other crew members. Thus, immunity to economic constraints appears to be less for unlicensed operators than licensed operators positions.

The site visits indicate that the effect of economic constraints on positions outside of the operations shift crew may be even greater. In some cases, even though new non-crew positions had been officially approved, these positions had not been filled due to economic constraints. For example, at Plant 2 several operations support coordinator positions that had been approved by management had not been filled. In addition, there was considerable agreement among interviewees at six of the plants that staffing shortages were greater for operations administrative staff than for shift crew staff. The exception, Plant 6, was experiencing a shortage of shift crew staff due to license requalification examination failures. At Plant 5, interviewees noted that while the level of control room staffing exceeded that of similar plants, their total operations staffing level was lower. This was perceived to be a fairly significant problem. At most plants there was a sense that non-control room duties were becoming increasingly important in determining operations staffing needs.

As clearly shown in the case studies, economic pressures have had some effect on operations staffing, even though this impact may be less than for other departments. While the number of shift crews, as well as the number of positions per crew, have increased in spite of economic pressures, there was a general level of agreement at six of the seven plants that the most pressing operations staffing needs now involve non-crew positions.

5.3 Performance Issues

Performance concerns can be divided into two basic categories: safety and efficiency. Regulatory pressures drive plants to be concerned about safety-related issues; economic pressures drive plants to be concerned with efficiency. Efficiency concerns were clearly seen by interviewees as becoming a more important performance concern during the period of time covered in this study. Several plants had recently undergone systematic organizational assessments of staffing levels and allocations for the purpose of improving plant efficiency. While there was also evidence to indicate that self-identified safety concerns had a strong role in determining operations staffing decisions, most of the safety issues mentioned at these plants as driving staffing changes were in response to NRC or INPO concerns. However, there was evidence of a growing concern on the part of a number of interviewees at these plants that buffering the control room staff from the ever-expanding demands on their time and attention was becoming an increasingly important issue.

5.3.1 Efficiency

Concern with efficiency for the plant as a whole was expressed in three areas: eliminating redundancies, increasing technological sophistication and computerization, and improving coordination. Only the last area was seen by interviewees as having a strong effect on operations staffing needs and decisions.

Eliminating redundancies was seen by interviewees as mainly affecting the arrangement and composition of the engineering staff. Responses to questions about the effect of computerization on operations staffing indicated that operations departments had not experienced much of an

Table 5.1 Changes in crew composition

Plant	Changes in Composition by Plant
1	1982: Added extra SRO (CRS) 1987: Added 6th crew 1992: To add STA to shift crew
2	1988: Added 6th crew
3	Mid-1980s: Added 5th crew 1989: Added 3rd SRO and 1 AO
4	1986: Removed 1 RO 1987: Added AO Mid-1980s: Moved STA on shift crew; added 1 Shift Supervisor 1988: Added RO back to crew
5	1985: Added AO helper Late '80s: Added utility shift operator (RO)
6	Recently added RO and AO to crew
7	Recently added two Class "C" AOs and will lose two Class "B" AOs

Key:
SRO: Senior Reactor Operator
CRS: Control Room Supervisor (SRO license)
STA: Shift Technical Advisor
RO: Reactor Operator
AO: Auxiliary Operator, also called Nuclear Auxiliary Operator (NAO), Nuclear Operator (NO), Equipment Operator (EO), Technical (or Turbine) Auxiliary Operator (TAO), and Nuclear Plant Operator (NPO).

impact. The only operations activities mentioned by interviewees as having efficiency improvements due to computerization were maintaining control room logs and performing tag outs.

On the other hand, efforts to improve inter-departmental coordination of plant activities were mentioned at all seven plants as having a large effect on operations. In addition to implementing an outage planning group, several plants have recently introduced a non-outage work planning and scheduling group. At some of these plants, the group was headed by an operations representative. At other plants, a designated work planning and scheduling group liaison was created in the operations department. In addition to coordinating roles associated with work planning and scheduling, one or more specific liaison positions were established by several operations departments to improve coordination between operations and engineering, operations and maintenance, and operations and radioactive waste (see Table 5.1).

5.3.2 Safety-Related Performance Issues

The extent to which regulatory pressures have affected operations staffing has previously been discussed. However, there are other ways that safety considerations are beginning to affect operations staffing practices. Increased workload is becoming one of the major safety issues facing operations departments. The critical concern is to buffer the control room staff from increasing workload demands in order to maintain adequate surveillance of the panels and monitoring of plant conditions. In spite of the relative stability in the amount of work required to directly operate the plant, several plants reported increased numbers of control room operators. This increase was not because surveillance of the panels now requires more staff than in the past, but rather because operators who are responsible for control room operations are often burdened with other tasks.

Besides the coordination role played by operations staff, other factors have contributed to increasing the workload of operations staff. Several of these factors have been mentioned previously. Training was the most frequently mentioned factor affecting operations workload during the past five years. Both operator training as well as assistance in helping the training department handle its workload have had a major effect on operations departments at all seven plants. Paperwork and procedures-upgrading were the next most frequently cited causes of increased operations workload. Finally, various added responsibilities, such as fire watch or converting to in-house refueling, have had an impact on operations workload.

The need to buffer operations staff from these additional workload demands is particularly an issue for the day shift. Even if some of the paperwork is done on the night shifts, day-shift personnel, especially supervisory-oversight personnel, often tend to have less time to attend to operations functions per se.

The ways in which plants were attempting to buffer the operations shift staff varied substantially. Administrative positions were added to four plants to relieve the control room operators of some of the paperwork. At one plant, an administrative shift rotation was created to function as a day shift performing administrative tasks for a one- to two-year period, after which time it would move back into the regular shift rotation schedule and a different crew would rotate into the administrative day shift (see the discussion in Chapter 3). This was a unique solution to buffering the control room crews from excessive paperwork demands.

At most plants, both administrative and coordination positions were added. The purpose of adding these coordinating positions was to create a single point of contact for other departments, both enhancing efficiency and preventing as many of the demands as possible from burdening operators. For example, at Plant 1 a new day shift position was created for providing support to special projects, assisting training, and overseeing emergency preparedness. However, review of design changes were reported to take up 100% of the time of this new position. A second person was added, which was still considered insufficient to cover all the tasks allocated to this position. Also, at one plant, encouraging shift supervisor level operators to assume temporary one- to two-year positions in other departments, in order to increase the level of operations input to these departments while decreasing the burden on the operations department, was being considered. Finally, at two plants a separate operations support group or department was created to buffer the operations department from as many non-control room activities as possible. Most administrative and coordination functions are to be handled by the operations support group, allowing control room operators and operations department supervisors to concentrate on the day-to-day operation of the plant.

In general, at smaller one-unit plants the simpler strategy of establishing new administrative and coordination positions has been adopted. At both plants where the most elaborate strategy of creating a separate operations support group was adopted, the plants were older plants with two or more reactor units. It may be that there are more demands on the operations staff at older plants because, as several interviewees suggested, older plants often have a more difficult time upgrading to meet some of the post-TMI NRC regulations and higher performance standards industry-wide.

5.4 Summary

External pressures aimed at enhancing plant safety continue to have a strong effect on the number and composition of the operations staff. However, economic constraints, such as hiring caps, appear to have a lesser effect on operations, particularly control room staffing, compared to staffing in other departments. Recently, a new safety concern that is not solely a direct response to external pressures has had a growing impact on operations staffing decisions. This safety concern stems from increased workload demands on operators and the need to buffer operators in order to ensure proper surveillance of control room boards and plant conditions. In addition, growing economic constraints have made efficiency an increasingly significant performance concern of several of the plants that were visited, and efficiency concerns have tended to increase operations staffing needs relative to other staffing areas. The need for greater operations input and the need to buffer operators from escalating demands on their time and attention are increasingly driving operations staffing decisions at all seven plants. These needs are in many ways contradictory, and meeting both needs constitutes one of the biggest challenges currently facing these operations departments.

6 Processes for Staffing Level and Composition Decisions

In previous chapters, key staffing changes and the driving forces behind them have been outlined. In this chapter the processes used in making staffing decisions in nuclear power plants are explored. The particular issue of interest is how decisions are made at plants about adding authorized positions: how additions are planned, how additions are justified, and where decision-making authority lies.

6.1 Planning and Analysis

Plant staff reported using two distinct methods for planning and analysis of staffing needs. The first method involves ongoing planning for long-term staffing needs, while the second method involves periodic intensive reorganization or planning initiatives.

The first method--routine long-term planning--was used at two plants out of the seven sites visited. At Plant 1 managers are required to submit five-year staff projections, and, in order to request additional staff, managers prepare a justification report and a budgeting report. The justifications refer to needs due primarily to anticipated requirements (including expectations of the NRC, INPO, and NUMARC) and actual or anticipated changes in workload. The request then undergoes a peer review and proceeds up the chain of command for approval. At Plant 4 there is a five-year planning process for construction projects, which involves identifying needs due to regulatory changes and looking at the types and sizes of anticipated projects in an attempt to match resources to workload. Similarly, there is a three-year rolling schedule at this plant for predicting staff needs in maintenance and operations, based on new projects and the budget available.

At the Canadian utility, a maintenance labor-forecasting system has been developed. This systematic planning tool projects maintenance workload by factoring in the historical allocation of staff hours for corrective maintenance, preventive maintenance and modifications, plus equipment reliability statistics, outage data, backlogs, and expected modifications. Then the amount of work anticipated for the next ten years is predicted. At this point, this is a very new tool, and it is just beginning to be used to justify overtime usage. There are plans to use the system in the future for projecting maintenance staffing needs. The use of maintenance forecasting tools was not mentioned at any of the U.S. plants.

At five sites interviewees reported using the second method, periodic reorganization. Each of these plants have undergone an intensive planning or reorganization initiative in the past five years. These reorganization initiatives involve a large number of staff and significant resources. The outcome usually is an altered organizational structure based on a systematic analysis of staffing needs. Often these initiatives are utility-wide, and they are generally prompted by economic pressures or efficiency concerns. While the intent is usually to reduce staff by eliminating redundancies, in the case of two of the older plants these utility-wide assessments led to an increase in staff in the nuclear operation division of the utility. In both of these cases there was a decrease in staff in most other divisions of the utility.

These reorganizations are noteworthy for several reasons. First, the reorganizations demand a lot of resources, either through the use of external consultants or by redeploying utility staff to focus on organizational issues. (For example, a manager at one plant estimated that 11 managers worked full-time for one year on their recent internal review of operational effectiveness and resulting reorganization.)

Second, perhaps as a consequence of the resources expended, respondents reported that it was difficult to have staffing levels changed in later years after they had been established based on the organization-wide analysis. These one-time planning efforts yield a recommended structure and staffing complement, which appear to be difficult to change in subsequent years.

A third aspect of utility-wide reorganization is the issue of multiple sites within larger utilities. It may be the case that the structure and staffing complement recommended in the course of a utility reorganization is not suitable for all plants operated by the utility. This was considered a difficulty for staffing decisions at Plant 3, an older, two-unit site whose parent utility also operates a newer, post-TMI era two-unit site. Respondents at Plant 3 expressed the opinion that the staffing levels suggested by the recent review of activities and resource allocation might have been appropriate for a newer plant, but failed to take into account some particular and differing demands on their plant, which was much older. They thought that issues and needs that were unique to their circumstances were overlooked by the utility-wide review and reorganization. Only recently, after considerable efforts by plant staff and management, were these differences receiving attention and serious consideration by utility management.

Respondents at two of the sites visited reported that their plants tend to be largely reactive in their decision making about staffing. A respondent at one plant, a site with a history of poor performance, stated, "We don't usually plan--we react." This plant has historically responded to poor NRC reviews, INPO audits, and public pressures. Recently, a new planning initiative was undertaken with the assistance of consultants, which will focus on operations needs and emphasize efficiency in running the plant.

At another plant, one manager reported that there was no systematic decision-making process; instead, staffing needs are determined "backwards." He reported that plant management does not look at the numbers of staff needed to do the work. Instead, they have periodically cut back on approved positions, then augmented staff with contractors as needed, then eventually replaced contractors with permanent staff as appropriate, thereby starting the cycle over again.

While managers and staff spoke readily about new initiatives, new programs, or new work that had been adopted by the plants, there was no mention of systematic analysis performed regarding staffing for new work initiatives. For example, when a task, such as fire brigade duty, is added to an operator's workload, a new job task analysis is not performed. This leads to staff in some cases feeling overloaded or feeling that new tasks are handed down without systematic assessment of the feasibility of performing them.

Similar patterns of decision-making are seen in the process of changing shift schedules for operators. At both Plant 3 and Plant 5, a 12-hour shift schedule was implemented in the past few years, but the processes for that change, and the consequences, differed greatly. At Plant 3, the change was implemented utility-wide (the utility operates one other two-unit plant), and staff at the site expressed several negative opinions. Many operators felt that the new shift had essentially been handed down to them. Interviewees indicated that they were given little input, little notification, and little training in the new shift rotational system. As a consequence of all of the above, the operations staff was dissatisfied with the new shift schedule and was pressuring management to return to eight-hour shifts. In contrast, a systematic assessment was conducted at Plant 5 before implementing a 12-hour shift. They hired consultants to review schedules, conduct computer-based alertness testing, and make scheduling recommendations. Operators voted on the change and accepted a trial period, after which they voted again and instituted the 12-hour shift. Respondents report being very content with the shift schedule. While this example has to do with staff deployment rather than staff level or composition, it is included here as an illustration of different planning processes.

In conclusion, the managers at plants surveyed for this study do not, for the most part, engage in on-going routine long-range planning for staffing needs. However, some of the reorganizational initiatives have been extremely thorough and systematic. A better understanding of the systematic criteria involved in a reorganization can be gained by examining one illustrative case.

6.2 Reorganization: A Case Study

Plant 3 is an example of the process used in a utility-wide re-examination of organizational structure and resource allocation. With the assistance of consultants, Plant 3's parent utility underwent a multi-step process of review and revision.

The first step was a thorough review of the current organization, activities, and costs. The organizational review included identifying all organizational units, each person within each unit, and the activities of each person. Special attention was paid to span of control issues: how many individuals each manager supervised, how many levels of management there were, and how much time was spent managing.

Activity review involved identifying every activity that every utility employee engaged in. Activities were coded as key activities, or the work for which the unit exists (e.g., monitoring the boards for an RO), management activities, administrative activities, and secondary activities (anything not key, management, or administrative). This enabled the identification of fragmented tasks, as well as the identification of time spent on secondary work. Activities were narrowly defined; for example, maintenance activities included maintenance of rights-of-way, maintenance of power sources, maintenance of generating equipment, and maintenance of overhead distribution lines. The cost review then assigned a staff time cost to every activity.

Each unit manager received a report listing all activities performed by the unit. The following information was outlined in this report: the payroll cost of each activity, the time spent on each activity, the number of other units where the activity was being performed, the number of people actually performing an activity, the number required if each person performed that activity full-time, and the average amount of time spent on the activity by each employee performing an activity (specialization).

This report was then used to identify the activities that command the greatest share of payroll costs, to clarify the relative focus or fragmentation of each activity, and to draw attention to those activities that might warrant additional resources. Another report was used to identify where each specific activity was being performed, to see where an activity might be reassigned to reduce duplication and inefficiency.

Managers then identified what was needed strategically, managerially, and organizationally. They acted to eliminate unnecessary activities, positions, and levels, and regrouped the remainder to clarify responsibility, focus on whole jobs, and ease communication. Missing elements--activities, resources, and positions--were added, and the eventual restructuring resulted in an increase in staffing in the nuclear operations division, both at the corporate level and at the plant level, while other utility components lost staff.

This example is offered as an illustration of the kind of detailed and systematic decision making that can occur in a utility-wide reorganization.

6.3 Justification for Changes

In this section, the reasons managers use to justify requests for staffing changes are explored. Managers were asked what criteria they looked at in determining that they needed to add positions to their department. The results are presented in Table 6.1.

The factors cited by the managers cluster around issues of workload (backlog of work, overtime usage, new programs or responsibilities). Many of these factors, such as backlogs, overtime usage, and daily workload, have a direct effect on safe operations. Benchmarking was cited at six of seven plants as a means of determining optimum staffing levels. Future work was cited at only one site as a justification, while at another plant the ability to be active rather than reactive was mentioned.

At one plant, documents were provided, which detailed justifications for 35 position additions that had been approved in 1990. In the summary for these 35 justifications, the reasons most often cited were regulatory pressures (the primary factor in 11 additions), reorganization (the factor in 10 additions), and INPO training accreditation (the factor in 7 additions). As discussed in the previous chapter, regulatory pressures include those from the NRC, NUMARC, INPO, and the PUCs. Regulatory forces were cited in relation to specific initiatives such as design basis review programs, as well as more general issues including configuration management, licensing liaison, and backlogs of work (which attract regulatory scrutiny). Other factors include new initiatives, increased workload, increased administrative burden, and increased computerization, all of which are used to justify additional positions. The NUMARC comprehensive procurement initiative was cited in three justifications, while INPO reaccreditation of training programs was a factor in a variety of work categories, including mechanics and electricians.

6.4 Authorization of Positions

The final aspect of staffing decision making is the management level at which the final determination is made regarding adding positions. Generally the plant manager has discretion to deploy positions within the plant as long as he maintains the given staff level. To add to that total level, however, requires approval farther up the chain of command.

How far up the decision is made is a function of utility complexity. At the smaller utilities (Plants 1, 2, and 5), the final decision is made by the CEO. Within a smaller organizational structure, such decision making is located with the top command. At Plants 3 and 4, both of which are part of larger, multi-divisional utility companies, the final decision for approving staffing increases is made by the senior vice president of nuclear operations. Here a senior vice president of nuclear operations makes those decisions in a larger utility where specialized understanding of the needs of the nuclear units might be a factor in decision making. Plants 6 and 7 present a slightly different case. While both plants are operated by larger utility management structures, which also operate other nuclear units, in both cases the final staffing decisions are made at the top by the CEO or the managing director. The difference here is that both of these utilities are almost exclusively concerned with operating nuclear stations. That is, the corporate management either operates no other forms of power generation stations (e.g., fossil, hydro, etc.), or it operates generating units that are a very minor element of the overall organization. Thus the specialized nuclear power operation knowledge and oversight that resides with the senior vice president of nuclear operations at Plants 3 and 4 resides with the CEO at Plants 6 and 7.

Table 6.1 Criteria used to justify new positions

Criteria	Number of Plants
Backlog of Work	7 of 7 plants
Benchmarking	6 of 7 plants
Overtime Usage	6 of 7 plants
Workload	4 of 7 plants
New Programs or Responsibilities	4 of 7 plants
History	2 of 7 plants
Task Analysis	2 of 7 plants
Absenteeism	1 of 7 plants
Turnover	1 of 7 plants
Contractor Usage	1 of 7 plants
Customer Satisfaction	1 of 7 plants
Future Work	1 of 7 plants
Ability to be Active	1 of 7 plants
Requirements	1 of 7 plants

6.5 Summary

In this chapter, it has been established that most of the nuclear power plants visited do not have an established on-going planning cycle for analysis of staffing needs. Instead, it appears that it is more typical for periodic utility-wide reorganizations to take the place of on-going analysis activities.

In the next chapter, the mechanisms used by nuclear power plants in implementing staffing changes is explored.

7 Staffing Policies and Mechanisms for the Plant

In previous sections of this report, the key staffing changes that have occurred in nuclear power plants over the past five years have been outlined and the reasons for those changes have been explored. The key changes observed were increases in staffing levels at all plants and expansion of administrative, coordinative, supervisory, and operational positions within operations. The primary driving forces were regulatory pressures, economic constraints, and performance issues.

In this section, the policies and mechanisms through which these staffing changes have occurred are discussed. The mechanisms to be discussed are plant reorganization, contractor reliance and reduction, hiring freezes, and overtime policies and constraints. Each mechanism represents a manner of meeting regulatory and performance expectations while curtailing the expansion of economic costs.

7.1 Plant Reorganization

As discussed in Chapter 6, five of the seven plants in the study sample underwent a major reorganization initiative in the past five years. These reorganizations were generally utility-wide, prompted by concerns for efficiency and cost-effectiveness. And each reorganization led to significant staffing changes.

Plant 2 underwent two reorganizations in the 1980s. The first, in 1984, was prompted by a PUC audit that recommended a complete organizational assessment. At this time, the corporate human resource department performed job task analyses of all positions to determine optimal staffing levels. In 1988, an INPO review suggested, in the words of one respondent, that "they weren't doing so well," and so the utility brought in a consultant for a management audit. Most of the resulting restructuring occurred at the managerial level, with one layer of management being eliminated. Concerns about communications and oversight also contributed to the reorganization, which resulted in decentralization and greater delegation of authority to unit managers, as well as more direct responsibility for support activities. This reorganization allowed the general manager for plant operations to focus on safe and efficient operation of the plant.

At Plant 3, a utility-wide review of activities and resource allocation was implemented in order to cut costs and plan for the future. As described in Chapter 6, systematic analysis of workload, task analysis, and staffing resulted in widespread restructuring. While most utility components lost staff as a result, the nuclear group gained staff. While the initial driver for this utility-wide reorganization was pressure toward cost-efficiency (from the PUC and in anticipation of future need), the timing of the review coincided with a period when the plant was under significant NRC scrutiny, due to performance problems. The resulting restructuring aimed to broaden corporate structures for better oversight and control in the nuclear organization. The corporate vice-presidential level was restructured for better oversight, and assistant managers were created at the plant for more direct lines of reporting and authority, to reflect added emphasis on licensing and regulatory issues. The plant staff was also increased as a result of this reorganization.

At Plant 4, the emphasis was also on efficiency, and the focus was on management. A utility-wide review assessed the tasks that people performed in order to make the tasks more consistent across sites. Another aim was to reduce levels of management both at headquarters and at the sites. By reducing the number of managers and increasing their span of control, the intent was to ensure that managers were full-time managers, rather than splitting their time between managerial tasks and operational tasks. Efforts to streamline and increase efficiency were behind this refining of areas of responsibility.

The reorganization at Plant 5 was also part of a utility-wide review, prompted by a need to be more effective without increasing staff. A thorough review of job descriptions was combined with staff interviews and assessments to determine optimum organization. The restructuring resulted in a shifting from discipline-based groupings to function-based groupings (e.g., engineers assigned to groups based on the work they perform). One respondent indicated that a number of "small pockets of bureaucracy" were eliminated in the interest of responsiveness and cost-effectiveness.

The case of Plant 7 is unusual in that reorganization came about as a consequence of the plant being absorbed into a large, multi-plant management structure. Again, cost-effectiveness was an issue: in order to receive approval for the merger from the PUCs, the management group had to provide assurances that the restructuring would not drive costs up. A consolidation study recommended centralization of support functions (e.g., design engineering, licensing, human resources) to the corporate level. Chronic craft-labor shortages during outages suggested the possibility of centralizing a permanent outage support staff that could work at the several nuclear sites operated by the management group. This was the only plant that had experienced decreases in staff size in several of its departments.

The Canadian case is similar to the U.S. experience with reorganization. At the time of the site visit, the Canadian utility was in the midst of a redesign of the organizational structure of all of its nuclear plants. The goal of this reorganization was to restructure the work in such a way as to increase individual performance and efficiency without adding staff. The reorganization was prompted by the utility's difficult financial state, which coincided with a period of poor performance at one site. The recommended restructuring (which had not yet been approved) involved no net staffing changes and a new plant organization that was expected to increase efficiency, promote autonomy, and stimulate employee motivation. In the words of one manager involved in the reorganization, "It was designed to have no effect on staffing needs. Instead, it's a better way to use the staff we have."

Reorganization, then, is generally forced by concerns for economics, efficiency, or performance. While reorganization is usually undertaken to change organizational structures to reduce or maintain the existing staffing levels, it often results in staff increases in some areas, notably in nuclear operations.

7.2 Contractor Reliance and Reduction

The use of contractors is common practice in American nuclear power plants. Contractors are used to supply specialized labor, to augment the regular workforce during periods with special work needs (such as outages), and to help a plant meet short- or long-term temporary initiatives (such as steam generator tube replacement). Both the reliance on contractors and the reduction in their use are important staffing mechanisms.

It is often difficult for managers to justify the addition of new positions, even to accommodate additional work. Respondents have reported that it is often easier to receive permission to hire contractors than to increase permanent staff. Especially if there is a utility-wide hiring freeze, as there was at Plant 1 in the 1980s, hiring contractors may be the only permissible way of acquiring the labor needed to carry out necessary work functions. However, contractor reliance has certain drawbacks. While it can often offer an effective short-term solution to staffing problems, reliance on contractors presents long-term costs. This proved to be the case at Plant 1, where many contractors were used on a year-round, full-time basis due to the hiring freeze. An analysis revealed that the cost of a single full-time, year-round contractor was 1.8 times the cost of a full-time utility employee. A systematic program of contractor replacement (hiring permanent utility staff instead of using contractors) was begun at Plant 1, which was cited as the primary reason for the 46% increase in staff the plant has experienced in the last five years.

Indeed, at all seven of the plants visited in this study contractor reduction was reported to be a factor in plant staffing changes. In each case, the effects of economic constraints can be seen. Of course, there are other issues in contractor use too, including difficulty in hiring and retaining qualified contractors and coordinating and overseeing contractor work. The primary reason cited for reducing contractor use, however, was economic. When contractors are used on a regular full-time basis they cost more than permanent staff.

This cycle of contractor reliance and contractor reduction illustrates the ad hoc approach to staffing decisions noted by a manager at Plant 7, as cited previously. However, this cycle may also be a practical staffing method. That is, when a new work initiative is presented to management, it is not always clear how much work will be involved, nor how long the program of work will take to complete. Hiring contractors may be more efficient under such circumstances than hiring permanent staff. If, over time, it becomes evident that there is a long-term need for additional workers, the contractor positions can be converted into permanent plant staff positions.

In contrast to the U.S. situation, collective bargaining agreements in Canada preclude the extensive use of contractors. In facing a major system overhaul like steam generator tube replacement, additional permanent staff is hired at the Canadian utility, with the expectation of retaining and redeploying these new employees once the new project is completed.

It is important to note that contractor employees are rarely used in the operations department. When they are used, it is generally for clerical work or procedures work.

7.3 Hiring Freezes

As mentioned previously, contractor reliance is especially prevalent when hiring is constrained by hiring caps or hiring freezes. In essence, all plants have a hiring cap in that they operate with a fixed number of authorized positions and are required to justify any additions to that headcount. A hiring freeze where the plant or utility is enjoined from making new hires even to fill authorized positions is a different issue and generally occurs in response to significant economic problems.

Two plants in the sample experienced hiring freezes in the 1980s, while at a third plant a freeze was instituted in 1990 and was on-going at the time of the site visit. The two earlier hiring freezes present interesting cases, because they enable analysis of the after-effects of those freezes.

At both Plant 1 and Plant 4, the hiring freeze lasted for three years. In each case, contractors were successfully hired to augment the utility staff. What is especially interesting is the staffing changes that occurred in the aftermath of each freeze. At Plant 1, there was a significant hiring boom, involving both contractor replacement and staffing up to meet requirements and the staffing levels of similar plants (benchmarking). At the utility, considerable effort was expended to manage the increase and to add new staff gradually, and there are plans to continue to add staff in the coming years. Several respondents who had worked at the site for many years had some concerns about this significant increase in staffing levels. Respondents felt the loss of a small organization atmosphere where informal contacts were a major mode of communication, and they expressed concern about the pace and the scope of expansion, even as they acknowledged the need for additional staff.

The hiring freeze at Plant 4 occurred from 1984 to 1987, during a time when new plants were being brought on line. The lifting of the freeze in 1987 was followed by a utility-wide assessment and analysis that resulted in significant reorganization and staffing up in all parts of the nuclear division. Respondents at the plant still felt the need for additional personnel but recognized the difficulties inherent in pushing the O&M budget too far, especially after it had undergone a 50% increase since 1986.

In both of the above cases, the hiring freeze caused by economic difficulties was followed by reorganization or expansion. The third case is somewhat different. At the utility for Plant 2, a hiring freeze was instituted late in 1990 due to serious downturns in the local economy. A reduction in sales of 20% was experienced at the utility due to a recession in the major local industry. During the same period, the utility underwent some organizational review and reorganization. As a consequence, some new positions were created and authorized but have never been filled due to the hiring freeze. The freeze has created difficulties with mobility and promotion.

In all three cases, the hiring freeze was a response to economic pressures. In each case, the effect on staffing was determined by the plant's particular situation, but the three instances together illustrate the use of hiring freezes as a staffing mechanism.

7.4 Overtime Policies and Constraints

When budgets are restricted or when hiring is frozen, overtime is often used rather than hiring new employees to perform necessary work. Such overtime use is often easier to justify than hiring new staff and is seen by some as easier than using contractors. Staff at four of the sites visited mentioned that overtime was less expensive than hiring new staff or contractors.

However, plants are faced with two pressures to reduce overtime use. One pressure is economic: at three plants increased pressure to reduce overtime use because of cost considerations was reported. Especially in departments outside of operations, there is a growing sense that some overtime could be reduced by better planning, coordination, and efficiency. The second pressure is regulatory guidance on limiting overtime use. This guidance recommends that operators and other personnel in safety-related positions work no more than 16 hours in one day, 24 hours in two days, and no more than 72 hours in a week. While these recommended overtime limits can be exceeded with management approval, interviewees indicated that there is pressure to stay within the policy guidance of the NRC.

7.5 Summary

The primary staffing mechanisms used at the plants in this study include plant-wide reorganization and reassessment of position responsibilities, cycles of contractor reliance followed by contractor reduction, temporary hiring freezes, and selective overtime use.

In the next section, mechanisms for staffing the shift crew are explored in detail.

8 Staffing Policies and Mechanisms for the Shift Crew

Important functions in staffing operations at nuclear power plants are to find, train, and retain qualified operators. In this chapter those activities of human resources staff and operations staff that seek to find and retain qualified personnel are discussed. All power plants are under financial constraints that limit how many staff can be hired, promoted, and trained. However, as was discussed in Chapter 5, operations departments appear to be less constrained in hiring staff than are other departments. Thus, there is more flexibility to recruit and retain operations staff. The current status of turnover and retention of operations staff through recruiting, promoting, and scheduling in operations is discussed in this chapter.

First, current turnover and retention rates and practices are described. Next, recruiting practices and issues are presented, followed by a discussion of career paths in operations and management. Thus, in this chapter actual staffing practices are described in light of the driving forces that influence staffing decisions as presented in previous chapters.

8.1 Turnover and Retention

Turnover in operations is a difficult issue because, in addition to the usual concern over experiencing high turnover, there is also a problem if turnover is extremely low. This paradox occurs because it is expensive to train and license operators, so the loss of these operators is expensive in terms of time and money; however, a certain amount of turnover is necessary to provide opportunities for promotions. Thus, when turnover is very low, there is little opportunity to promote newer operators and operators-in-training.

At the sites visited in 1991 and 1992, turnover rates ranged between 1.6% and 13.5%, as seen in Table 8.1. Utility human resources personnel were asked to provide data on turnover rates. However, these data were not consistent across sites and so were averaged in with estimates made by respondents. At six of seven plants, turnover was fairly low, 6% or less per year. At one plant, turnover was reported to be about 13%, which is somewhat high. At four of seven plants, the entry-level operations positions (clerks or AOs) had the highest turnover (they also make up the greatest number of people in operations). At Plant 4, ROs had the highest turnover. At this plant, if an RO does not succeed in obtaining an SRO license, he or she usually leaves operations. It is important to note that most turnover is the result of internal transfers, not staff leaving the plant.

Once an employee is licensed, it is a considerable burden for the employee to be replaced since it is time-consuming and expensive to train a replacement for licensing. Thus, significant management attention is directed at ways to retain licensed personnel, generally resulting in lower turnover in licensed operator positions.

Ensuring a sufficient labor supply of licensed operators is an important staffing issue. Long-term planning is necessary to ensure an adequate future supply of licensed operators because of substantial and lengthy training requirements. In addition, there is a degree of uncertainty in projecting the progression of staff through the system because of initial and requalification licensing examination requirements. However, it is expensive for plants to maintain additional back-up licensed positions beyond the needs of shift-crew staffing because of the annual training and requalification requirements to maintain operator licenses. The various approaches used to retain staff are discussed in the remaining sections.

8.2 Shift Schedule

Shift scheduling, particularly the use of a 12-hour shift, was reported by management and operators at a number of plants as a means to retain operators. The shift schedules of the seven plants visited are discussed in detail below.

At three plants, a 12-hour shift schedule was mentioned as a way to retain operations staff. The shift schedules of the seven plants that were studied are presented in Table 8.2. Overall, at three of seven plants changes in shift schedule are planned in the near future. At one of the seven plants, the shift schedule was recently changed, so more than half of these plants are in shift schedule transition.

Below some key points concerning the use of 8-hour and 12-hour shifts are summarized.

Four of seven plants currently use an 8-hour shift schedule; three plants use a 12-hour schedule. Two of the four plants on 8-hour shifts plan to change to a 12-hour schedule in the near future; one of the three plants on a 12-hour shift plans to change back to an 8-hour schedule.

At one plant, operators who were on a 12-hour shift returned to an 8-hour shift schedule due to dissatisfaction. The operations department was understaffed and operations staff were not allowed to take extended periods

Table 8.1 Annual turnover in operations

Plant	Estimated Turnover	Positious with Higher Turnover
1	10.0%	None noted.
2	13.5%	Lower among NOs.
3	1.6%	Shift clerks have highest turnover.
4	6.2%	ROs. If you don't make SRO, you leave.
5	4.1%	AOs have highest turnover.
6	6.0%	Clerical engineering has highest turnover.
7	6.0%	AOs have highest turnover.

away from work, which was seen as the main advantage of the 12-hour shift schedule. Thus, operations staff worked a lot of overtime and had only limited time away from work. Health physics and chemistry staff have remained on 12-hour shifts at this plant.

Operators at two of the three plants currently using 12-hour shifts are very satisfied. They report advantages including extended time away from work, less forced overtime, longer vacations (in conjunction with regular days off), shift change back to the same people for more continuity, more time with family, easier commute times, and a less variable work schedule. The reported disadvantages of the 12-hour shift include longer periods of time in which staff are away from the control room, an increased daily workload because there are two people instead of three people working over each 24-hour period, and more operator errors because of fatigue.

At one plant, one-half hour of paid overtime is built into each shift schedule to cover the shift transition period. The paid overtime is seen as an advantage by operators, but may be a disadvantage for plants. Although the 12-hour shift is viewed as an improved schedule that is attractive to operators, both 8-hour and 12-hour shifts have certain advantages and disadvantages. The importance of adequate numbers of staff, planned time off, and a predictable work schedule, appear to be more important than shift length per se.

8.3 Recruitment

Overall, entry-level positions were reported to be relatively easy to fill. The major difficulty cited was that the process of recruiting new staff took too long, rather than that qualified applicants were not available.

The shortest time that it takes to fill a position is estimated to be three weeks to three months to hire and train an in-house person. Most respondents estimated the time to fill operations positions to be around 30-60 days. The more skill and experience the position requires, the longer it takes to fill that position.

While all interviewees reported that vacant positions are easy to fill at this time, most anticipate more difficulty in the future because fewer people will be available to be recruited from the Navy, and universities are dropping nuclear engineering or related technical programs. Location of the site was mentioned by interviewees at only one plant as causing difficulty in filling entry-level positions. At one site, location was an advantage since the site is located near a source of Navy personnel.

Interviewees from all of the plants in this study report that there have been recent changes to recruiting practices and that more changes are planned in the future. The changes involve targeting recruiting, expanding recruiting beyond Navy personnel, recruiting local candidates, and

Table 8.2 Shift schedule information

Plant	Plant Age	Shift Length	Year Implemented	Expected Change	Comments	Same Shift Schedule for All	Backshift Support: Maintenance On-Site	Backshift Support: Engineering On-Site
1	Older	8-hour		Yes	Plan to go to 12-hr. shift to help retention and work fewer consecutive days.	No. STA on 24-hr. shift	0	0 (5 say STA)
2	Older	8-hour		No		Yes	2-10 Ops Readiness Support Crew	0
3	Older	12-hour	1990	Yes	Expect to return to 8-hr. shift; workload too strenuous; union wants 8-hr. back.	Yes	10-20 (4 hrs. out of 24 hrs. not covered)	0 (3 say STA)
4	Older	8-hour		Yes	Negotiating with union to put in 12-hr. shift.	Yes (since '85)	~30	0 (Except outages)
5	Newer	12-hour	1990	No		Yes	0	0 (2 say STA)
6	Newer	8-hour	1990	No	Used to have 12-hr. shift; implemented poorly--not enough staff, so people got little time off.	No. STA on 24-hr. shift	17 swing shift 7 nights	1 on swing shift 5 maintenance engineers (1 says STA)
7	Newer	12-hour		No		No. STA rotates with crew but works 6-6 (rather than 7-7)	6	0

focusing on recruiting at regional community colleges and technical schools. Thus, candidates are being sought from a broader range of sources than in the past. Several interviewees mentioned affirmative action commitments and are seeking candidates who are women and candidates from different ethnic backgrounds. Recruiting was primarily an activity conducted by human resources personnel and some operations management staff.

Most human resources staff are becoming more involved in regional recruiting at technical schools and community colleges. Additionally, human resources staff at one plant work closely with and rely on a local community college as a major source of recruits. Other recruiting practices involve traveling to the locations of a nuclear power plant that is closing down and recruiting those staff who seek new jobs.

In summary, most human resources staff report that recruiting practices are becoming more systematic at the plants. There is less informal recruiting and hiring practices than was common in the past. Additionally, there are more systematic processes, such as structured screening interviews used to select staff.

An interesting contrast to the U.S. experience is seen in the Canadian case. The most notable recent change in Canadian recruiting practices was the inclusion of the shift operating supervisor (SOS), the equivalent to the SS in the U.S., in recruiting activities. The utility had encountered problems with retention of college-educated operators, and responded by involving the SOS in recruiting. The SOS could communicate more accurately the description and expectation of what an operator's duties entail. The more realistic a recruit's introduction to the demands of the job, the more likely he or she will be to stay on the job. Involving the SOS in recruiting is the Canadian response to potential retention problems.

8.4 Career Paths in Operations

A clear career path for operators and regular promotions are seen by most interviewees as important elements for retaining licensed operators on shift. When promotions are slow to come, management and staff believe that people will leave shift positions and transfer to other plant jobs. Typical career paths of operators and the alternative career options established by some plants are described in this section.

8.4.1 Operations Staff Career Paths

Career path descriptions indicate what positions operations staff see as normal promotion routes. Two data sources provide information about career paths. The first source is subjective impressions of the ease of promotions in operations, and the second source is the interviewees' actual career experiences--that is, what previous positions they have held prior to their current position.

8.4.2 Ease of Promotions

Many operators reported limited opportunities for advancement in the promotion path in the operations department. Most operators also appeared to judge whether promotions are frequent enough in comparison to how long promotions took in the past. For example, many of the current SROs or SSs had relatively short tenures in positions such as AO or RO. Their rapid promotion was due, in part, to the sharp increase in the number of operators needed during the 1980's because of a combination of post-TMI staffing requirements and a significant number of plants becoming operational during this period. High demand for operators led to fast promotion rates. This also appears to be the standard by which most current AOs and ROs judge the time it should take for promotions. Thus, according to this standard of the past, current time to promotion is often judged as taking too long.

Ease of promotions is directly tied to turnover rate: the more turnover, the faster the time to promotion. At all plants, low turnover was reported to contribute to slow promotion routes. However, low turnover is positive because it contributes to maintaining experienced staff on shift. This dilemma is being addressed at some plants. At one plant there were lateral transfers into other departments, particularly training departments. These transfers enable operations staff to gain other nuclear power plant experience. At another plant, selected operators are rotated out of shift work positions for one to two years for special projects, then rotated back on shift. This rotation scheme allows for others to be promoted and gives the operator some job variety and time off shift. Through this job rotation experienced operators are retained, plus operators benefit from increasing promotion opportunities.

8.4.3 Career Experiences

In order to better understand the issue of opportunities for advancement, typical promotion routes and career experiences of interviewees are described in this section. Promotions in the operations shift crew are typically from AO to RO to SRO to SS. Interviewees were asked to estimate the time it takes to be promoted within operations. These data are presented in Table 8.3. At most plants it takes approximately four to seven years to be promoted from AO to RO. Moving from RO to SRO takes four years or less at three plants, but ranges from a low of one year to a high of 10 years.

Promotions to operations management (control room supervisor or shift supervisor) are not automatic. Interviewees perceive that Navy experience or some college education are advantages for promotion.

STAs have a different promotion route. They are often hired out of college and are on a fast track to get licensed. There are different criteria for their promotions over other operations people. STAs are also aligned with engineering or technical services, which have different promotion opportunities.

8.4.4 Summary of Career Paths in Operations

There is a fairly automatic path from AO to RO, but promotion is less automatic to SRO. After SRO, the promotions are to management positions and there are fewer opportunities. In addition, there are few monetary advantages to going into management. Interviewees often mentioned the lack of overtime pay as a disadvantage of management positions.

There is considerable variation at nuclear power plants regarding when training is offered for becoming ROs or SROs. At some plants, regularly scheduled training prepares operations staff for promotions and licensing; at other plants intermittent training is offered based on specific needs. Those interviewees from plants with regularly scheduled training reported less dissatisfaction with the time to promotion. There was more dissatisfaction when promotion routes were ambiguous, regardless of the length of time it took to get a promotion.

Table 8.3 Estimates of time length to promotion

Plant	AO to RO	RO to SRO	SRO to SS
1	4-5 years	3-4 years	8-10 years
2	2 years	2-4 years	1-3 years
3	8-10 years	5-10 years	--
4	3-7 years	6-7 years	--
5	4 years	1 year	--
6	5-7 years	--	--
7	4-7 years	4-6 years	--

8.5 Managerial Career Paths

Nuclear power plant managerial career paths were also investigated in this study. Of particular interest was how people in operations progressed out of operations into management, and what types of plant experience or education determined a management career track.

Based on the information supplied by interviewees about their work experience, engineering and operations work were the most commonly reported experiences leading to a managerial career.

Operations supervisors and managers have all had experience in operations, but engineering experience is also common. Engineering, maintenance, and training experience appear to be common experiences of managers in many departments (except health physics, chemistry, and security). While it is common for headquarters staff to have engineering experience, only a few have operations experience, in particular, those in the position of vice president of nuclear operations.

Engineering seems to be the most relevant experience for management; that is, most managers in nuclear power plants have had some type of experience in engineering at the plant. Additionally, most engineers have college degrees, which was considered an advantage and increasingly was seen as a requirement in practice, if not by policy, for higher management positions.

Almost all managers at the plants visited have college degrees. A college degree is not a stated qualification for promotion to management, but is the reported norm among managers. Most managers in all areas of the plant and at corporate headquarters reported having four-year degrees, typically engineering degrees. ANS 3.1 presents a standard for education and training of personnel that many utilities commit to; the finding that most managers have college degrees may result from commitments to that standard (American National Standards Institute, 1987).

Managers also reported diverse experience in the power plant. It was rare among the interviewees to encounter a manager who had experience in only one department at a plant, except for health physics or chemistry.

Few shift supervisors in operations at the plants visited reported having four-year college degrees. When they began work in the nuclear industry it was uncommon for operations staff to have a college education. Further, many came out of the Navy with considerable specialized training but little college course work. Current AOs and ROs typically reported having completed more college course work than current SSs.

Plant programs providing educational opportunities for operators appear to be part of the reason for the increasing number of operations staff with a college education. Educational opportunities include providing technical training and paying for college degree course work for operators. As more operators obtain college degrees, more management opportunities are likely to become available to them.

8.6 Summary

Current low turnover in operations has resulted in slow promotion rates, creating limited opportunities for advancement from the point of view of many AOs and ROs. This perceived stagnation is believed to cause dissatisfaction and may potentially result in increased turnover. Thus, most plant managers take steps to alleviate the problem.

Mechanisms to retain operations staff at the plants visited included the following:

- offering the benefits of a 12-hour shift length (primarily longer periods of time off);
- allowing lateral transfers from operations to training and other departments; and
- providing educational opportunities for operators.

However, the paradox of slow time to promotion and retaining licensed operators remains. Most interventions are aimed at improving both opposing processes. Further, management at most power plants continue to be concerned about staffing in the future. That is, they are concerned that the nuclear power industry is slowly diminishing and fewer people will be trained (e.g., through technical or university nuclear power programs). So, managers at the plants in this study are concerned about current and future staffing and are active in trying to improve their recruiting, hiring, and retention practices.

9 Summary and Conclusions

In this chapter the key findings are summarized regarding staffing patterns and decision processes at the seven U.S. nuclear power plants visited in this study. The links between staffing processes, pressures, and safety issues are discussed at the end of this chapter.

9.1 Changes in Staffing Levels and Positions

The most significant trend seen plant-wide was an increase in staffing levels at all seven plants. At all these plants, increases were seen in the main functional areas of operations, maintenance, and engineering, and at six of the seven plants there were increases in training staff. Departmental decreases in staff size were not typical. Decreases in only one area were reported at two out of seven plants. Decreases in several areas were experienced at only one plant, and this plant had become part of a larger utility management structure which, in turn, led to headquarters centralization of a number of former plant-level functions.

In the operations department, the major trends seen in staffing are as follows:

- addition of a sixth shift crew in six of seven plants;
- addition of coordination positions in five of seven plants;
- addition of administrative positions in four of seven plants;
- addition of licensed operators on shift in three of seven plants; and
- addition of supervisory staff on shift in two of seven plants.

9.2 Driving Forces

The general forces driving staffing changes at the plants in this study are external pressures, economic constraints, and performance issues.

External pressures include regulations and requirements. Plant staff reported experiencing pressures not only from the NRC, but from INPO, NUMARC, and the PUCs as well. Specific examples of these pressures include increased training requirements, the maintenance rule, design basis reviews, and the NUMARC procurement initiative. In most instances, new requirements or regulations lead to new work initiatives that drive staffing needs upward.

Economic factors tend to constrain staffing growth. Pressures toward cost-effectiveness and increased efficiency were cited by respondents at six of seven plants as curbing staff growth.

Major performance issues include performance concerns identified by the NRC and INPO as well as continuous increases in performance standards. To a lesser extent, there are some performance issues related to technological change and plant aging. Each of these factors tends to drive staffing levels upwards.

9.3 Impact of Driving Forces on the Operations Department

The general forces of external pressures, economics, and performance issues affect the operations department in several specific ways.

The external pressure having the greatest effect on staffing is the initiative to improve operator training programs. This initiative has both a direct impact, as operators (such as the sixth shift) are added to ensure control room coverage while operators spend more time in training, and an indirect impact, as operations staff members are increasingly called upon to support training departments. Other pressures affecting operations workload include operator input to design basis reviews of plant systems and to reviews of procedure upgrades.

Economic pressures appear to have less of an impact on operations staffing than on staffing in other departments. In particular, control room staffing is less affected by financial pressures than is staffing in other functional areas, due to considerable regulatory oversight of operations and the centrality of operations to plant safety.

As a result of plant performance concerns, administrative and coordination demands on operations staff have increased. These demands have led to more operations input into other departments' planning and work activities. This increased workload places greater burdens on operations staff, particularly the day-shift crew.

In general, operations staffing appears to be more strongly affected by regulations and requirements than most other plant departments, while operations staffing is somewhat buffered from the effect of economic pressures.

Plants have responded to increased industry-wide demands and specific plant performance concerns in a number of ways: establishing new, permanent non-shift operations positions; adding positions on-shift; and, in two cases, creating a special operations support group.

9.4 Processes for Staffing Decisions

Analysis of staffing decision-making processes revealed limited use of regular, on-going, long-term planning for staffing needs. Management at most plants in this study rely on periodic efforts to assess their departmental organization and staffing patterns. This approach results in a recommended organizational structure and staffing levels that are retained for several years.

The most common justifications offered for the addition of new positions are increased workload due to new programs or requirements, backlogs of work, and overtime use.

New positions are typically authorized at a very high level in the organizational structure, usually by the CEO or the vice president of nuclear operations.

9.5 Plant Staffing Mechanisms

A variety of staffing policies and mechanisms are used at plants to meet regulatory and performance expectations while curtailing the expansion of economic costs. The most common mechanisms seen in the site visits were as follows:

- reorganization of functional groups, usually based on a utility-wide initiative aimed at increasing efficiency and reducing costs;
- contractor use, including both reliance on contractors to augment authorized staffing levels and replacement of full-time, year-round contractors with permanent staff to reduce costs;
- hiring freezes or caps on hiring; and
- overtime policies, including the use of overtime to meet workload demands and constraints on overtime use to reduce costs.

9.6 Shift Staffing Mechanisms

Mechanisms for staffing the operations shift crew include retention programs, recruitment practices, and career paths.

In general, turnover in operations staff is relatively stable, with rates estimated at around 5-13% per year over the past five years. Shift scheduling policies are viewed by some plants as a mechanism for addressing turnover issues, with the 12-hour shift seen by some plants as a way to retain staff. Most turnover is due to shift staff moving to other positions in the plant, not to staff leaving plant employment.

Recruitment practices for operations staff have become more structured in the past several years. Recruits for operations positions are generally sought from a variety of sources, including the Nuclear Navy and local or regional sources, especially technical schools and community colleges.

Career paths for operations staff are fairly structured. The most significant concern mentioned was the issue of limited opportunities for advancement. Operators at the plants in this study face fewer promotional opportunities and a longer time between promotions than five years ago. There is concern at some plants that limited career opportunities may lead to higher operator turnover in the future.

Managerial career paths are distinguished by experience in several functional areas, with engineering experience of particular importance. Most managers hold a college degree.

9.7 Staffing Issues and Plant Safety

The findings presented in this report suggest several implications for plant safety. Four issues were raised concerning economic pressures, increased workload demands, appropriate numbers of licensed operators, and plant performance evaluations.

9.7.1 Potential Conflict Between Economic Pressures and Safe Operations

The strong and increasing pressure for economic efficiency is a consistent theme affecting all seven plants, as well as the Canadian utility that was visited. This pressure toward increased productivity to limit or reduce staff size is occurring at the same time as an increase in workload across all of the plants, due to the following:

- a general expectation of higher standards of operation;
- specific initiatives for industry-wide improvement, e.g., in training programs, in procurement systems, and in engineering reviews; and
- responses to individual plant evaluations that identify specific areas needing attention.

The sources of these workload pressures are both the NRC and the industry itself, primarily INPO.

The tension between economic constraints and increased workload demands has been central to staffing decisions at the nuclear power plants in this study. To the extent that economic constraints limit the plants' ability to meet increased work demands, there is the potential for an adverse effect on the safe operation of nuclear power plants. However, at this time there is no evidence to indicate that economic constraints have taken precedence over meeting safety-related workload demands, particularly within nuclear divisions of utilities and within the operations departments of plants.

There have been increases in operations department staff and the creation of new positions to meet specific added work responsibilities in almost all of the plants that were visited. In some cases, reassessments of staffing prompted by economic pressures have resulted in staffing increases rather than decreases. For example, two utilities in this study had gone through a corporate-wide restructuring analysis for the purpose of developing a more efficient operation and down-sizing staff. However, as a result of the restructuring analysis, staff was actually added in the nuclear operations division at these utilities. Staff size was reduced in most other areas of operation, such as fossil plants and customer service. In these cases, a systematic assessment of work responsibilities indicated insufficient staff at the plant level, as well as at the corporate nuclear division at one of these utilities.

Only one utility had a hiring freeze in effect at the time of the site visit. The freeze was due to a regional recession and a reduced demand for electricity. At two other utilities a hiring freeze had recently been removed, and significant staff increases followed the lifting of the hiring ban. While the use of contractors increases during freezes on hiring permanent staff, lengthy hiring freezes are a safety concern because of the limits placed on the plants' abilities to respond to new demands. One plant cited in this study had difficulty in upgrading the operator-training program during a hiring freeze period. Although contractors were used, this approach was considered inadequate. Additional reliance on operator input to improve the training program both increased operator overtime and placed an additional workload on operators during regular shift duties.

Continued NRC attention to the economic pressures faced by utilities is important to ensure that in the future economic constraints do not lead to inadequate staffing. Inadequate staffing could result in a plant's limited ability to carry out added responsibilities that are necessary to ensure the safe operation of the plant.

9.7.2 Increased Workload Demands on the Operations Shift Crew

The increasing demands on the operations shift crew at all plants visited have been discussed extensively in this report. The involvement of operators in design basis reviews, procedures upgrades, and training enhancement has placed an increasing burden of responsibility on the operations shift crew. While it was common for additional positions to be created to address some of these specific demands on operator time, it was also clear that operators felt that their overall workload was increasingly demanding. The trend of increasing operator involvement in current activities and new initiatives was expected to continue.

Because of the need to interact with other staff, such as from maintenance or engineering, the impact of the increased operations workload appears to be experienced primarily on the day shift. However, the other shifts are likely to pick up the uncompleted tasks of the day shift, such as updating paperwork.

Increased operator involvement in a broader set of tasks, particularly providing input into the conduct of new initiatives, has the potential of adversely affecting safe operations to the extent that these new demands interfere with the main function of operating the plant. However, this involvement also has the potential for enhancing plant safety. The inclusion of operator expertise in planning, reviewing, or at times carrying out work related to new initiatives may lead to improved approaches to plant functioning and to better integration across plant departments. For example, the breakdown between engineering department solutions and operations department needs was sometimes cited as an area where better coordination would lead to improved performance.

9.7.3 Maintaining an Appropriate Number of Licensed Operators

Maintaining a sufficient number of licensed operators to operate the plant is a critical part of ensuring plant safety.

Management at plants face the difficulty of maintaining enough licensed staff to cover unexpected needs for licensed operators, while not devoting limited resources to maintaining an over-supply of additional licensed staff.

For example, if some licensed operators do not pass requalification examinations, back up operators are needed. Without additional operators available, the remaining licensed operators in the regular shift-crew rotations take on additional shift hours to operate the plant. This increases the use of overtime and reduces the operators' scheduled time off. There is potential for decreased performance by these operators if licensed positions remain understaffed for an extended period of time.

On the other hand, there can be a problem of "too many licenses," as suggested by one utility manager who was interviewed. This manager's concern was a reduction in the time licensed operators were actually responsible for running the plant. He considered a high-level of on-shift experience with supervising normal evolutions and responding to unplanned situations necessary for the safe operation of nuclear power plants. While simulator training is a major way of providing operators with experience in responding to unusual situations on a regular basis, actual on-shift responsibility is also important in ensuring safe operations.

9.7.4 Impact of Performance Evaluations by NRC and Industry Review Groups on Staffing

The regular and event-based reviews of plant performance carried out by the NRC and by INPO have had a significant impact on staffing decisions at the plants in this study. Staff at these plants and their parent utilities took actions based on NRC and INPO evaluations of plant performance. Because of the impact of these evaluations on utility actions, these reviews can serve as an important mechanism for ensuring that plant management continues to emphasize safety-related needs as a basis for staffing decisions.

9.8 Implications for Regulatory Policy

Strong and increasing pressures to limit staff growth and become more economically efficient were found at all of the plants visited. These pressures are countered by regulatory requirements for operations staffing, policy guidance limiting the use of overtime, the need to maintain enough licensed operators, requirements addressing training programs, utility (as well as NRC and INPO) initiatives focused on performance improvement, and ongoing NRC and INPO plant performance evaluations that identify areas needing attention.

In general, operations staffing has increased despite economic pressures that would be expected to produce the opposite effect. This increase is due in part to the involvement of operators in a broader range of activities than in the past, driven by both regulatory actions and industry improvement initiatives. Although operations staffing has increased, operators generally think that their overall workload has increased even faster, and they expect this trend to continue.

The results of this study do not indicate that safety performance is declining. What these results do indicate is that opposing pressures on staffing decisions are strong, and that changes in the strength of these opposing forces could have a significant effect on plant staffing. The major forces, including their many components, that drive staffing decisions at a group of seven U.S. nuclear power plants were identified in this study. With these various factors identified it is possible to anticipate where imbalances between workload and staffing levels are likely to occur in the future. For example, the ability of staff in operations departments to take on many additional responsibilities is limited. Regulatory attention that focuses on the extent to which new activities are undertaken, the approaches to carrying out these new activities, and the bases for changes made in staffing levels can contribute to early identification of potential safety concerns.

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BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)

NUREG/CR-6122
PNL-8428

2. TITLE AND SUBTITLE

Staffing Decision Processes and Issues

Case Studies of Seven U.S. Nuclear Power Plants

3. DATE REPORT PUBLISHED

MONTH	YEAR
March	1994

4. FIN OR GRANT NUMBER

B5696

5. AUTHOR(S)

B. Melber, A. Roussel, K. Baker, N. Durbin, P. Hunt, J. Hauth, C. Forslund, E. Terrill, Battelle Human Affairs Research Centers

B. Gore, Pacific Northwest Laboratory

6. TYPE OF REPORT

Technical

7. PERIOD COVERED (Inclusive Dates)

9/89 to 11/92

8. PERFORMING ORGANIZATION – NAME AND ADDRESS (If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)

Pacific Northwest Laboratory
Richland, WA 99352

Battelle Human Affairs Research Centers
Seattle, WA 98105

9. SPONSORING ORGANIZATION – NAME AND ADDRESS (If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)

Division of Systems Research
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

The objective of this report is to identify how decisions are made regarding staffing levels and positions for U.S. nuclear power plants. In this report, a framework is provided for understanding the major forces driving staffing and the implications of staffing decisions for plant safety. The focus of this report is on driving forces that have led to changes in staffing levels and to the establishment of new positions between the mid-1980s and the early 1990s. Processes used at utilities and nuclear power plants to make and implement these staffing decisions are also discussed in the report. While general trends affecting the plant as a whole are presented, the major emphasis of this report is on staffing changes and practices in the operations department, including the operations shift crew. The findings in this report are based on interviews conducted at seven nuclear power plants and their parent utilities. A discussion of the key findings is followed by a summary of the implications of staffing issues for plant safety.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)

staffing, staffing levels, staffing changes, staffing issues, operations staffing, regulatory impact, economic constraints, plant organization, plant staffing, shift composition, shift schedule, reactor operators

13. AVAILABILITY STATEMENT

Unlimited

14. SECURITY CLASSIFICATION

(This Page)

Unclassified

(This Report)

Unclassified

15. NUMBER OF PAGES

16. PRICE

Printed on recycled paper

Federal Recycling Program