Evolution of Operations Culture

D.Gould
Retired Shift Manager Bruce Site

Abstract

Over the last three decades there have been many changes in the operating culture of nuclear power plants. One of the main thrusts of these changes has been to move away from an early model where there was heavy reliance on trained and experienced personnel with free reign to do the right thing, towards a newer model relying on strict adherence to prescribed procedures and processes. This paper will discuss how some of these changes have taken place and briefly consider at what point the correct balance between these models is achieved.

This paper is based solely on the experience of the author who has spent twenty years as a licensed control room supervisor. The reader may view this paper as more of an opinion piece than a typical scientific paper.

1. Introduction

During the seventies, the nuclear industry was rapidly acquiring new staff as nuclear expansion continued. A large influx of personnel was required as new units came on line. A look back at this era reveals a different culture and attitude among station staff. The stations were just finishing a lengthy construction and commissioning period. One of the main cultural norms of this period was “learning by doing”. There was little experience on the site with long term steady state operation.

This was followed by a period of relative stagnation with small turnover of staff. We are now entering a new era where hiring has drastically increased once again. The new staff entering the industry at this point are facing a very different culture than was encountered decades earlier. The experience base is being rapidly depleted.

Some of the major areas that influence culture and attitudes are procedures, training and working conditions. There have been major changes in each of these areas.

2. Procedures

Originally operating manuals consisted mainly of lengthy narrative descriptions of system features with very few actual procedures. In order to accomplish various tasks and evolutions, operators were required to utilize system and equipment knowledge and to determine required actions essentially on the spot. This sometimes resulted in errors and equipment damage as operating techniques were not consistent and depended almost entirely on the knowledge and experience of the persons in question.

One of the first changes to affect plant operations was the introduction of new operating manuals. The new manuals were written to a new standard format. Operating manuals contained step by step procedures often written in flowchart style. The operating manual revision process was gradual. As the new manuals were issued operating staff became more aware of standardization of operating procedures. The manuals were written or reviewed by experienced station operating staff. They were written in terminology and with a frame of reference common to operators and hence were readily understood. As a result station systems began to be operated to standard optimal procedures rather than according to varied individual experience.

Acceptance of the new procedures was also gradual. Experienced personnel had to be convinced of the value of standardization and optimization. There had been a certain amount of pride of accomplishment in operating in a relatively unstructured environment. This behavior had been valued and rewarded. Some people preferred the challenge of operating from memory and experience or at least had become familiar and comfortable with this knowledge based behavior. This attitude began to change as the availability of procedures resulted in fewer mistakes and more efficient operation. As well, the quality of procedures steadily improved, resulting in staff becoming more confident in relying on procedures.

More recently as a result of WANO bench marking the concept of procedural compliance has become more rigid. There is little room for interpretation of intent during execution. The emphasis is on strict compliance. Some operators have seen this as a repudiation of their skills and ability to interpret procedure intent and to adapt procedures to specific operating circumstances. Strict compliance results in the need for increasing numbers of procedures to account for varied circumstances and configurations. The need for increasing quantities and quality (specificity) of procedures continues.

Inevitably not all circumstances can be anticipated nor can procedures be developed for every possibility. As a result operating staff are encouraged and required to verify their interpretations and decisions with other qualified staff. This results in an increased degree of attention and consideration being brought to bear on situations that may be more problematic.

3. Training

Originally the bulk of operations training took the form of "on the job" training. This was fairly loosely structured. Qualifications were usually received by means of an experienced person "signing off" on a trainee. Experience was the major factor in the assignment of duties to personnel. Once an individual had negotiated a task without incident, he/she was usually considered qualified to be assigned this task and indeed was often asked to show someone else how to do it.

Once a qualification was achieved it was "good for life". There were originally few requirements for requalification or refresher training.

In some cases for the first few years of station operation there was no station specific full scope simulator in existence. Control room personnel were trained by classroom means only. Qualifications were received solely on the basis of written exams. When the simulator was initially made available it was used only for illustration and demonstration of system operational features.

Simulator use was first integrated with initial candidate training and subsequently began to be used for refresher training of currently licensed control room staff. At first refresher training was somewhat unstructured and subjective. Later more specific objectives were formulated for refresher training.

The operating staff devised a structured approach to manpower deployment during off normal operation that had been previously informal and somewhat random. As well a series of overall strategy and supporting objectives were developed to deal with unit and station upsets. The operating staff were intimately involved with these initiatives which resulted in greater acceptance and buy in. The simulator came to be used as a hands on practice tool for operations staff. Monitoring and diagnostic skills were enhanced. Eventually simulator tests were devised which were used to qualify and requalify control room staff.

All these processes involved negotiation with the regulator. These negotiations were necessary to balance the legitimate need to ensure competency of operating staff with practicalities such as the finite rate at which human beings can process information and make decisions.

Simulator training personnel have always been selected from the control room operating staff. The use of control room operators and shift supervisors in rotational training positions has resulted in a strong link between training and operations and has ensured that training continues to be relevant and useful in maintaining performance.

4. Control Room Environment

The control room was for some time a center for planning, briefing, authorizing, assigning and controlling work. Access to the control room was not controlled. There was not in all cases a clear definition or understanding of the “at the controls” area. The initial generation of control room furnishings and their layout resulted in a lack of definition of the at-the-controls area for each unit and lack of pedestrian traffic control throughout the room.

Access to the control room was not restricted. Casual visits for non essential purposes were not uncommon.

Several changes were made. The control room was remodeled with new functional furniture which served to delineate each units operating area. A management expectation was communicated to all maintenance staff to refrain from entering the control room during the turnover period. The work control area is staffed during busy hours to prevent high control room traffic flows. Control room access is limited to personnel with a legitimate requirement to be present. As well the overall number of people admitted per unit time is controlled by means of procedural barriers to minimize noise and distraction. Control room supervisory staff are expected to monitor control room conditions and ensure the primary goal of diligent plant monitoring without undue distraction is met.

As a result of these initiatives there are less distractions for control room operators. There is less control room traffic and noise. The ability to maintain focus and attention is enhanced.

Although most control room operators recognize the value of these changes, there is some sense that there has been a loss of communication. Previously there had been face to face contact with almost all personnel interacting with plant equipment in the field. This was no doubt beneficial in ensuring a common understanding of requirements, hazards and error likely situations.

In order to compensate for this it is necessary to ensure good procedures are in place and that other knowledgeable personnel such as maintenance supervisors and control room supervisors are capable of conducting comprehensive pre job briefings. Line supervision is now required to undertake more responsibility for work coordination and monitoring of field activities. The control room operators are appropriately relieved of these duties and enabled to fulfill their primary function of plant monitoring.

5. Role of Operations Staff in Operational Decision Making

There has been a change in the perceived role of operations staff. The concept of operations staff maintaining overall responsibility and control for station systems had been extended to overall responsibility for decision making. Although this remains essentially true it does not mean that operators must make all the decisions. It is now no longer considered appropriate for operations staff to make decisions in isolation. Operators are encouraged and required to involve support staff in making decisions with respect to reactor safety, technical, engineering and reliability matters.

Operational decision making procedures are in place which mandate support staff input whenever procedures and policies are not completely clear.

Engineering staff have stepped up their system surveillance activities. System and component functionality is tracked and monitored. Engineering staff are proactively involved with troubleshooting technical problems as well as addressing operations concerns. As a result operations staff have been able to concentrate on maintaining and adhering to excellent operational procedures and practices. Operations staff routinely involve engineering staff in resolving concerns regarding plant safety.

As a result of this increased oversight, the probability of ill informed or inappropriate decisions and actions with ensuing adverse consequences is decreased. Operations staff are encouraged to have a bias towards conservative action especially until further review can occur. Management attention via the Plant Information Package, System Health Reports and Management Leadership Meetings has resulted in efforts to improve plant status and overall operating conditions.

In any functioning organization a balance must be struck between production and safety. Although operations staff recognize that they retain the responsibility for operational decisions in a timely manner, engineering staff are routinely consulted on plant issues. This is often done proactively to ensure an action plan is in place in case the existing condition deteriorates.

The emphasis has shifted from making an on the spot diagnosis and taking immediate action to defaulting to a known safe state and obtaining further input from technical staff.

As conservative decision making and the use of a questioning attitude have been introduced the operating staff have moved away from a production emphasis and have internalized a good safety culture. Potential safety concerns are readily raised and dealt with.

6. Panel Monitoring Qualifications

Although a qualified operator is always assigned to each unit, in the past short absences from the panels were tolerated for trips to the control equipment room. At times a non licensed operator has been used for temporary relief during breaks. Originally the non licensed operator was a field operator given ad hoc instructions from the responsible operator. Subsequently this has been a non licensed operator who has been given a specific training course to be qualified to relieve the control room operator under certain restricted conditions. We are now staffing with more licensed control room operators. The use of non licensed staff at the panels is being phased out.

7. Error Free Operation

The term “event free tools” is now commonly used among operations staff. This term is simply a list of techniques used during the performance of tasks in order to minimize the possibility of error. An example of an event free tool is three way communication where an instruction or piece of information is repeated back to confirm that the message has been understood correctly.

Prior to the introduction of the event free tools, informal communications methods were used throughout the plant. Self checking was not utilized. The initial introduction of the event free tools was met with some reluctance and a general resistance to perceived regimentation. Persistent reinforcement over time has resulted in the habitual use of the event free tools. Three way communication is now the norm. Operators have spread this tool to the maintenance staff. These tools are seen as major contributors to error reduction.

8. Work Planning

Operations staff are involved in the planning of scheduled maintenance work as well as facilitating the execution of this work on plant systems. As a result operations has a stake in executing the plan on schedule. The timely completion of planned maintenance activities is seen as contributing to overall system health. Operations staff work cooperatively with planners and maintenance staff to ensure proper coordination of maintenance activities.

Non functioning alarms and control room panel deficiencies are tracked and worked down. Operator work arounds are tracked and considered for their impact on overall operability.

Plant systems are becoming more reliable. Many long standing equipment deficiencies have been addressed through component replacement and capital projects. Operational input into maintenance priorities is assured through the participation of operations staff in work planning.

9. Possible Negative Results of Change

Although there can be no doubt that these changes have appropriately moved plants in the direction of increased safety it is worth considering if anything has been lost in the process.

The limited access to the control room does tend to isolate operating staff from field workers. This communication link was of value and has prevented events in the past. This link has not been completely severed. Legitimate control room entry is still permitted and the telephone is still available. In addition coordination activities must be assumed by supervisory staff and procedures must specify coordination activities.

There is evidence that over emphasis on strictly regimented compliance with procedures can result in over reliance on procedures and a reduction in diligent monitoring and continual awareness of plant parameters and changing conditions.

Some time ago INPO SOER 96-1[1] extensively addressed the need for control room teams to avoid distractions and production pressures while maintaining effective monitoring and oversight of plant systems. More recently INPO SER 3-05[2] reiterated these points as well as emphasized the need for operators to have a good understanding of plant design features and integrated system functionality.

As the work force ages and experienced personnel are replaced, many control room personnel have not experienced significant transient conditions. This emphasizes the need to ensure experience from the past has been captured in simulator training and the lessons learned have been imparted to newer staff. Procedure usage and adherence cannot relieve personnel of responsibility for the plant. Procedures will never be able to cover every possibility. Only diligent operations staff can monitor actual plant conditions, detect potential problems and determine actions required to address them. In order to do that staff must be trained and well versed on all aspects of plant design features and operational limitations.

10. Conclusion

The changes discussed have improved the overall quality and safety of plant operation. Changes are more readily implemented when staff understand and accept the rationale for change and are involved with the implementation. Management and supervision needs to be continually aware that well intended changes may also have some unexpected adverse effects. The need for sound training and conservative operational practices has by no means diminished. Operating staff need to always be mindful that while procedural adherence is required, continuous awareness of plant status and the need to recognize potential adverse conditions is essential. There is a danger in over emphasizing any specific aspect at the expense of the overall goal. Event free tools such as procedural compliance are a means to an end, not the end itself. An appropriate balance is achieved when personnel understand and accept their core responsibilities and view aspects such as procedural compliance as tools to be used in order to fulfill those core responsibilities.

11. References

1 INPO SOER 96-1 “Control Room Supervision, Operational Decision Making and Teamwork”
2 INPO SER 3-05 “Weaknesses in Operator Fundamentals”