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Operator Stress

Operator Stress in the controlled testing environment of Operator licensing accreditation.

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Abstract

This paper addresses operator stress in the controlled testing environment of operator licensing accreditation for operation of a nuclear plant facility. From the perspective of stress theory, the authors look at the operator and shift supervisor under accreditation test conditions. They map theory to the real world of nuclear plant operations to reach conclusions concerning the stressfullness of the test situation, and recognize the stress management skills and self control of those operators and shift supervisors who successfully pass the test.

Introduction

Try to imagine yourself as the shift supervisor or the control room operator of a nuclear power plant. Reflect on stressful situations that you might be faced with and the stress you might suffer because of real situations and events that might unfold on your shift. The dimensions of your job include: responsibility and accountability for enforcement of the station's operating license; one of the few positions named in almost every piece of operating documentation as the ones who review and approve actions in the station; responsibility for a 1.5 to 2 billion dollar asset, responsibility for peoples lives; a mistake can cost you your license or severe reprimand or your job; you have to approve all activities that are carried out in your operating plant: - you might begin to worry about what can come back to haunt you. This is a recipe for stress. Only persons authorized by the regulatory agency shall act as shift supervisor or control room operator. The duty shift supervisor has the responsibility and authority for the operation of the station, and the safety of all persons on site.

The material developed here surely applies to those shift supervisors and control room operators that were on duty for the well publicized disasters of Three Mile Island, Bhopal or, Chernobyl.

In this paper we want to examine the presence of stressful situations with reference to stress theories and then look at the operator and shift supervisor under accreditation test conditions. Theory and laboratory findings will be setup first. We then describe the environment and the situations for the test and many aspects that impact on the test situation. We then map the real world of nuclear plant operations to the theory by identifying and describing stress situations and events. We reach conclusions concerning the stressfullness of the test situation the stress management skills and self control of those operators and shift supervisors who take the test.

We also point to what can be done to reduce the three types of stress that affect shift supervisors and control room operators. This will be done with reference to a nuclear power plant operator taking a licensing accreditation examination on a simulator. We discuss the licensing of these very important people in our society by the regulatory agency. This agency administers a series of simulator tests designed to test the operator or shift supervisor under abnormal and emergency conditions that could possibly occur in their normal course of duties.

The purpose of this paper is to recognize the stressfulness of the examination situation for the shift supervisor or control room operator candidate. Another paper will describe stress management skills training and how best to go about it. A third paper is required to address engineering design changes that will minimize or eliminate the occasions for stress from the environment.

Stress Theory

Some Definitions

Stress describes a process by which we perceive events as threats to our physical or psychological well-being. The emphasis is on the process of appraisal of both the events and our resources to estimate whether or not threats are present (Lazarus & Launier, 1978). If events are appraised as threatening they are called stressors. Cognitive, behavioral, emotional and physiological reactions resulting from stress appraisals are referred to as stress responses.

Psychologists identify three types of stress: physical, psychological and psychosocial. "Physical stress involves stressors in the environment - factors such as extremes in temperature, environmental pollution, constant noise, or electrical shock. Researchers also categorize physiological factors as physical stress; examples include injury, surgery, hypoglycemia, prolonged exercise, or an inadequate supply of oxygen." (Hafen, 1996)

"Psychological stress stems from the way we feel, the attitudes we have, and the way we react toward anything that is threatening us, whether the threat is real or imagined." (Hafen, 1996)

"Psychosocial stress involves stressors from interpersonal relationships, arguments or conflicts with family members, neighbours, employers, friends, or other people around us. Psychosocial stress may result from intense social interactions, but it can also occur when there is isolation as a result of inadequate social interactions." (Hafen, 1996)

Psychologists have found stressful events have certain characteristics. The most common characteristic of stressors is the requirement for changes in the life of the individual. Change or adaptations are required to a range of events from the everyday hassles that we all experience, such as breaking a shoe lace at the most inopportune time, to the major traumatic events and disasters that we hear so much about in the news. Stressor events fall into one or more of the following categories: traumatic events outside the usual range of human experience, uncontrollable events, unpredictable events, events that challenge the limits of our capabilities and self-concept, or internal conflicts." (Atkinson, 1996)

"The most obvious sources of stress are traumatic events - situations of extreme danger that are outside the range of usual human experience. These include natural disasters, such as earthquakes and floods; man-made disasters, such as wars and nuclear accidents; catastrophic accidents, such as car or plane crashes; and physical assaults, such as rape or attempted murder." (Atkinson, 1996). Nuclear accidents fit in this category. The shift supervisor and control room operator are being trained and licensed to prevent this particular traumatic event if it is at all within their power to do so.

Characteristics of Events

"Three characteristics of events determine whether they are perceived as stressful: their controllability, predictability and the extent to which they challenge the limits of our capabilities and our self-concept." (Atkinson, 1996) Tens of people, your management, your peers, anyone might judge an event as not stressful, but it is the individuals perception of the event that really makes the difference. Stressful events to one person are treated as a challenge by another.

Controllability - If we cannot control an event, we cannot stop it from happening. If we believe that we can control events, it appears from laboratory tests that the impact of the event will be reduced even if we never exercise that control. The important effect that controllability has is how it affects our performance on subsequent problem-solving tasks. If we think we have control, we will perform better than when we believe we do not have control.

Predictability - The severity of the stress will usually be reduced if we are able to predict the occurrence of a stressful event; even if we cannot control it. A warning signal before an aversive event allows a person to initiate some sort of preparatory process that acts to lessen the upcoming effects of the stressor. A warning signal of an upcoming stressor provides a signal that if lacking, would leave us in a chronic state of stress wondering when the stressor will occur. Fire fighting and emergency-room jobs are said to be "filled with unpredictability." (Atkinson, 1996)

Challenge to our Limits - Even if events are controllable and predictable, they can challenge our physical and cognitive limits and cause us stress. Final exam week is always cited as an example of events of this type because of the long study hours and the physical and cognitive exertion put out by many students. Exams can test the limits of our knowledge and intellectual capabilities. The possibility of failure can challenge our self-concept - our individual view of ourselves as competent.

Internal Conflicts - The events described above are external events - someone or something in the environment challenges our well-being. Internal conflicts can arise because we have two desires or goals that are incompatible. You want to become a control room operator but you cannot devote the time and effort and dedication to be successful in the job. Another aspect of internal conflict is two inner needs or motives in opposition. For example: cooperation and competition. Our society places great emphasis on competition and success. It starts in childhood and carries through into business and professional rivalry. At the same time we are urged to cooperate.

Duration - Short Term or Chronic - This is an important factor of stress events. Selye (1946) found organisms became exhausted under chronic stress. Ultimately, they had stress related damage in a variety of body organs.

"The body reacts to stressors by initiating a complex sequence of innate responses to a perceived threat. If the threat is resolved quickly, these emergency responses subside and our physiological state returns to normal. If the stressful situation continues, a different set of internal responses occurs as we attempt to adapt to a chronic stressor." (Atkinson, 1996) The fight-or-flight response of the body is valuable in the face of a physical threat requiring immediate action but not very adaptive for dealing with psychological sources of stress. Intense physiological arousal over an extended period of time can be harmful to the body.

Life Events Scale

The Thomas Holmes and Richard Rahe Social Readjustment Rating Scale - This scale measures stress in terms of life changes. Life changes are sometimes positive and sometimes negative. Nine of the 43 factors on the scale have to do with work and vary in rating from 15 to 47 out of 100 on the stress scale. Not with-standing the positive or negative aspect of the factors, all have to be dealt with by an individual experiencing these changes and these events give rise to stress. These factors are:

Fired from the job - 47

Retirement - 45

Change in Financial State - 38

Change to different line of work - 36

Change in responsibilities at work - 29

Outstanding personal achievement - 28

Trouble with the boss - 23

Change in sleeping habits - 16

Change in eating habits - 15

The scale includes many family related factors that affect how we perform at work. (Sternberg, 1995)

Riggio states the use of the scale: An individual "totals the numerical stress severity scores associated with the significant life events that they have experienced in the past year. This provides a personal life events stress index." "Research indicates that this score may predict certain work outcomes such as job performance, absenteeism, and turnover. Persons with high personal stress indexes tend to perform more poorly, have higher absenteeism, and change jobs more frequently than persons who experience fewer stressful life events (Bhagat, 1983; Weiss, Ilgen, & Sharbaugh, 1982)." (Riggio, 1990).

This test or one modified to the nuclear plant may be of some value to management. It could be used as part of a performance review of individuals such that certain training and re-qualification tests could be scheduled at optimal times.

The Situation and the Controlled Environment

The Candidates and the Control Room

There are two authorized, licensed positions in a nuclear power plant; the control room operator and the shift supervisor. The other high profile positions in the station, such as the station manager, are approved by the regulatory agency after interviews and reviews. To become a licensed operator in a nuclear power plant requires formal schooling, training, experience, concentrated licensing training and testing. Testing of the operator or shift supervisor candidate in a full scope replica simulated control room is one of the current testing methods. The simulator reproduces the performance of the process plant and the operator or shift supervisor interacts just as s/he would in the real control room. There are some differences.

The candidate enters the simulator testing room wanting to believe that s/he is prepared for possibly 3 to 4 hours of simulated plant problems, upsets and difficult situations. The management of the station as well as the training personnel also believe that the candidate is prepared for the accreditation tests. The tests are prepared as a result of five (5) weeks of work by the regulator examining group. The candidate is "supported" by a crew of operators or a supervisor as the case may be. The support cast all have scripts and specific instructions on how to interact with the candidate. There are at least three (3) examiners plus management or their representatives

witnessing the testing. A simulator operator controls the events being simulated according to a script and the examiner's instructions.

The candidate's skills, rules and knowledge of the nuclear plant can be examined. His/her behavior and the results of the operational maneuvers of the plant seem to be all that the examiners can use to determine if the candidate should be licensed.

Important Social and Social Interaction Aspects

A number of social and social interaction aspects set the background for the accreditation examination. These aspects affect the candidate directly or indirectly and set the initial conditions for the stress that will be experienced during the exercise.

Personal Private Problems - Personal and family problems may affect work performance. If it is obvious to the supervisor or the candidate, sources of available help could be suggested.

Shift Work Life Style - The life style of a long term shift worker is different than the life style of a day worker. For those working 12 hour shifts, the routine is work, drive, sleep, work turn around, work, drive, sleep and days off. Days off can have normal life characteristics as one gets time to spend with the family and others. The shift worker might not even know what day it is; it is the shift cycle calendar that s/he is following, not the Julian calendar that the rest of us use. In large enclosed plants, you cannot tell whether it is daylight or dark. Circadian rhythms are upset by the shift cycle. The body has to be gotten in tune for the next shift. Just 'getting into nights' may take two shifts; then you turnaround to days. Younger workers seem to be able to stand the changes more than older workers. Some people never really adapt to shift work life; they just endure it. Shift work life style impacts on all of the stress areas: physical, psychological and psychosocial. The scheduling of the candidate for accreditation or re-qualification testing in the shift cycle can be important. S/he may be caught at a really bad time.

Management and Supervision - A most important aspect for the candidate is the support s/he gets from the management and supervision. Management must first choose the proper candidate and then provide the program of training and experience that will prepare that person to be a license candidate. Management must also provide the environment for all their workers. Not just the physical environment and the crew that the shift supervisor and the control room operator must work with; but a mental environment in which the candidate feels informed and part of the plant management team. Management must communicate all aspects of policy and principles that affect the candidates. Management must put in place and then ensure that all management systems are functional and supportable by the first line people that effect the policies and enforce them. Some aspects of stress have their root cause traced to some management failing; some decision that sets the stage for unnecessary pressure. For instance, any lack of fidelity between the simulator and the real plant might be construed to be a management failure if management do not consider the infidelity serious enough to allocate funds and resources to reducing the difference.

Shift Turnover - When the shift supervisor or control room operator arrive for work, the first exercise that must be done is the shift turnover. In this brief period the incoming persons are briefed on what has happened since the incomer's last shift. The turnover is accepted and then all of that material must be assimilated and work for that shift gotten underway. If the shift happens to be a day shift, starting at 8 am, with day workers starting at 7:30 am, the candidates may not get things sorted out for the next two hours, during which time other staff are put on hold and wait. Physical, psychological and psychosocial stress are apparent during this time.

Instruction and Training - The instruction and training for the candidate should be complete by testing time. Enough time and enough hands on training must be provided for new

candidates and those being re-qualified after years of actual on-shift experience. For the case of operator accreditation, the best available techniques should be used for instruction and training and it is hopefully well done. An important aspect of training is the training and qualification of the support staff. The control room assistants might not be trained in aspects of operation that could aid the control room operator such as the ability to start and stop standby equipment or control some process to a desired setpoint. The result is that the operator must do many specific jobs themselves which results in a greater workload for the control room operator.

Documents - By testing time the candidate knows what documentation is available to run the plant and should be thoroughly familiar with all of it. During the test, the candidates will interact with the documentation many times and must have significant confidence and assurance in it, knowing that specific information needed during the test will be accessible and found. Documentation is a management responsibility. Documentation must be updated, current, approved and available for the running of the plant.

Work Place and Environment - The simulator testing work place environment is remarkably like the real control room. It must meet design requirements and all its nuances and problems should be known to the candidate; not necessarily to the examiners. Simple things like lighting, sounds, sights (walls, room equipment) and even the flooring should be very close to that of the real control room. Two sources of infidelity are apparent: simulator software model deficiencies and physical items not modeled or included in the simulator control room. When a disturbance occurs, the candidate must quickly decide if what s/he observes is part of the examination scenario or a simulator phenomena. If any actual control room equipment or apparati are missing, the candidate will not be sure if s/he will find what they need when they formulate an action plan and then effect it. For instance: looking for a document that they know contains information they want and finding that it has not been included in the simulator set is highly disruptive. Any differences will provide occasions for attentional distractions or confusion under high work load conditions.

Human-Machine Interface - The Human-Machine Interface (HMI) is fixed for the testing situation. The HMI is the only media available for the candidate to get information and control the plant processes. The candidate should be thoroughly familiar with the HMI and there is very little that can change during the test. Whatever HMI problems exist with the system should be known to the candidate. The HMI may be deficient in some aspects compared to a more modern design. It is doubtful that the accreditation test would be designed to highlight an HMI deficiency that would be a causal factor in the candidate's performance.

Re-qualification - Re-qualification is a new requirement. Shift supervisors and control room operators have been operating power plants in Canada for over 35 years and are now required to be re-qualified for their position. This sounds completely logical. However, it causes psychological and psychosocial stress for the licensed personnel. Who else has to go through such re-qualification? Do the plant management, the safety department, maintenance personnel, technical unit personnel and a host of others have to be re-qualified? In private conversation with an air-line captain about re-qualification it was conveyed that they periodically spend time on an aircraft simulator but it is not construed to be a re-qualification. It seemed to be more of an update of procedures, new ways of looking at upsets, incidents and accidents. Re-qualification is hence uncontrolled and forced. The re-qualification requirement forces the utility to develop and implement good training for the licensed personnel.

Assigning Blame - A significant psychological stress is the relative ease that blame can be assigned to shift supervisors and operators when something goes wrong in a nuclear power plant. They can be blamed because almost everything they do is based on some operating manual or procedure that they must execute without fail at the right time. Proper root cause analysis may possibly and properly shift the cause for an error or inappropriate action by

someone down the chain of command, or up to another level in the chain. The root cause may be in very poorly written procedures by engineers and others or supervision or management, communication, or a host of other reasons.

Security Investigations and Witch Hunts
Any investigations or interrogations that have to be made of the shift crew done before the shift or at the start of the shift can cause psychological stress for the shift supervisor or control room operator. Some investigations or interrogations can be upsetting and affect work performance; not only for that shift, but for several shifts thereafter.

Observations Made on the Environment and Candidate

Traumatic Events -

Large Loss of Coolant Accident
Simulator accreditation testing is about traumatic events. Probably the worst event that can be encountered in an operating nuclear plant is the Large Loss of Coolant Accident (LLOCA) and subsequent plant status degradation that can take place after the inception of the event. Lesser events than the LLOCA are not as dangerous and deleterious to personnel, plant and the environment as the LLOCA, are more manageable and hence less stressful for the operator or the shift supervisor. All of the events considered for the test cause a heightened state of arousal; but certainly the LLOCA fills the criteria for traumatic events in that it is outside the range of usual operating experience, not expected to occur more that once in 1000 years. Other events for consideration are not expected to occur more than once in 100 years. On the simulator, the LLOCA has a distinct signature and is relatively easy to identify and manage. However, when subsequent failures are interjected to complicate and confound the primary event, the operator and shift supervisor may conclude that they do not know what is going on and be forced to use a generic emergency operating procedure and determine the state of the plant from scratch. This is especially true if dual redundant and backup information systems are lost and the candidate has to rely on his/her crew members to collect and present data required for decision making. This situation is most stressful for the candidate since all else has failed. On the simulator these events can be made to happen at the will of the examiner.

Uncontrollable Events -

Initiating Event
Of concern to the candidates is the fact that they cannot control the selection of the event that they will have to deal with, nor can they control the subsequent events that will occur as the examiner chooses to fail more equipment and systems to further deteriorate the plant state after the inception of the initiating event. Sometimes failures are caused that have no relation to the initiating event; but serve to complicate the situation and of course, elicit a response from the candidate. Added events to complicate an already undesirable situation cause the candidate psychological stress, in that they have no idea what compound failure will be indicated or when it will occur.

Failing Equipment
Systems and resources that are normally available to the candidate somehow become unavailable or fail exactly at the most inopportune time. Control mechanisms available to the candidate as part of his/her arsenal that become unavailable, for seemingly no good cause, cause the candidate stress as they get backed into a corner from which there may be no successful solution. Some of these failures violate the causal reasons and probability statistics for their occurrence. If the candidate believes failures of this nature are not likely and not

expected to happen, they become stressed and it possibly affects the outcome of the test. Problem solving from this point on in the test can be impaired. Cognitive resources can be overloaded with too many subsequent failures. At this point, the candidate may be so stressed that s/he will give up and fail to proceed.

Documentation

Operating documentation can be a source of psychological, physical and psychosocial stress. As a scenario develops, the examiners may move the event into an area of operation not specifically covered by operating procedures, to determine how the candidate will perform without specific instructions. The candidate can be psychologically stressed if they are not completely familiar and practiced with particular procedures. The candidate must have a high level of confidence in the documentation and must be extensively knowledgeable of it and be skillful at accessing the information. Also with documentation is the physical and psychological stress that arises from having to handle and reference as many as 5 to 7 documents during any one event; keeping mental track of the references and formulating the plan to implement the actions required therein at the appropriate time. The candidate can call upon an assembled crew member to assist him/her by getting these documents from the book case and looking up the information; but the candidate may be the best person for this task at test time because they may be the best informed and possibly the most skilled on the crew at that moment. As chains of references build and more manuals become opened, the candidate's psychological stress level can rise because of the building frustration they have with documentation. Most operating documentation is not necessarily designed to be accessed rapidly and used during upsets and emergencies. Documentation is typically organized around a system and not around several systems that work together and controlled together as the unit is started up or shutdown. There is a psychosocial stress that can develop here if the candidate requests documents that are not needed, the assisting crew member gets the wrong document or just too many requests. One can imagine the crew member saying; if they were actually on shift, "make up your mind."

Level of Training

The candidate must be comfortable with the level of training that they have been given. Otherwise, any perceived lack of training is a stressor. It is time consuming and expensive to take people off shift and assign them to training to prepare them for accreditation or re-qualification. The scope of material must be covered and enough time must be allocated to the training or re-training sessions. Candidates become stressed with lack of time for training or lack of depth in training. They may not make this known to the training staff and management because of peer pressure and authority. Acceptance of any deficient training leaves them with the stress associated with preparedness and it applies to many aspects of readying oneself for evaluation.

Unpredictable Events -

Pass or Fail - What Happens Next?

As far as we know, there are only two results from an accreditation examination: pass or fail. It is possible that a conditional pass could be granted upon the completion of remedial training. The obvious objective for the candidate is to pass the tests and become qualified or re-qualified as the case may be. There is no other acceptable result! Right here we have the first and foremost psychological stressor. It is a do or "die" situation. What happens if the candidate fails is totally undetermined. The entire circumstance goes up for evaluation and negotiation. There is no logical, pre-planned path for the unsuccessful candidate to follow; nor should there be.

Totally Unexpected Events

Similar to the uncontrolled event types mentioned above, is the unpredictable nature of the situation. Psychological stress occurs if a prepared candidate cannot predict or have a logical basis for the occurrence of an event; especially those subsequent events that occur after the initiating event. Subsequent events are usually required to further complicate a plant upset to force situations where the candidate is required to respond in a predictable or unpredictable fashion. The initiating event is usually well understood and well managed. Procedures exist for almost any occurrence in a nuclear power plant. However, it is the second and third contingencies that are more difficult to manage.

Duration

A stressor can last 10 to 15 minutes and be all over. In the real plant environment, it might be 6 am and the loud noise of the main steam safety valves lifting might lift you out of your chair and the psychological 'rush' begins. There may have been a lightning strike in the switchyard or on a transmission line. The plant response is automatic and if everything worked well, the decision is made to restore generation or shutdown. Once either of those decisions is made, different stressors come into play.

Limit and Capability Challenging Events -

Cognitive Connection

Rasmussen discusses a human-system interaction model that focuses on human resources for information processing. He says that capabilities and limitations are influenced from the bottom and goals and intentions are determined top-down. In the following figure, one can see how influence upon the human at any of the lower levels of the model can modify capabilities and limitations at the abstract information-processing level.

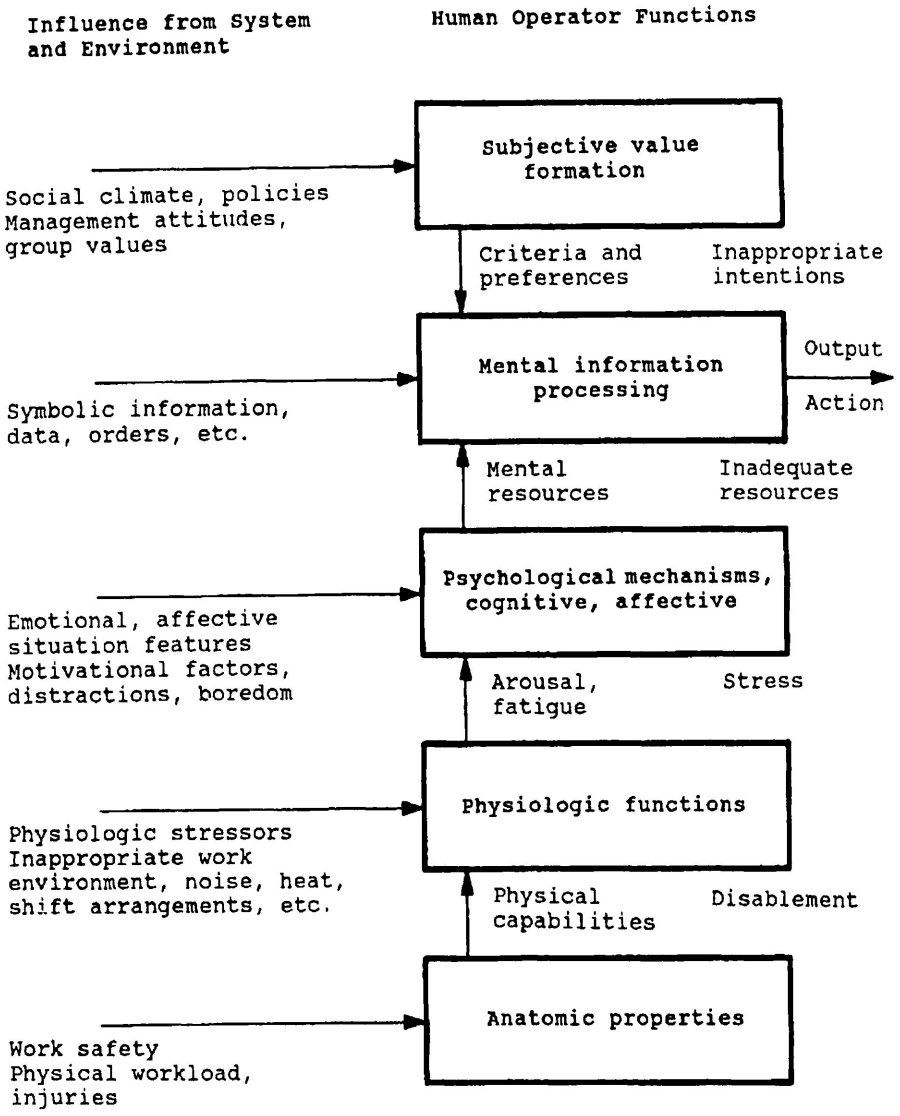

Figure 8.1. The diagram illustrates the complex interaction in a man-machine system that controls the mismatch features in an error situation. [Reproduced from Rasmussen (1982) with permission from Elsevier Science Publishing Co., Inc.]

The figure shows the interface with the human work environment and psychological properties. Psychological properties are the dependency of the human upon the interface to the system and its information coding, motivational factors related to boredom and fatigue, performance requirements, work load and stressors. Rasmussen describes the human higher level functions as low-capacity processes and the lower levels of abstraction interaction in the time-space environment as high-capacity parallel processes. Operators have a repertoire of ingenious tricks and rely on intuitive judgments and expectations, owing to the nature of their world model, may be based on representativeness rather than on a rational foundation. He suggests that humans use focusing strategies under the influence of the law of least resistance

for diagnosis purposes. The goal is to form and synchronize an internal world model of a given situation.

Stress developing in situations with high workload, threat to the individual, or debilitating physical environments affect the human information processes and the commitment of errors. These situations are usually periods of major disturbances of operation when high risk for losses is present together with time stress caused by system dynamics. "The identification of an unusual state in the physical system depends on functional reasoning, i.e., diagnosis through hypotheses and test or topographical search strategies, which require much higher information capacities than is the case during familiar periods when identification is based on recognition of signs. This directly implies that less capacity is available for general monitoring and scanning to maintain a wide field of attention." (Rasmussen, 1986) "In cases of disturbances, however, the correlation of variables from the disturbed function changes and, in order to diagnose, the entire set of variables from that function must be included in the observation. Consequently, the observer will focus on the disturbed function with a 'cognitive tunnel effect' as the result (Moray, 1981). (Rasmussen, 1986)

"The disintegration of behavior during periods of high stress may be directly related to the structure of human information processing with its frequent shift in strategy." (Rasmussen, 1986) The shift in strategy may be needed to find a better resource/demand fit and lead to a hectic looking for a better way to approach the problem.

Rasmussen wonders what influence upon performance comes directly from the affective arousal involved in stress. Rasmussen quotes Broadbent as identifying three distinct mechanisms in the information processing model: perceptual encoding, translation processes, response selection and execution. Stessors or general conditions of the system may potentially affect the operation of any of these mechanisms in the model. Psychologists found that the fatigue stressor does not affect skilled subroutines; but it does affect higher-level coordination. Rasmussen draws conclusions from work done by Mandler, "Whenever such events call for conscious attention, the limited capacity will be drained, and other cognitive functions will deteriorate." "Stress is an emergency-signaling interruption and competition for capacity of cognitive mechanisms...." (Rasmussen, 1986)

Wickens has a chapter on "Stress and Human Error" That emphasizes the cognitive aspects of stress from which we glean the following points.

Time Stress - If vibration reduces the quality of visual and motor input, and noise reduces the quality of auditory input, then time stress may simply reduce the amount of information and quality of information that can be perceived and hence degrade performance. Wickens says that some mechanisms that influence the efficiency of information processing like anxiety, fear, or incentives, have not yet been described.

Wickens says that there are five critical information processing components: general arousal, selectivity of attention, speed of performance, accuracy of performance, and short-term memory (working memory) capacity. The influence that the stressors, anxiety, fear, or arousal associated with failures of task performance or dangerous, threatening environments has on each one of these information processing components is important and is addressed in the following paragraphs.

Attention Narrowing - Yerkes-Dodson in 1908 came up with the inverted U-shaped function that related arousal to performance. Easterbrook in 1959 described the upward limb of the curve as energizing, expanding the amount of resources and the downward limb as narrowing of attention or tunneling. "High levels of stress narrow the spotlight of attention." (Wickens, 1992) Wickens notes from his study that degradation of performance is less for the individual with greater experience. He also notes that ".....it is difficult if not impossible to know, a priori, where the optimum level of arousal is for a particular task and, hence, whether the introduction of a stressor will lead to an initial increase or decrease in task performance." Some tests showed a greater focus of attention was beneficial and based on priority. Peripherial stimuli were not automatically filtered. This tunneling effect "is optimal, but will provide undesirable effects if the subjective importance of the attended channel proves to be unwarranted." (Wickens, 1992).

Working Memory Loss - "Although it is intuitively evident that noise would disrupt the verbal phonetic working memory system (Poulton, 1976) it appears also that the combined effects of noise and anxiety may disrupt spatial working memory systems as well (Stokes & Raby, 1989). Wickens, Stokes, Barnett, and Hyman (1991) observed that the effects of noise were greatest on problems that relied on spatial visualization for their successful resolution." Wickens, 1992.

Long-Term Memory - Stress seems to hinder the encoding of new information into long-term memory; but it does not seem to disrupt retrieval if that information is well rehearsed and memorized. However, stress has a similar narrowing effect on long-term memory as it does on perception and selective attention. "It narrows the information retrieved from long-term memory; specifically those habits that are well learned or overlearned (Eysenck, 1976)." (Wickens, 1992).

Strategic Shifts - There is a tendency of the stress of emergency to cause a shift in performance from accurate to fast (but error prone) responding. "Hockey (1986) concludes that there is a general effect of noise and anxiety stress on the speed-accuracy trade-off, a shift to less accurate but not slower performance." (Wickens, 1992)

Decision Making - "...without tight experimental control, it is often difficult to know if a real-world decision that failed was in fact a poor one in foresight as well as in hindsight." (Wickens, 1992). Also it is difficult to tell whether the stress was itself a causal factor or whether the conditions that produced it also degraded the information available in such a way that a poorer decision became more likely. Psychologists have found that subjects terminate their decision process before all alternatives have been considered for some stressors. As noted under working memory loss, the combined stress of noise, time pressure, risk and task loading produce a general degradation on problems that are difficult in spatial memory demand.

Making Errors

The very nature of accreditation testing carries with it the flavor of challenging the candidates limits of error avoidance, skill based and rule based performance and knowledge based capability. Criteria for failure set by the examiners detail the nature and number of errors that can be committed by the candidate before failure is declared. The emphasis seems to be, and is considered by the candidates to be based on errors and not positive performance aspects and end results of plant state that the candidate achieves as they manage the event(s). There is a fear of making errors and committing a critical error that signals immediately failure. (Wickens, 1992) wonders if high levels of stress will degrade human information processing and then states, "This degradation may compound the effects of any initial error or failure that led to the crisis in the first place. Indeed, it often seems that stress and errors are tightly linked. When errors are made (and we become aware of them), they cause stress; and when high levels of stress exist, errors are more likely to occur." The psychological stress caused by this stressor is significant.

Cognitive Work Load - Cognitive work is any mental activity that involves exactitude, rapidity, long term and short term memory access, working memory comparisons of values and plant mental model assessment and manipulations, attention, perception, reasoning, imagery, language, and problem solving. The aggregate of these mental tasks for any emergency or

situation involving stress, represents the cognitive work load on a given individual at that particular time. It is difficult to quantify. Perhaps comparisons between normal situations and emergency situations of each type of mental task and the number of tasks can be a measure of the work load. The measure could then be established for an experienced individual and at least this level set as a cognitive work load limit. A familiar example of high cognitive work load is writing an examination such a mathematics, physics, essay composition; all under time constraint. Simulator accreditation examination is a similar experience.

Constantly Accessing the Machine

A problem that is apparent when observing a candidate under test is the constant accessing of the machine for data. The candidate spends considerable time at the keyboard entering and observing data or walking back and forth in front of the control panels reading meters, indicating lights and annunciation messages. A measure of memory and skill is required to remember parameter numbers, display screen numbers and to key these numbers into the computer confidently and competently. This task can be a physical and psychological stressor if the candidate is not skillful and practiced at the keyboard and does not remember key numbers to facilitate his/her rapid accessing and assessment of data. It can be time consuming and distract attentional resources from changing plant conditions. Simulator response to the keyboard can be slower than actual plant equipment. This necessitates slowing key entry considerably to ensure you get the correct display. Under the stress of evaluation, repeated attempts to access the same information does not leave a favourable impression with an evaluator. Many cognitive activities are taking place while accessing the machine. These activities involve exactitude, rapidity, long term and short term memory access, working memory comparisons of values and plant mental model assessment and manipulations.

Physical Stamina - Duration

The event challenges the candidates physical capabilities in that it is 3 to 4 hours long. This can prove to be exhausting to the candidate and a source of stress. Using physiological indices for the major biological systems of the body: cardiovascular (eg. Heart rate or blood pressure), respiratory (eg. Respiration rate or oxygen consumption), nervous (eg. Electric brain potentials or muscle activity), sensory (eg. Visual acuity, blink rate, or hearing acuity), and blood chemistry (eg. Catecholamines) a picture is formed of the possible physiological effects. During the 3 - 4hours of testing, the candidate is erect and walking from control panel to control panel making observations, gathering data, making assessments and interacting with the crew. All this time s/he is standing. There is no occasion during these types of events when the candidates are required to be seated to accomplish a task. The candidates never or very seldom sit during the examination session. From tables in (Sanders, 1993), the work performed might be compared to a laboratory technician and from Table 8-4, the grade of work is estimated at moderate work 5.0-7.5 kcal/min, 2400-3600 ;8h(kcal/d), 100-125 beats per minute heart rate and 1.0-1.5 L/min Oxygen consumption. The candidates are required to voice their thoughts and actions as they carry out their duties during the test. Time, position and little opportunity for refreshment and recovery make an exhausting testing session. Depending on the number of candidates being tested, this process may span two days, carrying with it the accompanying levels of stress. The physical shape of the candidate is important as they must endure the test period and hopefully with little or no affect on the outcome. The duration of the event, the actions and interactions, the verbalizing everything that is done are a source of physical stress to the candidate and can affect the outcome of their test.

Self-concept Challenging Events -

Examinations

A measure of psychological stress is caused when the candidate thinks about going through yet another set of examinations. The older shift supervisors and control room operators can

remember their first set of exams required to become licensed. Almost everyone had one failed exam on the first try and most candidates had more. Why did they fail? For various reasons. The training might not have been all that good. The regulator might not have been squeaky clean. Could they fail candidates for a new plant if they thought the plant itself wasn't ready to startup? It could easily delay the startup process until they were completely satisfied with the construction and commissioning of the new plant. Also, the candidates for re-qualification are at a stage in their lives when they have to consider if this is the job they want to continue in for another period of years; until the next re-qualification cycle maybe.

Play Acting

With all the attempts to make a high fidelity simulator, the environment in which the candidate finds him/herself is not quite the same as the real control room. S/he must see her/himself as a control room operator or a shift supervisor and must 'play' the part of a control room operator or a shift supervisor and s/he must play it effectively before an audience. Their jobs depend on how well they play out their parts. The type of audience assembled will probably never observe the candidate in the real operating situation. They are not stage actors, yet they must now role play and be video taped for examination evaluation purposes. Fortunately, their training includes videotaping significant training sessions for their own personal use and assessment. This scene describes a social situation and it is a source of psychological stress.

Social Facilitation

Psychologists have determined that "simple responses, highly practiced responses, or instinctive responses (such as eating) were typically facilitated in the presence of coactors or audiences, whereas complex or newly learned responses were typically impaired." (Atkinson, 1996) There are theories that try to explain why this is so. One theory is more behaviorally oriented and says that motivation drives social facilitation. "A high level of drive or arousal tends to energize the dominant responses of an organism..... and the presence of others will facilitate the dominant response..... For complex behaviors or behaviors just being learned, the dominant or most probable response is likely to be incorrect." (Atkinson, 1996) Another theory suggests that, "social facilitation in humans is due not to the mere presence of others but to feelings of competition or to concerns about being evaluated, and it is these cognitive concerns that raise the drive level." (Atkinson, 1996) Under the circumstances of the accreditation test described previously, it is obvious that this is a source of psychological stress to the candidates and that the probability of incorrect responses is high.

Distraction - Conflict

Two other theories of social facilitation impact on the performance of the candidate. "Distraction-conflict theory suggests that the presence of others distracts the person, causing a conflict over how to allocate attention between others and the task to be performed." (Atkinson, 1996) This is an attentional conflict and it is this that raises the drive level in humans, rather than the mere presence of another person or a concern over being evaluated. Raising the drive level can be equated with a change in the level of psychological stress and the presence of others not normally involved in the candidates actual job, remains a source of psychological stress. A mere distraction causes an attention change and the candidate may miss a check that will signal failure to the examiner.

Self Presentation

Another source of psychological stress is highlighted by self-presentation theory. It proposes that the presence of others enhances the individual's desire to present a favorable image. "On easy tasks this leads to more effort and concentration and thus improved performance. On difficult tasks, however, this desire magnifies the frustration imposed by tasks and leads to embarrassment, withdrawal, or excessive anxiety, all of which lead to poorer performance." (Atkinson, 1996)

Social Support Group

Their assembled crew is not the crew that they have worked with for on-the-job training. This lack of their customary support group is a psychological stressor for the candidate. Relationships are fostered in a crew environment and a team concept is promoted. The candidate grows to depend on the crew and the crew grows to depend on the candidate. A familiarity exist after months on shift that is suddenly lost in the test situation. Unfortunately, during the test, the candidate is on his/her own.

Communications

Communications can be a psychosocial stressor during an event. Clear concise exchange of information and instructions is of paramount importance during any plant upset. It starts with the instructions given to the candidate and a simulated shift turnover after which the candidate is left in full control of the station. Failure of the candidate to clarify instructions or communications with any of the crew helping him/her to manage the event will cause stress because of the uncertainty that exists; and these types of communication can be fraught with breakdown and failure. The candidate may feel it a weakness to be seen constantly verifying communications. Any communication breakdown will be a source of stress during the event. Of course all conversations are being taped and can easily be verified to prove whether a communication was properly given. All communication checks are the responsibility of the candidate. His/her assembled crew will only do what s/he instructs them to do. They will not question any instructions; possibly only confirm them. The assembled crew may err on the side of conservatism rather than be too informative or suggestive. Candidates must check that their instructions have been executed accurately and in a timely manner. The candidate is on his/her own.

The Job - Characteristics of Healthy Jobs

There seems to be no question in the prospective shift supervisor's and control room operator candidate's minds that written examinations are required and accreditation and simulator testing is required to receive a license to operate a nuclear power plant. Their self-concept sees them in these positions and many have been prepared to put up with and suffer the stress that goes with getting the job. No job is stress free and some stress on the job is essential to keep us motivated, inspired and productive. Psychologists describe job characteristics as healthy if they have a healthy level of stress. The job characteristics are presented here and with each characteristic is a physical, psychological or psycosocial stress that shift supervisors and control room operators deal with every day.

- *Skill discretion* - "Your job allows you to make maximum use of your skills and provides the opportunity for you to increase or broaden your skills." (Hafen, 1996) (Skills could be management and organizational skills, technical skills, interpersonal skills, etc. These people are the captain of the ship. The candidate will use his/her skills during the accreditation test. A measure of psychological stress will occur simply because it is somewhat an artificial situation.)

- *Autonomy* - "Your job allows you some sense of control. You don't feel as though you are a child being disciplined. You get to participate in long-term planning, and your employer allows flexible hours. You control the machines at your workplace, not the other way around." (Hafen, 1996) (Autonomy is one thing that the shift supervisor and control room operator have or at least are formally vested with. See the opening paragraphs on their position requirements. This is one of the most attractive drawing cards to these types of jobs. The autonomy of these jobs is a source of psychological stress. Correspondingly, any violation of their autonomy causes psychological stress. They do have control; but can be second guessed by their supervisors instead of supported. They should be treated

with respect; but are sometimes treated as children, when something goes wrong. Supervisors and leaders at any level should actually help reduce the level of stress on the job if they are doing a good job themselves. They usually feel isolated from the main stream planning, but information does eventually get filtered down. Shift work surely can be equated with flexible hours. Even though there is a fixed schedule, it is so varied that the need for flexible hours is easily satisfied. And, by all means, they control the machines.)

- *Psychological Demands* - "You have some say over the magnitude of the demands placed on you, and the routine demands you are faced with are mixed with new, unpredictable challenges that help keep the job exciting." (Hafen, 1996) (This describes the psychological aspects of the shift supervisor and control room operator jobs to the proverbial 'T'. There is never a dull moment in a nuclear plant; there are new, unpredictable challenges every shift. However, when you are forced to take a re-qualification test, you have no say or control of the matter. Hence a level of psychological stress occurs.)

- *Social Relations* - "You are encouraged to collaborate with your coworkers. There is a sense of teamwork and support." (Hafen, 1996) (This is exactly the environment and the attitude on shift. A crew can range from 15 to 25 persons and there is a sense of belonging that develops that ensures support and teamwork; both on and off the job. When the social relations are changed, there is a psychosocial stress involved. In the testing environment the candidate does not have his/her team and the assembled team can only cooperate with him/her in a scripted fashion. The candidate is on his/her own no matter how much the team want to help.)

- *Social Rights* - "When problems arise, democratic procedures are used to solve them. If you have some kind of a grievance, you know there's an accepted way for you to solve it." (Hafen, 1996) (In the broadest sense of social rights aspect, this is exactly the format for handling problems on shift. During an upset, information is accepted and weighted from the whole crew. No input is rejected or discouraged. Both the shift supervisor and the control room operator know the limits of their authority and the shift supervisor knows that the responsibility and the authority for the final decision rests with him/her. Upsetting this normal mode of operating causes psychosocial stress. The simulator accreditation test does not allow for this type of democracy. Suddenly, the candidate must switch to an authoritarian style of management. There are no social rights to be respected in this situation.)

- *Meaningfulness* - "Your job has some meaning for you. You know what you are producing, and who it is for. You have ready access to feedback from your customers (the people you work for all day)." (Hafen, 1996) (Both jobs are full of meaning for the individual. The basic objective is to produce power by turning the energy in a raw material into electrical energy to be used by the friends, neighbors, countrymen and the rest of the people on this planet. The jobs are possibly also full of symbolic meaning to the individual. The meaningfulness of the need for a re-qualification test could be questioned by the candidate. It s/he doesn't like the answer, there will be psychological stress.

- *Integration of family and community life with work* - "The people on the job share the responsibilities of running the business so there is time - and energy - left over for activities other than work." (Hafen, 1996) (This aspect of a healthy job is true for the shift supervisor and control room operator jobs. However, psychosocial stress will occur if there are not enough shift supervisors or not enough control room operators. Then the situation gets real interesting. If something happens to a person in these positions and another is not available to take their place, someone has to work overtime. Overtime is

fine and there is a sense of accomplishment in working for someone else to fill a void; not to mention the monetary reward that accompanies it. The same situation arises if overtime has to be worked to take training or stand-in for those taking training, or a shift supervisor or control room operator calls in sick or is sick for several days; perish the thought, weeks. If there are not enough people to fill the positions, then new candidates for those positions are under tremendous pressure to complete their course of training and become authorized as quickly as possible. Often, time schedules are advanced to get the candidate trained. With this type of pressure on his/her head, the candidate takes the test with all intentions of supporting the management team by doing their best. There can also be an attitude that management did not do their job to assure that there would not be a staffing shortage. Attitudes such as this cause psychological stress for the candidate even as their schedules are being changed, if the candidate is rushed into something they feel could have been prevented. They are on the hot seat then. Hopefully they are not over-committed; over-committed by management.

One might get the idea that the two jobs described here are ideal jobs. They do look as though they fill the requirements for a healthy job.

The Job - Characteristics that Cause Stress

We have looked at the characteristics of jobs that have a healthy amount of stress, so now we turn to the characteristics of jobs that Industrial/Organizational psychologists have identified that cause stress. Each job characteristic will be presented and examples of physical, psychological or psycho-social stress that shift supervisors and control room operators deal with every day will be given. These do not necessarily apply to the testing situation being addressed in this paper but set the job scope and dimensions for the role(s) being played out during the test.

- *Work overload - time pressures and too much work* - Riggio calls this - "task based organizational stress." (Riggio, 1990). This stressor is the one first thought of when considering stresses on the job. Power plant operating work tends to be event driven. That is, unplanned events occur and add to or override the planned work for the shift. Much of the job is planned and work is scheduled for certain shifts and for most cases, dictates the amount of work that a shift crew must try to accomplish. Time pressures occur from trying to complete tasks on schedule, trying to squeeze jobs into narrow time slots before those jobs have to be abandoned all-together and trying to get the unit on-line after a shutdown. Most of this type of stress is psychological stress created by a schedule set by management or created internally by the individuals desire to please and perform. The cognitive work load is addressed under *Limit and Capability Challenging Events.*

- *Under-utilization of worker knowledge, skills, ability or energy* - The shift supervisor or control room operator are not likely to suffer from this source of stress by feeling that their knowledge, skills or energy are not being fully used. The only way that stress from this source can be visualized is if the candidate felt they had more to offer the company and wanted to be promoted to the next higher position and were somehow unable to gain that advancement. There could be a case causing stress if an individual aspired to leave their job and go into private practice and was somehow frustrated in doing so by family or circumstance. See *Skill Discretion.*

- *Dangerous work conditions* - This could be a major source of stress for both the shift supervisor and control room operator depending on the individuals psychological perception of this aspect of the job. One of the first activities to sort out upon shift turnover is who is on the response team for that shift. The response team is under the direction of the shift supervisor and typically lead in the field by a licensed operator. Their duties are to respond to emergencies involving human safety, radiation, chemicals,

and fire. Very few incidents occur in the normal operation of a plant and emergency exercises have to be carried out to hone response skills and keep the teams prepared.

- *Responsibility for the health and well-being of others* - The shift supervisor has responsibility for the safety and health of those on the station and the public at large. The control room operator also has responsibility for the safety and health of those working under his/her direction and for those in the public by properly operating the plant and its processes under normal, abnormal and emergency conditions. This characteristic contrasts with that of the healthy job characteristics 'autonomy' and 'meaningfulness'. Coupled with the characteristic 'dangerous work conditions', one can see that the responsibilities of these two positions are considerable indeed and can be a significant stressor.

- *Difficult or complex work tasks* - The tasks are difficult and complex but for the shift supervisor and control room operator, most of the tasks are of a cognitive nature. The cognitive aspects are considered under the section on *Limit and Capability Challenging Events*. It is these cognitive tasks that seem to be the source of the most of the psychological stress that the candidates must deal with.

- *Unpleasant or uncomfortable physical work conditions* - The physical work conditions do not seem to be a source of stress for the shift supervisor or the control room operator in a well run nuclear plant. The ergonomics of their respective work stations and creature comforts do come up from time to time and if not addressed by the management can lead to frustration, feelings of not being cared for or respected and then down right irritation and indignation. Chairs and other simple amenities of control room life are most important if the plant is running well and shifts turn into days and days into months. The significant behavior that seems to flag this sort of stress would be called complaining by most management. A most amusing incident occurred at one nuclear plant during cost cutting measures that cut the supply of pens to the staff. Individuals were issued one pen and then could only get refills. Workers do not keep track of pens and could not get another so they improvised by drawing out refills and pencils and scotch taping a refill to a pencil. Needless to say, the costs switched from pens to refills, pencils and scotch tape. Stressors of these sorts can be easily minimized and eliminated by management and positive attitudes of caring and benevolence can be promoted.

- *Interpersonal conflict - Interpersonal Stress* - This is a psycho-social stress type arising from difficulties with others in the work situation. Aspects of this type of stress are covered under the *Social Support Group, Communications,* and *Social Relations* sections of this paper. Difficult coworkers or simply a coworker experiencing upsetting problems may give rise to conflict situations. Other than facing a situation with an individual with whom you just cannot work, the shift supervisor and control room operator tend to be leaders, reducing conflict situations, resolving personnel problems and helping coworkers adjust and cope with changes in their lives that are causing them stress. If either person in these positions or their management tend toward dictator, authoritarian style management and not leadership and empowerment, there will be interpersonal conflict and stress.

- *Decision Making* - Decision making is a psychological stress that goes with these two jobs. It starts with the documented responsibilities and authority vested in the two positions and is a matter of course in the shift operation of a nuclear power plant. Some decisions are cut and dried and company policies and procedures must be followed and implemented. These decisions may be the easy ones to make. The 'big' decisions are resource dependent (crew, capability, materials, time) and call for astute judgment. Under test conditions the candidates have to make all the decisions and commit themselves to a course of action.

- *Organizational Change* - Organizational change can be a major source of psychological and psycho-social stress. "One of the top sources of organizational culture stress is the power struggle and related heightened competition, power games, and political alliances." (Hafen,1996) Changes in the structure, policies and processes of the organization are the most common, and these affect the shift. The shift crews could get a new manager as a result of some organizational changes. The new operations manager may make changes affecting the number of staff on shift, may have a different emphasis on job performance, a different approach to job training, different criteria for promotion, different criteria for sending crew members to conferences and a host of other views and changes that do not line up with those who have gone before or those of the individual. The boss's boss may have a different way of interacting with the shift. S/he may contact or visit the shift more often, be available and accessible in the control room or discuss matters more freely than the boss. Or, they could behave just opposite: unavailable, closed door, not seen. Any change is a source of stress; whether positive or negative.

- *Lack of support from supervisors or coworkers* - These sources of stress are mostly psychological and are self-concept challenging events They may have their roots in social relationships. See the sections in this paper on *Social Support Groups, Autonomy and Social Relations.* Stress from these sources can easily result in failure to perform and the need for an individual to be removed from the position to avoid any further deterioration that might have already occurred. Sometimes the supervisor may be at fault and his/her behavior may affect others under their supervision. A form of lack of support from supervisors is lack of appreciation for a job well done. A candidate may become licensed, another may become re-qualified, another with his/her team may successfully startup the unit or shut it down without incident and they receive no acknowledgment for their efforts with these billion dollar assets of the company. People become frustrated when they cannot deduce what, if anything, pleases the boss. Lack of support from supervisors or coworkers stress ranks high on the stress chart.

- *Lack of control over the work situation* - Lack of control for shift supervisors and control room operators seems only to affect the autonomy aspect of their job. They may not have the control over the members of their crews that they think they should have because many administration aspects of crew work might be handled by their managers or others on day shifts. The actual work situation on shift is much the same for each and every shift crew. The work situation does not change much over time. If one was taken off shift and assigned to a special project or it was their turn to participate in outage coordination or be the outage coordinator and the individual had no say in the matter; then there is lack of control of the work situation. Individuals could easily suffer a lot of psychological stress if they are forced to fill a position they do not really care for.

Internal Conflict Events -

Fear of Failure

Fear of committing errors and fear of failure give rise to internal conflict and psychological stress that may result in inaction. Inaction could result in lost time to ameliorate the event and the end result could be failure because of lack of performance. In this same context is the psycho-social stress from management and crew members as the candidate knows s/he may be falling into indecision and inaction. They can remember the familiar 'friendly' jabs; "this is what you are getting paid the big bucks for", "if you can't stand the heat, get out of the kitchen", "look at him/her sweat." Depending on the situation, people actually derive pleasure at seeing another person in a stressful situation. Fortunately, if an event were to actually happen in the real plant, all crew members would pull together and each member would have to ensure that they could now do their job and not worry about another's performance.

Safety or Production

A conflict is always present for the shift supervisor and the control room operator in trying to decide if a given problem poses a safety or a production concern. There is always a lot of 'second guessing' that goes on after an event in any power plant or industrial plant for that matter. Second guessing is usually called the 'Monday morning quarterback' syndrome by most shift people. They pick Monday morning because the weekends, and especially long weekends, are when events can happen and the advice of the back-room experts is not immediately available when critical decisions have to be made. Technical experts and management will judge the actions of the licensed people up to two or more weeks after an event. Modern information systems permit technical staff and management to review and analyze actual upset data for months following the event. The decisions made on shift are supposed to be those decisions a committee of experts would have made after they have all the information to work with long after the event. When do you shutdown the plant, when do you cool down? How do you recognize the conditions that require shutdown and cool down? It is not economical to shutdown a large nuclear plant and lose the generation that it can produce. Some reactors are designed to be unable to start for a day and a half after a shutdown. Sometimes you don't have a lot of decision making freedom. Your decisions supposed to end up with the execution of 'well thought-out' procedures. It is so important that the shift supervisor and the control room operator have all the required information, from the machine, to make these important decisions. All of this is psychological stress for the candidate as they take their test.

Forced Process

A psychological stressor that might not seem like much; but can cause a penalty or failure if it is not done, is the need to force ones self to go through a procedure demonstrating to the examiners that you have covered specific possibilities even though you already know the answer. This is akin to a professional chess player explaining all of his/her moves for the benefit of the audience even though they have iterated hundreds of solutions before choosing their final move. Not only do the candidates go through the procedures, they must verbalize their thinking. There is an extra cognitive process to do this. The candidate probably does the initial thinking first and, then formulates the formal thinking for verbal presentation.

Personality Types

To the writer's knowledge, there has not been an effort on behalf of management to warn candidates of the various types of behavior that individuals can have and train them to handle the down side of their particular type of behavior. (Hafen, 1996) warns, "According to Friedman, Type As struggle ceaselessly and senselessly to accomplish more and to involve themselves in more, not because demands are being placed on them but because they are placing demands on themselves. Friedman theorizes that the typical Type A struggles because of a hidden lack of self-esteem and a need to prove himself." The message here is that different personality types are going to handle and suffer stressors differently. Management and the candidates should both know and recognize personality influenced stressors and protect against them. It is intuitive that all candidates do not have the ideal personality type.

Everyday Hassles

There is a goodly measure of psychological and psychosocial stress that goes with job in the form of everyday hassles. These are events similar to those experienced by any manager or supervisor and are presented here to round out the stressor events experienced by the shift supervisor and control room operator. These events weigh on the candidates mind and can affect performance if not addressed and handled properly. The writers suggest an Artiss, Bradley, Patterson Stress Scale of Operating Events that goes somewhat like this:

The Artiss, Bradley, Patterson Stress Scale of Operating Events

No attempt has been made to order these events. A survey is required.

Shift Event	Value
Large Loss of Coolant Accident	100
Other Emergencies covered by procedures	
Other Unplanned Events and Upsets	
Abnormal Operation of a System	
Lack of support from supervisor	
Approving Safety Work Permits	
Personnel Discipline	
Performance Evaluations of Crew Members	
Shift Meetings	
Approving Maintenance Work Permits	
Speaking in Public, Dealing with the Public	
Daily Planning Meetings	
Trouble Shooting Problems on Shift	
Your Performance Evaluation	
Interviews by your Boss	
Interviews by Higher Management	
Assigning Work to the Crew	
Other Normal Duties	
Dealing with a Union Grievance	

Reasons why many of the events listed in this scale are stressors have already been described. Why are some of the other events stressors? Probably for one of three reasons: there is no company policy to apply, there has been no specific training in handling some of these events, or there has been no practice. Skills and abilities handling many of these events do not come through the technology path nor are they gained through osmosis.

Comments on the Life Event Scale

With a little reflection on the 9 events chosen from the Life Event Scale presented earlier, one can see that these psychological and psycho-social stress events are applicable to the candidates as they prepare for and take their test. These events may weigh on their minds and could impact their performance. If you fail this examination, you are certainly going to have trouble with the boss, fired from the job will cross your mind, a change to a different line of work and change in responsibilities are cause for meditation and there will certainly be a change in financial state. If you are old enough and have had enough of this type of stress, you might consider retirement. Even if you are young, you might consider a career change now that your career seems to be taking a turn. Thinking too much on these stress events could cause a change in eating and sleeping habits. If you have trouble eating and sleeping, you could be in for trouble. However, if you pass the test and become authorized for the first time or again as the case may be, then you will faced with a new set of stressors from the list of 9 and one of them will be outstanding personal achievement. This is the one that we can stand a lot of.

Conclusions

This paper has identified a variety of stressors associated with both the position of control room operator in a nuclear power plan and the accreditation tests taken by these individuals. Many stressors are inherent in the position and this should be recognized by the incumbent and important associates. With recognition a variety of situation, personal and interpersonal actions and strategies can be enacted to counteract the effects of stress. A particular focus in the paper was on stressors in accreditation tests. The point made was that stress in these test should accurately reflect stressors in the plant. Because the testing situation is an inherently stressful simulation, it is possible to create stressors that are unique to the test process but have little to do with satisfactory job performance. High fidelity matching of position and test stress requires attention.

We have not mentioned in detail the effects of any of these stressors on the candidates whether they be distress (negative stress) or eustress (positive stress). Change in sleeping and eating habits are mentioned as being stressors themselves. They are also effects of stress. The effects and management's monitoring for them can be brought out in cognitive stress training. We can visualize a practical psychological assessment over and above what management and supervision should be able to recognize after some training themselves.

Ultimately important is the identification and subsequent description of the particular stressors acting on the candidate and his/her associates in given situations. These descriptions will facilitate the development of appropriate strategies to ameliorate the negative effects of those stressors. Training can help the candidates overcome the physical, psychological and psychosocial stress that they face during an accreditation examination.

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