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U.S. Nuclear Regulatory Commission  
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Subject: Modification to Operator Alertness Lesson Plan

Dear Mr. Adams,

As a follow-up to our phone conversation on April 24, 2004, we hereby modify the operator alertness lesson plan that was attached in our response dated March 31, 2004. Please contact the undersigned or Dr. Bernard should you have any further questions.

Sincerely,

Edward S. Lau  
Acting Director of Reactor Operations  
MIT Research Reactor Laboratory

EL/gw

Enclosure: MITR Operator Alertness Lesson Plan Revised 5/7/2004

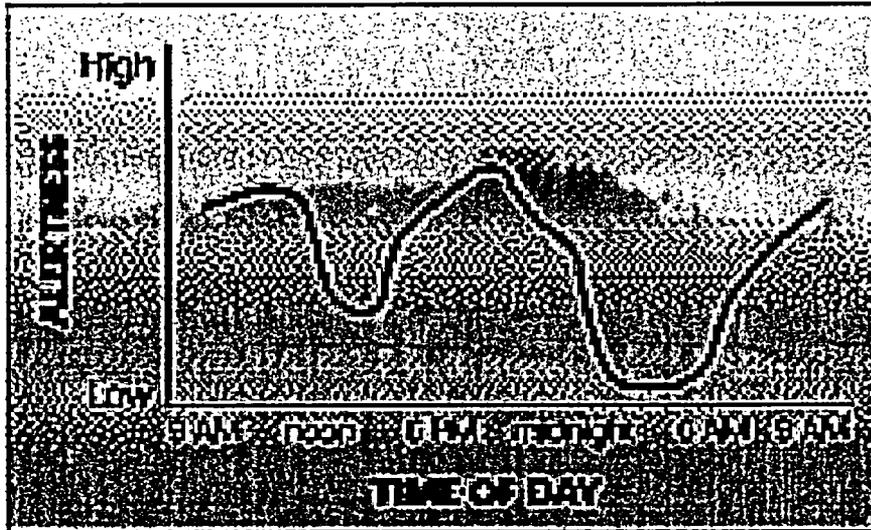
Cc: Document Control Desk  
Thomas F. Dragoun, Project Scientist

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## MITR Operator Alertness Lesson Plan

Sleep is a basic restorative process and one always has to be sure to get enough sleep, to maintain performance commensurate with one's responsibilities.

### Circadian Clock



- The human body naturally follows a 24-hour period of wakefulness and sleepiness that is regulated by an internal circadian clock. The circadian clock is linked to nature's cycle of light and darkness.
- The clock regulates cycles in body temperature, hormones, heart rate, and other body functions.
- For humans, the desire to sleep is strongest between midnight and six a.m. Many people are alert in the morning, with a natural dip in alertness in the mid-afternoon.
- This circadian rhythm is set and maintained mainly by two external stimuli: light and noise.
- It is difficult to reset the human internal circadian clock.
- It usually takes at least two to three weeks before we are fully adjusted to a total day-night reversal.
- 10-20% of night shift workers report falling asleep on the job, usually during the second half of the shift when the alertness is lowest.
- Shift workers who work all night may find it difficult to sleep during the day, even though they are tired.

## **Sleep Deprivation**

- When sleep deprived, people think and move more slowly, make more mistakes, and have difficulty remembering things.
- Lack of sleep is associated with irritability, impatience, anxiety, and depression.
- Shift workers experience more stomach problems (especially heartburn and indigestion), menstrual irregularities, colds, flu, and weight gain than day workers. Heart problems are more likely too, along with higher blood pressure.
- The risk of workplace and automobile accidents rises for tired shift workers, especially on the drive to and from work.
- Shift workers must also cope with a lot of family and social problems. They have to work while the rest of the world is in bed, and sleep while the rest of the world is at work and engaged in leisure activities.
- Many studies show that workers who frequently change shifts are generally more stressed than conventional day workers and that shift workers get less sleep overall. Studies have shown that, on average, shift workers sleep for 1.5 hours less a day than permanent day workers.
- The Exxon Valdez oil spill and the nuclear accidents at Three Mile Island and Chernobyl all happened in the early morning.

## **Signals of Overtiredness**

- Pay careful attention to signs of sleepiness or fatigue.
- Pay attention to signals such as yawning, frequent blinking, or a sense of tiredness.

## **Increasing Operator Alertness**

### **Worker Actions**

- Take short breaks throughout the shift.
- Try to work with a "buddy". Talking with co-workers can help keep you alert. And co-workers can be on the lookout for signs of drowsiness in each other.
- Try to exercise during breaks.
- Try to eat three normal meals per day. Eat healthy snacks, avoiding foods that may upset your stomach.
- Don't leave the most tedious or boring tasks to the end of your shift when you are apt to feel the drowsiest. Night shift workers hit their lowest period around 4 to 6 a.m.
- On the last few days of the current shift, sleeping time should be gradually adjusted to be ready for the new shift. For example, if your next shift will be the evening shift, try to delay your sleeping time and hence your wake up time 1 to 2 hours every day to ease into the new night shift.

- If your shift is at night and you have to sleep in the daytime, simulate the night environment in your bedroom by making it dark and quiet. White noise (constant low background noise like a fan or air conditioner) may help block out external noise.
- The worker should follow the sleep schedule of each shift as strictly as possible even in the off days.
- Changing the sleep schedule during the weekend to cope with the social commitments may upset the sleep schedule for the whole week.
- Get sufficient sleep on days off. Practice good sleep hygiene by planning and arranging a sleep schedule and by avoiding caffeine, alcohol, and nicotine.
- Avoid reliance on stimulants, both over-the-counter and otherwise. At best, caffeine, uppers, and up-all-night agents only temporarily fool the body into thinking it's functioning properly, which further complicates sleep disorder.

### **Management Actions**

- Shift work should be organized in way to help the shift worker sleep better. That can be done by rotating clockwise from day to evening to night. This approach is more natural and helps the worker to adjust his/her circadian rhythm gradually.
- It is better to have longer shift periods to allow the body to adjust to the new shift (i.e., a three-week rotation is better than a one-week rotation).
- Install bright lights in the work areas. A well-lit workplace signals the body that it is time to be awake and alert.
- Schedule shifts to allow sufficient breaks and days off, especially when workers are re-assigned to different shifts. Plan enough time between shifts to allow employees to not only get enough sleep, but also attend to their personal life.
- Don't promote overtime among shift workers.
- Decrease the number of night shifts worked in a row. Shift workers working the night shift sleep less than day workers and become progressively more sleep deprived over several days. If one can limit the number of third shifts to five or less, with days off in between, recovery from sleep deprivation is more likely. If working a 12-hour shift instead of the usual 8 hours, it is recommended that one would limit work to four shifts in a row. Furthermore, one should optimally have more than 48 hours off after a string of night shifts.
- Avoid extended work hours; this includes working prolonged shifts and excessive overtime, and taking short breaks.

### **References**

<http://www.sleepsa.com/shiftworkerseng.html>  
<http://www.sleepfoundation.org/publications/shiftworker.cfm>  
<http://sleepdisorderchannel.com/shiftwork/>  
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