

6/10/82

168

TESTIMONY OF MURRAY MELBIN, PH.D.
COMMENT ON EMERGENCY PLAN FOR INDIAN POINT POWER PLANT

I. Credentials

I am Murray Melbin, Professor of Sociology at Boston University. For the past ten years I have been studying aspects of human life around the clock, including its social, psychological, biological, and economic dimensions. My work might be called a 'temporal ecology of society.' It deals with rhythms of emergencies as well as with normal behavior and the functioning of organizations.

II. Capability and performance of individuals at night.

Humans have distinct 24-hour cycles for many of their physiological functions, including heart rate, breathing, body temperature, production of various hormones and decision speed in the brain.

These bodily conditions are related to performance, and almost everyone is more sluggish at night and has less mental acuity. On the job, where such aspects could be measured, there are more errors of judgment than are made in the daytime. Impaired performance shows itself in decreased visual sharpness (1), slower responses to telephone calls (2), more accidents involving the operation of machinery (3), slower work on precise tasks and more of it defective. (4) In general the efficiency and grade of workmanship at night is inferior to that of daytime. (5)

One conclusion from this is that any set of plans will be carried out less effectively at night, and additional precautions have to be taken to compensate for the risks of errors in judgment and behavior.

The risks are compounded if the personnel are subjected to erratic shift work schedules, for these interfere with short-term memory as well as performance. (6)

Furthermore, there is fairly widespread evidence that at night "monitoring personnel," that is, those whose work entails surveillance in situations in which most of the time 'nothing' happens, sleep on their jobs. (7) Even if only some of the utility employees do so, it still raises the likelihood of delay in detecting a malfunction then.

Many organizations are continually active but their primary administrators--directors, heads of departments, mayors--are

asleep at night and a decentralization of power is in effect. To some extent this is the result of authority explicitly delegated to lower echelon personnel. But it also happens that lower echelon personnel are reluctant to waken their superiors, and lesser officials make decisions that in the daytime would be deferred to higher-ranking staff. There is a strong disposition on the part of those awake to imagine that matters can wait until the following morning. Both have happened when national security was at stake. (8)

The implications for coping with an emergency in a nuclear power plant is that at night there will be an increase in the normal tendency to delay. There may be postponement 1-of imperative actions and 2-of notifying responsible authorities who are sleeping; and, given the lower level of alertness and acuity at that time, the report is more likely to be inaccurate.

III. Vulnerability of suddenly wakened people.

Sleep has a typical sequence of four stages, and this cycle is repeated several times during the night. Stages 3 and 4 are ones in which the person does not dream, is least responsive to the environment, and very difficult to rouse. When wakened from stage 3 or 4 sleep, a person is muddled and disorganized and may not remember what is said even though attempting to be coherent. (9)

The implication of this is that people wakened at night will be less effective. When told what to do in an emergency they may misunderstand or misinterpret instructions and do the wrong thing. Top officials roused then will not be able to function with clarity right away.

IV. Dispersal of people and activities around the clock.

I have seen estimates of evacuation times for daytime and nighttime conditions prepared by Parsons, Brinckerhoff, Quade & Douglas, Inc., which indicate that evacuation is assumed to be quicker and easier at night. Such a conclusion may ignore several important factors, as follows:

Evening and night shift work is common and large numbers of people are so employed. Ten million people are on the job at ten o'clock in the evening, seven million are working at midnight, and during the night the figure does not go much lower than four million. (10) Most of these individuals come from separate households. In families having more than one adult in the work force it is common for the members to work on different shifts.

The implications of this are that one cannot assume that

All members of a family are together after dark and throughout the night. In great numbers of households one member is away on the job during that period. In case of an emergency, night workers would probably want to telephone home (which would burden the phone lines more than anticipated), and then would attempt to travel home to reunite with their families before undertaking evacuation. Those families may delay departures while waiting for the workers to return. Indeed, shift workers are more likely to use their own cars rather than public transportation in order to get to work, which means that the family car will not be at home at night in those families; they would not have ready transportation then.

The night is usually a time of rejuvenation for the community itself. Maintenance activity is carried out. Cleaning and repairing takes place, and "down time" for many machines are scheduled then for such purposes. Vehicles and transit system tracks undergo repair during the night, bridges are closed to traffic while roadbed and cable maintenance are performed, and turnpike entrance and exit ramps are closed for reconstruction and new construction. Most of these activities have irregular schedules.

The implications are that traffic system capacity during the day may be sharply curtailed at night and create bottlenecks or unfamiliar detours. It may not be possible to activate them quickly. To get bridges open, to get vehicles out of repair, to get tracks cleared, may require hours of work before the system is as usable as during the day.

Notes

1) Bjerner, B., Holm, A., and Swensson, A. "Diurnal variation in mental performance" British Journal of Industrial Medicine v.12, 1955:103-110.

2) Brown, cited in Luce, Gay Gaer BIOLOGICAL RHYTHMS IN PSYCHIATRY AND MEDICINE Washington, D.C.: National Institute of Mental Health, PHS Publication #2088, 1970.

3) von Hentig, Hans THE CRIMINAL AND HIS VICTIM Archon Books, 1967, also Fishwick, Frank and Harling, C.J. SHIFTWORKING IN THE MOTOR INDUSTRY London: National Economic Development Office, 1974.

4) Fishwick, Frank THE INTRODUCTION AND EXTENSION OF SHIFTWORKING London: National Economic Development Office, 1980:24.

An example of the difference in performance by time of day, in a situation involving human lives, is that ten times as many airplane accidents occur at night as in the daytime. (NOVA program, WGBH-TV, Boston, January 1975.)

5) Smith, Robert S. MILL ON THE DAN: A history of Dan River Mills, 1882-1950. Durham, North Carolina: Duke University Press, 1960:220.

6) Tapp, W.N. and Holloway, F.A. "Phase shifting circadian rhythms produces retrograde amnesia." Science v.211, 6 March 1981:1056-1058. This is based on an experiment with rats, an animal whose physiology closely resembles that of humans.

There are further indirect harmful effects of erratic schedules, which make sleep inadequate. People awake at night who have not slept well have an additional handicap to competence. Czeisler, C., Weitzman, E., Moore-Ede, M., Zimmerman, J., and Knauer, R., "Human sleep: Its duration and organization depends on its circadian phase" in Science 12 Dec 1980:1264-1267.

7) Some police officers on duty make themselves unavailable by sleeping in their cars, an old custom in New York City where it is called "cooping." New York Times "'Cooping': an old custom under fire" 15 Dec 1968:Sec.4,6D. Hospital personnel have been found sleeping at their posts. New York Times "Auditor raids at 3 state hospitals find 22 night employees asleep" 26 June 1977:14.

8) The penalty for postponing a matter of vital interest from night to morning was dramatized harshly by the sequence of events that ended with the bombing attack on Pearl Harbor on December 7, 1941. (a) Having intercepted and decoded messages from Japan to its envoys in the ten days preceding December seventh, the leaders of the United States knew that trouble was brewing fast and that a rupture in relations with Japan, and

war, was imminent. (b) Yet in spite of the fact that the War and Navy Departments had been alerted and lights in those offices burned all night (c), the Secretary of the Navy called a meeting of the heads of state for the next morning, Sunday, at 10 a.m.. Nighttime then was perceived to be a phase during which even urgent business could be suspended. A message alerting the garrison was sent, but arrived four hours too late. Assuming that all other mistakes and delays had occurred (d), if the vital meeting had not been postponed because of nighttime the message would have arrived far enough in advance of the attack to disperse the fleet clustered in the harbor.

a) This account is drawn from the following documents and the page references in the succeeding three notes refer to them:

i. "Attack upon Pearl Harbor by Japanese armed forces" Washington, D.C.: U.S. Senate Document 159 (microfiche serial set 10676) 1942.

ii. "Investigation of Pearl Harbor attack" Washington D.C.: U.S. Senate Document 244 (microfiche serial set 11033) 1946.

iii. Morris, Richard B. and Irwin, Graham W. (eds) HARPER ENCYCLOPEDIA OF THE MODERN WORLD New York: Harper & Row, 1970.

b) Ibid., ii:564,566-567.

c) Ibid., ii:567.

d) There were other factors contributing to the outcome and to the amount of damage wrought. (See ii:553, i:11-12, iii:502, ii:569,530.) But there would not have been such severe consequences if the meeting in Washington had been held Saturday night.

The attack on Pearl Harbor occurred forty years ago but it was not the only incident of its kind. On August 19, 1981, while the President of the United States was vacationing in California, a dogfight took place in the Mediterranean off the coast of Libya and two of that country's fighter planes were shot down by U.S. naval aircraft. News of the clash reached military headquarters in Washington, D.C. six minutes after the incident. It was after 11 p.m. in California. Presidential aides notified other top officials but did not inform the President until nearly six hours later. (e) It is fair to surmise that if it were earlier in the day the President would have been told immediately.

e) Newsweek "To the shores of Tripoli" 31 Aug 1981:14-18; also Facts On File "U.S. Navy F-14s down two Libyan jet fighters" 21 Aug 1981:589-590.

Such delays also occur in hospitals and factories.

9) Broughton, Roger J. "Sleep disorders: Disorders of arousal?" Science v.159, 9 Mar 1968:1070-1077.

10) U.S. Bureau of Labor Statistics data for 1980, gathered via the Current Population Survey. These are conservative estimates because some categories of workers are omitted.

These are figures for the entire nation. It is realistic to estimate the numbers for the greater New York metropolitan area as paralleling the proportion of the country's population living in the region.