LIC 12/22/80

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
METROPOLITAN EDISON COMPANY	)	Docket No. 50-289 SP
	)	(Restart)
(Three Mile Island Nuclear	)	
Station, Unit No. 1)	)	

LICENSEE'S TESTIMONY OF

DR. ERIC F. GARDNER

IN RESPONSE TO CLI-80-5,

ISSUE (2), ANGRY CONTENTION NO. IV,

SHOLLY CONTENTION 14(b), AAMODT

CONTENTION NO. 2 AND CEA

CONTENTION NO. 13

(OPERATOR TRAINING)

OUTLINE

The purpose of this testimony, by Dr. Eric F. Gardner, is to respond to the questions raised in CLI-80-5, Issue (2), ANGRY Contention No. IV, Sholly Contention 14(b), Aamodt Contention No. 2, and CEA Contention No. 13, insofar as they pertain to the training program established at TMI-1 for NRC-licensed nuclear reactor operators. Dr. Gardner is an educational psychologist with special expertise in educational and psychological measurement, psychometrics, test construction, and curriculum and program evaluation. As a member of the TMI-1 Operator Accelerated Retraining Program (OARP) Review Committee, Dr. Gardner had the opportunity to evaluate in detail the OARP and to insure that adequate attention was given to the educational and psychological aspects of the training program. Dr. Gardner concludes that the OARP for retraining TMI-1 nuclear reactor operators was carefully developed and implemented to be consistent with effective educational and psychological principles. This conclusion is based on a number of aspects of the OARP, including the fact that careful planning preceded the initiation of the program; the OARP was implemented in accordance with this preplanning; the oral exams administered by the Company's consultant, Mr. Frank Kelly, were fully satisfactory (in spite of Dr. Gardner's initial bias against the single oral examiner technique); the required minimum scores on quizzes and final written exam

administered to operators during the OARP assured satisfactory levels of knowledge; and, finally, that the Company took into account the issue of operator "mindset" or "response-set" in the development of its program of training and education for TMI-1 operators.

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This testimony, by Dr. Eric F. Gardner, Professor Emeritus at Syracuse University and educational and psychological consultant, addresses the following questions and contentions:

CLI-80-5, ISSUE (2)

> Whether the operations and technical staff of Unit 1 is qualified to operate Unit 1 safely (the adequacy of the facility's maintenance program should be among the matters considered by the Board).

ANGRY CONTENTION NO. IV

> The Licensee lacks the management capability to operate a Nuclear Generating Station without endangering the public health and safety.

SHOLLY CONTENTION 14(b)

> The Licensee's management capability, in terms of organizational, staffing, and technical capabilities, is not sufficient. Specifically, the following deficiencies in Licensee's management capability are contended:
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> . . .
>
> (b) Licensee's operations and technical staffs are not sufficiently qualified to safely operate TMI-1.

AAMODT CONTENTION NO. 2

> It is contended that TMI-1 should not open until the performance of licensee technicians and management can be demonstrated to be upgraded as certified by an independent engineering firm. This upgrading should include 100% test performance of job description with provision for retraining and retest, or discharge of those who cannot consistently and confidently master all necessary information for safe conduct of their job descriptions under all anticipated critical situations as well as routine situations.

CEA CONTENTION NO. 13

> CEA contends that there is a specific need for the establishment of training for operators that addresses the problem of a 'mindset' that denies information indicative of serious problems.

I am Eric F. Gardner, an educational psychologist with special expertise in educational and psychological measurement, psychometrics, test construction, and curriculum and program evaluation. As professor of education and psychology and later the Margaret O. Slocum Professor of Education and Psychology at Syracuse University, I taught graduate courses on evaluation, educational and psychological measurement and on test construction and test use in the School of Education and the Psychology Department of the College of Arts and Sciences from 1947 to 1978.

During my career at Syracuse University, I was Director of the Division of Advanced Studies in the School of Education from 1952 to 1961, Chairman of the Psychology Department of the College of Arts and Sciences from 1961 to 1976, and Director of the Psychological Services Center from 1961 to 1976. During these periods, I was called upon to participate as a member (and occasionally as chairman) of evaluation committees set up by the National Council for Accreditation of Teacher Education, Middle States, Southeastern States and other accrediting agencies to examine and/or accredit the educational programs in

various colleges and universities. Among the institutions visited as a member of such committees were the University of Pennsylvania, the College of William and Mary, the University of Buffalo, Cornell University and Indiana State College.

I am the author or co-author of three books including a textbook in educational psychology, over twenty tests published by Harcourt Brace Jovanovich, ten chapters in technical books, and about fifty articles published in professional journals.

I have been an active participant in the professional organizations in my field and have served as a member of the executive committees of the American Psychological Association Divisions of Educational Psychology and Evaluation and Measurement, and also as President of the Division of Evaluation and Measurement and President of the National Council on Measurement in Education. I am a Fellow in the American Psychological Association and a Certified Psychologist in New York State.

I have served on a number of national, state and private institution committees. Included are memberships on the National Research Council Committee on Aviation Psychology (1951 to 1958), College Entrance Examination Board Committee on the Scholastic Aptitude Test (1956 to 1966), U.S. Office of Education Cooperative Research Committee (Chairman, 1956 to 1959), the New York State Committee on Proficiency Examinations and the New York Regents' External Degree Program Advisory Committee (1974 to the present).

I am currently the Margaret O. Slocum Professor Emeritus at Syracuse University and am an educational and psychological consultant.

I have been asked by GPU to provide my views on the training program established at TMI-1 for NRC-licensed nuclear reactor operators, particularly in light of my participation in the TMI-1 Operator Accelerated Retraining Program (OARP) Review Committee. The members of the TMI-1 OARP Review Committee were selected specifically to include individuals with the various kinds of backgrounds, training, and experience needed to make an effective evaluation of a training program for nuclear reactor operators. Included among the various kinds of individuals required for the task was a person with background and experience in curriculum and program evaluation, knowledge and experience in the psychology of teaching and learning, measurement and testing devices, and enough engineering background to be able to communicate with the members of the Committee who had technical expertise in nuclear energy and power generation. I was recommended by the Psychological Corporation and was selected by the Training Department of Three Mile Island to perform this specific role as a member of the review team.

My duties as a member of the Review Committee were to participate in all Committee discussion to insure that adequate attention was given to the educational and psychological aspects of the training program and to personally make the

necessary observations of the various aspects of the program including those associated with teaching-learning situations. Although all aspects of the final report were discussed by the Committee as a whole, my particular responsibility was to write Chapter Six, Evaluation of the Operator Accelerated Retraining Program, and the section in Chapter Ten on educational and training processes.

Careful planning preceded the initiation of the OARP. The "Primary and Backup Instructor Handbook," developed to provide a blueprint for the organization and administration of the OARP, presented information regarding goals, program format, rationale, instructional procedures, evaluation procedures of both students and instructors, and program schedule. The training program was implemented by instructors selected for their knowledge of a particular content area. Training materials were developed according to guidance given in the Handbook.

A careful examination of the Handbook as a descriptor of the proposed retraining program indicated that considerable thought and care were involved in planning the OARP. It provided the instructors with a valuable guide for lesson plan development, and a detailed description of their duties. It also directed them to be concerned about effective ways of presenting material, the use of references, the necessity for review and reinforcement, the integration of theory and practice, and evaluation of both students and their own

performance as instructors. While time constraints prevented this guide for the development of materials from always being strictly followed, the identified administrative deficiencies did not significantly detract from the quality of the program.

Data was gathered by the Review Committee to determine the extent to which the preplanning described in the Handbook had been implemented and to evaluate the adequacy of the program in terms of its content and the educational and psychological characteristic of the procedures used. An analysis of the accumulated data indicated that the OARP for retraining nuclear reactor operators for Three Mile Island - Unit One had been carefully developed and implemented to be consistent with effective educational and psychological principles.

A study of the various examinations, their interpretation and characteristics, was considered especially important by the Committee. Since one-on-one oral examinations are known to have a number of psychometric weaknesses, the Committee was expecially concerned with the effectiveness of oral examinations for reactor operator licensing in general, and the effectiveness of the oral examinations of OARP trainees administered by the Company's consultant, Mr. Frank Kelly, in particular. Both oral examinations by a board and a single examiner can fail to achieve their objectives.

To become better acquainted with the oral examining procedure of the Kelly organization and to evaluate its effectiveness, I attended the auditor-administered oral

examinations of two individuals which were administered by two different auditors. At the conclusion of each examination, the examiner and examinee discussed weak and stong areas of the examinee disclosed by the examination. I also conferred with both examiners after the examinations had taken place and discussed their effectiveness as examiners.

In spite of my initial bias against the single oral examiner technique, I was convinced that the examinations given by the Kelly team were effective and had achieved their major purpose. The examiners used a previously prepared set of topics to be covered, probed to determine depth of understanding, and used questions which required knowledge of important concepts in both theory and practice. Special emphasis was placed on safe operation, the safety devices built into the system, and the kind of action and diagnosis needed during transients.

Another important topic related to the safe operation of the nuclear plant and to which the Review Committee gave attention was the effect of the psychological variable, stress. People vary substantially in their ability to tolerate stress and to function effectively in a stressful situation. Psychological screening can eliminate candidates who have a low tolerance for stress and the examination situations of the retraining program themselves can provide enough stress to identify others. In addition to eliminating candidates who are identified as having low tolerance for stress, the training on

the simulator, which includes unannounced abnormal and emergency plant occurrences, is designed to reduce the stressfulness of transients and promote effective responses. These measures should give adequate protection in most situations. However, no psychological test exists nor is there any psychologist who can certify that any specific individual will behave in a stable fashion in all stressful situations. In addition to providing the best individual screening possible and the best training under stressful conditions, the final step is to provide checks and back-up elements among the personnel in the control room and, in addition, to provide them with access to other knowledgeable personnel outside the control room.

Two questions have been raised specifically about the retraining program of the TMI-1 operators. One maintains that the upgrading should require test performance of 100% of all examinees, and the other that there is need for specific training of operators that addresses the problem of "mindset."

A score of 100% on a number of cognitive tasks, especially when measured by some form of test -- either written or oral -- is relatively meaningless without some frame of reference for interpretation. The meaning of any score including a score of 100% is related to the difficulty of the task or test. For a very difficult test, a score of 50% could represent a higher level of knowledge than 100% on a much easier one. The tests used in the OARP were not designed to require scores of 100% to

represent satisfactory performance. However, in the opinion of the Review Committee the required minimum scores of 80% on quizzes and 80% on the Kelly exam do assure satisfactory levels of knowledge.

Mindset is a term often used in general conversation to indicate a person's general feelings about a situation or issue. Since it is impossible to measure or determine directly the specific physiological activity taking place within the brain that causes observable behavior (either mental or physical), knowledge about mental functioning (including the measurement of intelligence) must be inferred from observable responses related to specific stimuli presented to the person. Hence the term "response set" rather than "mindset" is a term usually used by psychologists when the discussion involves training or educating. Response set may be related to a variety of stimuli and the resulting desirable behavior is the aim of either training or education.

The safe and effective operation of the plant by nuclear reactor operators requires them to respond to a variety of stimuli to which the appropriate response varies from an immediate S-R (Stimulus-Response) response to a delayed response based on higher level cognitive processes. A satisfactory training program requires a combination of training in the narrow sense and education as preparation for more complex situations. This issue was discussed in detail in the report of the OARP Review Committee for Three Mile Island, pages

115-117. Briefly, training emphasizes mastery of specific tasks through drill and practice. Education, on the other hand, involves an open set of operations, eventualities which cannot be entirely anticipated, and possibilities too numerous to be learned individually. Emphasis is upon the transfer of knowledge to new situations through an understanding of concepts, and an acquiring of skills, attitudes and values. Both of these training processes were utilized during the OARP.

If the concern which was expressed in the query as to whether or not retraining undergone by the nuclear reactor operators in the Operator Accelerated Retraining Program focused on the kinds of behaviors and expected behaviors that the operator would perform when confronted by unexpected situations in the control room, the concern is an important and legitimate one. Some of the functions of the nuclear reactor operator in the control room necessitates training which requires a specific immediate response to the stimulus when it is presented. For example, when an automatic reactor trip occurs the operator is required to immediately activate the manual trip. Similarly, if high pressure injection occurs the operator is required to immediately trip the reactor coolant pumps. A third example would be phoning a supervisor to inform him of certain types of occurrences.

Other types of response sets require detailed analyses involving the immediate collection of data relevant to some unexpected transient. Associated with this latter situation

would be the response set that, in an unusual situation an immediate response would not be forthcoming, but that data would be gathered and analyzed before attempting a correction.

With respect to the safe operation of the reactor, a number of response sets need to be established so that the action by the control room operators will ensure safety of operation under all conditions. Among these are: 1) immediate reaction by the nuclear reactor operator according to operating procedures when the stimuli present the usual and familiar situations; 2) knowledge of prior transients and the appropriate response in the event similar situations should arise; 3) adequate knowledge of the reactor and its theory so that appropriate data will be collected, analyzed and a conclusion reached for unusual situations which have not occurred before; and 4) provision for the possibility of irrational behavior should there be a psychological breakdown by the individual reactor operator.

The kinds of issues specified in the previous paragraph were considered and discussed in detail by members of the Review Committee when they considered the adequacy of the OARP. I will comment on each one in sequence.

1. Immediate reaction by the nuclear reactor operator according to operating procedures when the stimuli present the usual and familiar situations. There seems to be little complaint about this aspect of the training of nuclear reactor operators. However, there is a serious danger that is related

to the training and education of the nuclear control room operator. There is evidence that a person can be too highly educated or trained for a particular job. For some jobs, boredom and lack of attention may result if the occupant is too highly educated. An extreme example would be the relatively poor performance expected from an academician on an assembly line. The nuclear reactor operator needs enough training and education to successfully and safely perform his own specific job and to function as a member of the team in the control room.

2. Knowledge of prior transients and the appropriate response in the event similar situations should arise. Nuclear reactor operator training programs should include information about the recognition and remedial steps taken during prior transients. The inclusion of "Lessons Learned" in the OARP curriculum was an important step to provide for the appropriate response set associated with such situations.

3. Adequate knowledge of the reactor and its theory so that appropriate data will be collected, analyzed and a conclusion reached for unusual situations which have not occurred before. To provide for the safe operation of the control room during new, unusual, critical situations, the OARP Training Program provided additional theoretical training reinforced with simulator training on appropriate responses to hypothetical transients. Special emphasis was placed on the importance of accumulating and analyzing data before taking

action. In addition, a one-week program on Decision Analysis training to supplement the OARP was taken by SRO's and STA's. The results were reported as impressive by the Committee Chairman, Dr. Uhrig, who participated in the program. He observed that during the training exercises, the senior reactor licensees and shift technical advisors dealt with problems that actually occurred in nuclear power plants and made "good" decisions. This type of training provides procedures to assist the control room team in handling unusual conditions and the Committee agreed it should be included in the training of the senior personnel in the control room. The control room team has been strengthened further by the addition of a Shift Technical Advisor (a degreed engineer) whose responsibility is not to focus on the routine operation but to be alert to unusual situations and to serve as a consultant to the shift supervisor and nuclear reactor operators.

4. Provision for the possibility of irrational behavior should there be a psychological breakdown by the individual reactor operator. Provision to assure safety in the control room during a possible breakdown due to psychological causes has been discussed in this testimony on pages 7 and 8. In addition, to assure that the necessary elements to protect against all hazards -- psychological and otherwise -- a needs and task analysis of the duties of all control room personnel has been undertaken. Specific responsibilities and back-up responsibilities to protect against unforseen emergencies are being defined and designated.

In conclusion, the OARP for retraining nuclear reactor operators for Three Mile Island-Unit One has been carefully developed and implemented to be consistent with effective educational and psychological principles. I agree with the other members of the Review Committee that the completed Operator Accelerated Retraining Program for TMI-1 operational personnel and the addition to the shift operating staff of Shift Technical Advisors, who are degreed engineers, provide a blend of training and education that should result in the safe, reliable operation of TMI-1.