

**SNUPPS**

Standardized Nuclear Unit  
Power Plant System

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Nicholas A. Petrick  
Executive Director

September 5, 1984

SLNRC 84- 0111 FILE: J-111/0278  
SUBJ: Human Factors Involvement  
in SNUPPS SPDS Design

Mr. Harold R. Denton, Director  
Office of Nuclear Reactor Regulation  
U. S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Dear Mr. Denton:

The NRC conducted an audit of the SNUPPS design for a Safety Parameter Display System (SPDS) in Wichita, Kansas, on August 20-22, 1984. During the audit, the Staff reviewer (Leo Beltracchi) requested additional information regarding the participation of human factors professionals during the design of the generic Safety Assessment System (SAS) from which the SNUPPS SPDS design has been derived.

The generic SAS design was sponsored by twelve utility owners of Westinghouse pressurized water reactor plants. Quadrex Corporation was responsible for the generic design, subject to direction from the utility owners and with the benefit of substantial participation by experienced utility personnel. Charles Tipple of Quadrex (resume attached) provided professional human factors input throughout the design process. He participated directly in design iterations at Quadrex and also participated in the owner's committee meetings where the display designs were reviewed and re-reviewed until each feature was specifically approved.

Mr. Tipple's participation during display layout design, for example, drew upon his human factors experience, unbiased by prior nuclear plant design experience. To guide the design team, he questioned the interrelationships and relative importances of proximate and separated parameters in draft layouts. He recommended the best uses of color and ensured appropriate color conventions, as well as redundant shape coding conventions. He conducted numerous experiments to select among design alternatives for such features as trend graph line weights or time axis labelling. He also compiled the human factors criteria document and prepared the final human factors summary documentation made available to the NRC Staff during the audit.

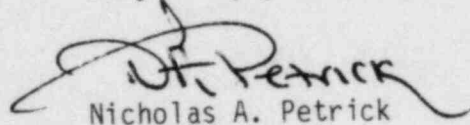
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Separately, human factors professionals from INPSYCH (resumes attached) were contracted to assist in both training and program evaluation. They guided the development of criterion referenced training materials used throughout the program to introduce the system to unfamiliar evaluators. They developed the companion on-site evaluation questionnaire which provided early independent operator feedback on the SAS design. Finally, they played a major role in the operator evaluation program conducted on the Indian Point simulator: they guided the evaluation design, served as observers as the transients were run, debriefed the operators, and compiled the feedback data.

In summary, as stated during the audit, human factors considerations were integrated throughout the SAS development program. The owners recognized that human factors engineering was essential both to fulfill the NRC requirements and to produce an effective design which would aid plant operation without detracting from it. Human factors professionals interacted with other personnel sensitized to human factors principles in order to ensure that design objectives were met. The substantial human factors engineering influence is evident in the final product.

Very truly yours,

  
Nicholas A. Petrick

SLA/n1d5b13&14  
Attachments

cc: G. L. Koester	KGE
J. M. Evans	KCPL
D. F. Schnell	UE
J. Neisler/B. Little	UE/CAL
H. Bundy	KGE/WC
B. L. Forney	USNRC/RIII
D. R. Hunter	USNRC/RIV
V. Stello	USNRC

## QUADREX CORPORATION

Charles H. Tipple, Jr.

### STAFF ENGINEER

#### Experience Highlights

- o Over 15 years in system, human factors and man-machine interface design.
- o Manager and technical contributor in functional analysis, requirements definition and equipment design
  - Performed system analysis
  - Conducted man-machine function-trade studies
  - Recommended facility and work-space design
  - Conducted operational performance testing

#### Professional Experience

Mr. Tipple is currently an Industrial Designer and Human Factors Engineer in the Quadrex Control and Instrumentation Group. He is involved in man-machine interface design, equipment and workspace layout and design, and workspace evaluation. Prior experience included human factors/industrial design group management. He was involved in a number of aerospace, government and commercial programs. He is knowledgeable in all aspects of the human factors engineering field, having performed detailed systems analysis, developed system design specifications, facility layouts, workspace designs and participated in pre- and post-equipment-design operational tests and evaluations. He has extensive experience in the development of effective equipment design and man-machine interface solutions.

#### Education

- o Bachelor of Industrial Design, Syracuse University, New York

#### Publications

- o Author of numerous technical reports and test reports within RCA Corporation.
- o Tipple, C.H. "The Role of Mock-ups in Improved Equipment Design," RCA Engineer. May 1981

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AMBRON, SUEANN  
Vice President, INPSYCH P.O. Box 1184 Cupertino, CA 95015  
(415) 966-1752

Education

Ed.D., Educational Psychology, 1973

Columbia University  
New York

M.A., Educational Psychology, 1968

Michigan State University  
E. Lansing, Mich.

B.S., Education and Science, 1966

University of Maryland  
College Park, Md.

Additional graduate work in computer science, including courses in PASCAL Artificial Intelligence and Instruction, and Cognitive Psychology Applied to Computer Science.

Stanford University  
Stanford, CA

Programming knowledge of PASCAL, BASIC and FORTRAN.

Employment

INPSYCH

1981-Present

Stanford University

1973-Present

Curriculum Development Corporation

1971-1972

Professional Affiliations

American Psychological Association  
American Educational Research Association  
Human Factors Society

Professional Experience

INPSYCH

Dr. Ambron is Vice President of INPSYCH and has major responsibility for the computer training and human factors projects. Her role includes design and management of projects that focus on human factors analysis of computer hardware and software or require training on or about computer systems. Dr. Ambron's unique combination of experience and knowledge of computers, training design, and evaluation adds to the quality of work on projects undertaken by INPSYCH.

### Stanford University

As an Assistant Professor and Senior Research Associate, Dr. Ambron managed a staff of 30 people including computer scientists, statisticians, and psychologists. In cooperation with Xerox, she supervised the human factors analysis of text editors. She also taught graduate courses in psychology, education and evaluation.

### Curriculum Development

Dr. Ambron was Vice President of Curriculum Development. Dr. Ambron was responsible for the design and marketing of staff training programs.

KAPLAN, ROBERT  
President, INPSYCH P.O. Box 1184 Cupertino, CA 95015 (415) 966-1752

Education

Ph.D., Educational Psychology, 1974	Fordham University, New York
Ph.D. Credits, Experimental Psychology	State University of New York at Buffalo
M.S., Engineering Psychology, 1969	State University of New York at Buffalo
B.S., Psychology, 1963	Pennsylvania State University

Employment

INPSYCH	1977-Date
Courseware, Inc.	1975-1977
Bell Laboratories Rutgers University	1970-1975
System Development Corporation Thomas Nelson Community College Christopher Newport College (William & Mary)	1968-1969
Cornell Aeronautical Laboratory, Inc.	1966-1968
Matrix Corporation, General Dynamics/ Electronics Division	1965-1966
American Institutes for Research	1964-1965
Pennsylvania State University (Staff)	1963-1964
Pennsylvania State University (Student)	1958-1963
U.S. Air Force	1956-1958

Professional Affiliations

American Educational Research Association  
National Society for Programmed Instruction  
Human Factors Society  
Psychometric Society  
American Psychological Association

Professional Experience

INPSYCH

Dr. Kaplan is the president of INPSYCH. INPSYCH is a company of instructional psychologists who apply instructional theory to (a) the design of instructional courses and (b) the optimal presentation of the developed instruction. The company provides consultation, workshop, and direct support in the area of training development. In this way, INPSYCH is able to determine the need for (a) training, (b) equipment or (c) organizational changes. As president of INPSYCH, Dr. Kaplan is involved in all phases of instructional analysis and development. This application of the "systems approach" to training includes job analysis, media selection, instruction writing and evaluation. INPSYCH applies this approach to any job, regardless of the type of skills involved.

Courseware, Inc.

Dr. Kaplan was the Director of Courseware's Bay Area Office. Courseware is a company that applies the "systems approach" to training to a variety of applied problems. As Director, Dr. Kaplan had technical and administrative responsibilities for all projects. Two types of activities were performed by the Bay Area office: instructional development and research in human learning.

The first area of activity involved applied projects that implement the "systems approach" to training. Here, basic learning principles and strategies were applied to training problems. A multimedia approach was used which incorporated computer-assisted instruction, text, and assorted audiovisual media. In addition, Job Aids, Manuals, Tests and other instructional devices were developed. Most of the projects at Courseware pertained to Navy and Air Force aircrew training.

The second type of activity was research in human learning. The research activity pertained to questions about how people learn from written and audiovisual instruction. Further, Dr. Kaplan's administrative activities included supervision of a team of 90 psychologists, media personnel and subject matter experts. He was also responsible for all budgeting and scheduling and for obtaining new contracts and grants in the Bay Area.

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### Bell Labs

At Bell Labs, Dr. Kaplan's research interests included human learning, training, and engineering psychology. He had several publications and papers in these areas and had regularly presented his work at national conventions (see attached publications). In addition to his research activities at Bell Labs, he served on the staff of three universities where he taught psychology courses and advised on dissertations. Much of this work concerned the application of research to learning situations.

Dr. Kaplan was in charge of Training Research in the Systems Training Department at Bell Laboratories. His responsibilities included three major activities: (a) basic research in human learning, (b) application of research findings to training courses, and (c) consultation with training course developers in the systems approach to training. In these activities, he supervised research teams of up to fifteen people and had budget responsibilities for each project.

Dr. Kaplan's research was primarily concerned with the use of adjunct aids for increasing learning from textual and audiovisual materials. This research was aimed at altering the learner's search behavior by giving the learner a set of instructional objectives (directions) or adjunct materials. This research has furthered our knowledge about how people learn from textual and audiovisual media (see attached publications).

Dr. Kaplan conducted several studies to determine the effectiveness of applying the results of the more basic experiments, as previously mentioned, in the classroom. He has published a series of Bell Labs memos which give specific recommendations for classroom application of learning aids.

In addition, Dr. Kaplan has consulted with course developers and instructors on the systems approach to training. In this area, he established procedures for developing objectives, test questions, and evaluation of materials. He was also contract monitor for investigations that compared learning strategies used by inner-city vs. suburban high school students. The aim of those projects was to determine if there were differences between inner-city and suburban youths in the effectiveness of various forms of training materials.

### Universities (while at Bell Labs)

Dr. Kaplan served as an Adjunct Professor of Psychology at Rutgers University, New Brunswick, N.J. In this capacity, he taught Introductory Psychology, Tests



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and Measurement, Measurement of Attitudes, Developmental Psychology, and Experimental Psychology. In addition, Dr. Kaplan has lectured to graduate students on the topic of prose learning. He has also advised graduate students at Temple University and at the University of Massachusetts on dissertations in the area of prose learning. Further, he has supervised students in his laboratory under an internship program from Temple University.

### SDC

At System Development Corporation (SDC), Dr. Kaplan was responsible for the engineering psychology aspects of Project TIPI (Tactical Information Processing of Intelligence Information). The project objective was to computerize and automate the formerly manual task of processing intelligence information. Dr. Kaplan was primarily concerned with the design of an intelligence analyst station. Some of the considerations included in the station design were anthropometry, control/display relationships, information processing, operator loading, and environmental control.

### Universities (Virginia)

While employed by SDC, Dr. Kaplan taught Introductory and Industrial Psychology at Thomas Nelson Community College and Christopher Newport College, both located in Newport News, Virginia.

### Cornell Labs (now CALSPAN)

At Cornell Aeronautical Laboratories, Dr. Kaplan was the project leader for the evaluation of electronic warfare stations in aircraft. This project involved analysis in the area of human engineering and anthropometry. In addition, Dr. Kaplan was the project leader for two associated contracts which involved the evaluation of several design concepts for a self-propelled Howitzer. Human engineering and anthropometric evaluations were the major considerations in these projects.

Further, Dr. Kaplan also participated in a full-scale study of driver performance in simulated collision situations. In this study, the ability of drivers to detect possible collision courses of two vehicles approaching an intersection was examined. He also participated in a study to determine the effects of computer-aiding a photointerpreter. Analysis of the data permitted observation of errors associated with computer-aiding. Attention was given to training

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implications. Further, Dr. Kaplan participated in the evaluation of human factors aspects of electronic penetration aids for aircraft. Attention was given to equipment design, training, and psycho-social problems among crew members.

### General Dynamics

During Dr. Kaplan's employment at General Dynamics/Electronics Division, Rochester, New York, he was the group leader for the Maintenance and Operational Task Analyses for the F-111 ground support equipment. This work consisted of developing a detailed description of the tasks involved in operating and maintaining the equipment and of designing the controls and displays for ground support equipment. Further, Dr. Kaplan was involved in the design of controls and displays for equipment used in an Automatic Digital Network.

### AIR

At American Institutes for Research (AIR), Washington, D.C., Dr. Kaplan was primarily concerned with psychomotor ability testing. He conducted research in the psychomotor laboratory, which contained performance tests used in the selection of U.S. Air Force pilots. One of these studies pertained to measuring psychomotor performance under the effects of incapacitating compounds. Included in this project was an experimental program which required modification of existing psychomotor ability tests for use in this unique situation.

Publications and PapersCognitive Studies

- Biedermen, I. & Kaplan, R. Stimulus discriminability and S-R compatibility: Evidence for independent effects in choice reaction time. Journal of Experimental Psychology, 1970, 83, 486-490.
- Kaplan, R. The use of objectives in training courses. Paper presented at the National Society of Programmed Instruction, New Orleans, 1972.
- Kaplan, R. Effects of learning prose with part vs. whole presentations of instructional objectives. Journal of Educational Psychology, 1974, 66, 787-792. Portions of this paper were presented at the national convention of the American Psychological Association, Montreal, 1973.
- Kaplan, R. Effects of grouping and response characteristics of instructional objectives when learning from prose. Journal of Educational Psychology, 1974, in press. Portions of this paper were presented at the national convention of the American Psychological Association, New Orleans, 1974.
- Kaplan, R. Effects of experience in using instructional objectives as orienting stimuli or summary/review upon prose learning. Journal of Educational Psychology, 1975, in press. Portions of this paper were presented at the national convention of the American Psychological Association, Chicago, 1975.
- Kaplan, R. & Burgin, E.M. Instructional objectives as an aid to learning from prose vs. videotaped instruction. Submitted to Journal of Educational Psychology, 1975. Portions of this paper were presented at the national convention of the American Psychological Association, New Orleans, 1974.
- Kaplan, R. & Frase, L.T. Learning with directions: Effects of dispersion and complexity of information upon memory. Submitted to Journal of Educational Psychology, 1975. Portions of this paper were presented at the national convention of the American Educational Research Association, Washington, D.C., 1975.
- Kaplan, R. & Rothkopf, E.Z. Instructional objectives as directions to learners: Effects of passage length and amount of objective-relevant content. Journal of Educational Psychology, 1974, 66, 448-456. Portions of this paper were presented at the national convention of the American Educational Research Association, New Orleans, 1973.
- Kaplan, R. & Simmons, F.G. Effects of instructional objectives used as orienting stimuli or as summary/review upon prose learning. Journal of Educational Psychology, 1974, 66, 614-622. Portions of this paper were presented at the national convention of the American Educational Research Association, Chicago, 1974.

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Rothkopf, E.Z. & Kaplan, R. Exploration of the effect of density and specificity of instructional objectives on learning from text. Journal of Educational Psychology, 1972, 63, 295-302. Portions of this paper were presented at the national convention of the American Educational Research Association, Chicago, 1972.

Engineering Psychology Studies

Kaplan, R., et al. Parametric design study for a close support artillery weapon, unarmored. Ch. 6, Human Factors Evaluation, Cornell Aeronautical Laboratory, Inc., Report No. GA-2577-H-1, May 1966.

Kaplan, R. Intelligence analyst station configuration. System Development Corporation, TM-LA-9/003/00, 20 August 1969.

Rubinstein, L. & Kaplan, R. Some effects of Y-axis vibration on visual acuity. Cornell Aeronautical Laboratory, Inc., Report No. VH-2298-B-1, 1967.

Rudov, M.H. & Kaplan, R. Human engineering problems in penetration aids utilization (U). Cornell Aeronautical Laboratory, Inc., Report No. UM-2176-E-SS5, Volume 1, 1966 (SECRET).

Rudov, M.H. & Kaplan, R. Complete protocols of selected human factors interviews for PENVAL III (U). Cornell Aeronautical Laboratory, Inc., Report No. UM-2176-E-SS5, Volume II, 1966 (SECRET).

Rudov, M.H. & Kaplan, R. Human engineering aspects of defense penetration in southeast Asia (U). Cornell Aeronautical Laboratory, Inc., Report No. UM-2336-E-MR15, November 1967 (SECRET).

Rudov, M.H., Been, R.T., Armstrong, T. & Kaplan, R. Human performance of target detection tasks with the aid of a computerized screening device. Cornell Aeronautical Laboratory, Inc., Report No. VE-2459-B-102, December 1967.

OLTON, ROBERT M.  
Executive Vice President, INPSYCH P.O. Box 1184 Cupertino, CA 95015  
(415) 966-1752

Education

Ph.D., Psychology, 1966	University of California Berkeley
M.Sc., Psychology, 1960	McGill University Montreal
B.S., Psychology, 1959	Trinity College Hartford, Conn.

Employment

INPSYCH	1980-Date
University of California, Berkeley	1978-1979
Xerox Palo Alto Research Center	1977-1978
University of California, Berkeley	1965-1977

Professional Affiliations

American Psychological Association  
American Association for the Advancement of Science

Professional Experience

INPSYCH

Dr. Olton is currently Executive Vice President of Inpsych. In this capacity, he directs projects concerned with all phases of training and personnel systems--analysis of training needs, development of instructional materials, evaluation of training effectiveness, design of job evaluation systems, productivity analyses, surveys, and performance appraisals. As author of a widely-used program for training problem-solving skills, Dr. Olton contributes his problem-solving expertise to training projects undertaken by Inpsych. In addition, his background includes activity in computer-assisted instruction, personality assessment, and competency-based educational programs.

### University of California, Berkeley

As Assistant Professor of Psychology, Dr. Olton taught a wide variety of courses ranging from very large, popular, introductory-level classes to small, specialized seminars. The content of these courses included general psychology, research methods in social and individual psychology, cognitive psychology, human problem solving, and special topics in educational psychology. In addition to these formal courses, Dr. Olton supervised the training of Teaching Assistants, directed advanced educational research projects, consulted on revision of the university curriculum, and supervised the training of doctoral students. He also contributed actively to professional research on human problem solving, thinking, and learning. His research studies, which involve both basic and applied work, are widely cited in the professional literature and have won awards for excellence and originality. For two years he served as a Consulting Editor for the American Educational Research Journal.

In addition to being an Assistant Professor, Dr. Olton held two other professional positions at Berkeley. As Assistant Research Psychologist and Joint Director of the Productive Thinking Project, he coordinated planning, development and production in an eight-year, \$200,000 project which developed and published training materials in human problem solving. This project also produced a number of research and evaluation studies concerned with training problem-solving skills, and with developing those positive attitudes and motivations which foster productive thinking.

Finally, Dr. Olton served as Lecturer and as a Researcher in the SESAME Group at Berkeley, an inter-disciplinary group of faculty and graduate students concerned with improving science and math education. This group uses the most advanced techniques of instructional and cognitive psychology to develop more effective instructional programs. In addition to producing classroom materials, the group has contributed to learning-oriented exhibits at the Lawrence Hall of Science, a hands-on, learn-by-doing science center on the Berkeley campus.

### Xerox Palo Alto Research Center

As a Visiting Scientist with the Learning Research Group at this center, Dr. Olton helped explore the potential for highly-advanced, state-of-the-art computer systems as an important new medium of instruction. The sophisticated new technology promises to make possible an instructional medium which is inter-

active, dynamic, and highly visual (via TV screen). It enables new ways of presenting, learning, understanding, and applying information. Dr. Olton's work involved development of instructional prototypes, using the new technology, for specific educational skills that are difficult to teach with existing materials. While at Xerox, Dr. Olton also contributed to the development of a computer-based "office-of-the-future" in which information is processed electronically instead of by traditional paper-and-pencil or hard copy.

### Publications and Papers

- Olton, R.M. Developing productive thinking skills: A new self-instructional program. In F.E. Williams (ed.) First Seminar on Productive Thinking in Education. St. Paul, Minnesota: Macalester College, 1966, 54-60.
- Olton, R.M. A self-instructional program for developing productive thinking skills in fifth- and sixth-grade children. Journal of Creative Behavior, 1969, 3, 16-25.
- Olton, R.M. The effect of a mnemonic upon the retention of paired-associate verbal material. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 43-48.
- Olton, R.M. & Crutchfield, R.S. Developing the skills of productive thinking. In P. Mussen, J. Langer & M. Covington (eds.) Trends and issues in developmental psychology. New York: Holt, Rinehart & Winston, 1969, 68-91.
- Reprinted in G.A. Davis and J.A. Scott (eds.) Training Creative Thinking. New York: Holt, Rinehart & Winston, 1971, 238-260.
- Olton, R.M., Johnson, D.A. & Covington, M.V. Convergent, divergent, and productive: A factor-analytic study of some new measures of productive thinking. Western Psychological Association; Portland, Oregon; April, 1972.
- Olton, R.M. & Johnson, D.M. Mechanisms of incubation in creative problem solving. American Journal of Psychology, 1976, 89, 617-630.
- Olton, R.M. Experimental studies of incubation: Searching for the elusive. Journal of Creative Behavior, 1979, 13, 9-22.
- Olton, R.M. Incubation in problem solving: The pause that refreshes? Journal of Experimental Psychology: General, in press.
- Lambert, W.E., Gardner, R.C., Olton, R. & Tunstall, K. A study of attitudes and motivations in second-language learning. In J. Fishman (ed.) Readings in the sociology of language. The Hague: Mouton & Company, 1968, 473-491.
- Wardrop, J.L., Goodwin, W.L., Klausmeier, H.J., Olton, R.M., Covington, M.V., Crutchfield, R.S. & Ronda, T. The development of productive thinking skills in fifth-grade students. Journal of Experimental Education, 1969, 37, 67-77.
- Reprinted in J.M. Seidman (ed.) The adolescent: A book of readings. Third Edition. New York: Holt, Rinehart & Winston, 1971.
- Gough, H.G. & Olton, R.M. Field independence as related to nonverbal measures of perceptual performance and cognitive ability. Journal of Clinical and Consulting Psychology, 1972, 38, 338-342.
- Covington, M.V., Crutchfield, R.S., Davies, L.B. & Olton, R.M. The Productive Thinking Program. Columbus, Ohio: Charles E. Merrill Publishing Co., 1972, 1974.