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UNITED STATES  
NUCLEAR REGULATORY COMMISSION

June 12, 1979

INFORMATION REPORT

SECY-79-3308

For: The Commissioners

From: Harold R. Denton, Director  
Office of Nuclear Reactor Regulation

Thru: Executive Director for Operations *MDJ*

Subject: Operator Emergency Response Training Required by Other Agencies,  
Using Simulator Training

Purpose: To inform the Commissioners regarding how other agencies approach training for unanticipated accident sequences and operator responses, by using system simulators, and to make recommendations for the NRC operator licensing program.

Discussion: In a memorandum from Samuel J. Chilk to Lee V. Gossick dated April 30, 1979, NRR was requested to inform the Commission regarding seven items relating to procedures for qualifying reactor operators.

Item 1 of the memorandum requested that we contact other agencies to determine how operator emergency response training is conducted and the use made of system simulators in such training. Item 1 further requested that recommendations for the NRC operator licensing program be proposed.

We have held discussions with the U. S. Navy, Federal Aviation Administration, National Aeronautics and Space Administration and American Airlines. The following is a brief description of the training and retraining requirements specified by each organization. It identifies how, and to what extent, simulators are used in the training programs. It also discusses the methods used for establishing and maintaining the competency of the operators.

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Finally, possible changes are put forth that may enhance the operator licensing program. These changes will be discussed in a separate Commission Paper that addresses the entire program.

U. S. Navy - Naval Aviation Command

Flight crew members reporting to operational squadrons will have qualified in basic readiness training in a Reconnaissance/Attack Training Squadron. During this initial training, some reliance is placed on the use of simulators, called Weapons System or Cockpit Procedures Trainers; however, major emphasis is placed on actual flying time. (An interesting point was made that where simulator time has in the past been substituted for flying time, eventually the flying time creeps back in and the simulator training becomes an add-on.) In our discussion, Navy personnel pointed out that economic incentives for military applications are quite different from civilian considerations. The Navy does not strive to minimize actual flight time as does the civilian aviation industry; therefore, simulators are not used as extensively as in the civilian industry.

The minimum requirements for initial pilot qualification for an operational squadron consists totally of actual flying hours. The simulators come into play in maintaining qualifications. For example, if a pilot has not flown the aircraft in 30 days, he must spend time in a simulator. In addition, for shore based squadrons, a once-a-month session is spent in the simulator. For ship-board squadrons, discussions using the plane's cockpit are conducted. Every contingency is periodically reviewed including all emergency procedures.

In order for a qualified pilot to maintain his "wings" he must pass an evaluation conducted at intervals of approximately 12 months from the previous evaluation. The evaluation consists of an open book examination, a closed book examination, an oral examination and a flight evaluation. A simulator may be substituted for the aircraft for the flight evaluation, which consists of normal and emergency procedures carried out by the pilot.

In order to provide standardization of evaluations, flight evaluations are conducted by a designated pilot from the fleet unit. The designated check flight pilots are themselves checked by a fleet check pilot.

### U. S. Navy - Surface Ship Command

The Navy surface ship command makes limited use, at present, of simulators. Where simulators are used, they contribute to the initial training of seamen and do not play a role in maintenance of personnel qualifications.

The major piece of simulation equipment used by the surface ship forces is the 1200 PSI Propulsion Plant Trainer. Located at the Great Lakes Naval Training Center, the trainer provides a realistic, real time simulation of the Fire Room, Engine Room, Auxiliary Machinery Rooms and Electrical Central of the FF 1078, a Frigate with a 1200 PSI Propulsion Plant. Normal, as well as casualty procedures, can be performed on this simulator.

The surface ship command also operates a surface warfare simulator at Newport, R. I. and by 1982, plans to install simulators in Norfolk, Va. and San Diego, Ca. These latter simulators would also be propulsion plant simulators although, because of differences in ship types, they may be generic simulators rather than specific, reference-ship simulators.

Following the initial training conducted at the training center, all subsequent proficiency training and qualification evaluations are under the jurisdiction of the Fleet Commanders. Propulsion Examining Boards are established in the fleets and are comprised of senior officers with appropriate command and engineering backgrounds.

Shipboard evaluations of personnel qualifications, machinery availability and administration are conducted following major maintenance outages, restricted availability in excess of four months and before a ship is certified as ready for unrestricted fleet operations. Thereafter, recertification evaluations are conducted on a 12 month  $\pm$  3 month cycle.

The personnel evaluations consist of both written and oral examinations for individual operators. A grade of 75% is considered satisfactory on the written examination. In addition, both in-port and at-sea casualty control drills are conducted to evaluate the overall training of the crew. Casualty exercises are selected from a published list and are made known to the ship prior to the commencement of the drills.

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NOTE: The Navy nuclear plant operator training and qualification program will be addressed, in response to Item 6 of the April 30, 1979 memorandum, in a separate report to the Commission.

Federal Aviation Administration -

The FAA has developed a highly detailed set of training requirements for flight crew members. Over the years, as simulators have become more sophisticated, more of the in-flight training and certification time is being replaced by simulator time. At present, it is possible for a First Officer qualifying for a Captaincy or a Captain qualifying in a different type of airplane from which he is presently rated, to do so with as little as 2- hours of actual flying time at the controls of an airplane. The FAA stated that the time is approaching when all qualifying will be done on a simulator. That is, the first time the pilot will fly the aircraft will be with passengers aboard.

In order to achieve this confidence in simulator training, the FAA has been intimately involved in establishing minimum training requirements, emergency procedures which must be performed and performance specifications for simulators.

Three basic types of training programs are established:

1. Initial Training - The training required for crew members who have not qualified and served in the same capacity on another airplane of the same group.
2. Transition Training- The training required for crew members who have qualified and served in the same capacity on another airplane of the same group.
3. Upgrade Training - The training required for crew members who have qualified and served as second in command or flight engineer on a particular type airplane, before they serve as pilot in command or second in command, respectively, on that airplane.

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For each type of training, the FAA specifies the requirements of the training program, the maneuvers which must be successfully performed and the simulator or training device upon which the maneuvers may be performed.

A typical Transition Training program for a DC-10 pilot would consist of the following:

- 9 days of ground school which includes the Systems Trainer and Cockpit Procedures Trainer
- FAA oral examination
- 20 hours of flight training in a simulator and 1 1/4 hours in non-revenue aircraft flight
- FAA rating check
- 25 hours of revenue flight under observation of an instructor
- FAA final certification

A pilot must be periodically recertified. This is done by way of proficiency checks, administered every six months, which make extensive use of simulators, and line checks which consist of observations. Proficiency checks are made following a specified program of maneuvers identified in the FAA regulations. Normally, proficiency checks take 3-4 hours to complete. Proficiency check procedures provide for evaluating the individual performance of cockpit crew members.

A line check must be passed within the preceeding 12 months. This check is performed during a segment of a commercial flight in which an examiner would ride the airplane cockpit and observe flight operations.

A simulator training program may be substituted for one of the two proficiency checks required annually. One very effective program is called a Line-Oriented Flight Training Program. This program has the advantage of simulating a real flight situation wherein there is an integral crew to cope with emergency situations. A simulated flight is set up with a duration approximating

that which would exist on the particular airline's routes. The simulated flight commences with pre-flight checks and takeoff and runs continuously to landing and docking. Malfunctions are introduced during the simulated flight and the crew must cope with them as they would during a commercial flight. This training program is very popular with the airlines because it places crew members in an environment similar to that in which they operate on a daily basis.

All evaluations of flight crew members are conducted by FAA inspectors or by "check airmen". Regardless of which category they are in, all evaluators are qualified pilots.

FAA personnel maintain their qualifications by going through the same recertification process that the commercial pilots do. Each inspector receives approximately 10 days of training and evaluation every 6 months. The FAA tells us that even though the training time places a scheduling and manpower burden on them, the maintenance of competency and credibility of their inspectors is well worth it.

"Check airmen" are supplied by the airlines and are considered the elite among the pilots. Usually they are selected from the better flight instructors and are given additional simulator training. They are certified by the FAA as being qualified to evaluate other flight crew members. They are paid a bonus by the airline to serve as check airmen. They must be recertified as pilots on the same frequency as other pilots.

#### National Aeronautics and Space Administration

NASA makes extensive use of simulators and other training devices in the aerospace program. Indeed, there is no other means available to practice and become proficient for a space shot.

At the Houston Space Center, the primary and backup teams for the space shuttle are presently training. At their disposal are two cockpit simulators, one with a fixed base and one with a motion base. Each of the space shuttle pilots will have spent 1100-1200 hours in a formal training program. Approximately 50% of the training time is spent in the simulators and one-half of that time is devoted to contingency training. i. e., emergency procedures training.

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In addition to the cockpit simulators, there is a Network System Simulator which ties the shuttle simulation into the Mission Control Center. In this way mission controllers are trained along with the pilots. The network system simulation includes ground stations and data tracking satellites as well as the ground switching networks.

In a separate room members of the training staff insert malfunctions into the simulator and monitor the response of both the shuttle pilots and the controllers.

The pilots receive no formal certification at the end of the training; however, they are continuously evaluated as training progresses. Each controller must be certified at the particular station he mans during a mission.

#### American Airlines

American Airlines maintains a flight academy in Fort Worth, Texas. All American crew members attend the flight academy wherein they learn, depending upon their job classification, such a range of things as preparation of meals to the use of aircraft emergency equipment to the flying of the airplane.

American strongly believes in "Learning by Doing" and the training curricula emphasizes "hands on" experience. For pilot training a succession of equipment is used to help student progress from classroom to cockpit.

First in order is the Systems Trainer, a device which duplicates the controls of an aircraft system and displays the system's operation. It demonstrates cause and effect, and it permits problem solving exercises.

The student then advances to a Cockpit Procedures Trainer. The CPT is a reproduction of the total cockpit. It provides students with their first real-world contact with actual aircraft hardware in a cockpit environment. The students become involved with checklist activities, normal and abnormal operating procedures and the development of crew coordination skills.



Finally, the student proceeds to the Flight Simulator. American has 12 simulators representing the various types of aircraft in their fleet. Each simulator represents a specific aircraft and is updated and modified whenever the airplane it represents is updated or modified.

Each flight simulator is capable of precisely reproducing all required performance and handling characteristics. A student undergoing flight simulator training is taken through the entire spectrum of flight maneuvers, perfecting the techniques related to routine performance, and learning to recognize and appropriately respond to situations involving emergencies. Landings are practiced under varying gross weight and wind conditions, and during daylight, dusk or darkness. The visual system with the simulator can introduce a complete range of visibility conditions.

Ground school instructors are usually retired military flyers. Flight simulator instructors are commercial pilots qualified in that aircraft, but who are not in a flying status. The best of the simulator instructors are selected to be check airmen.

Conclusions:

Based upon our review of these various programs, we have identified several changes that should be given consideration in the operator licensing program. These are listed below. They will be considered during development of overall recommendations for programmatic changes which will be presented in another Commission Paper.


1. Require all operators to be trained on a full-scope simulator representative of their facility.
2. Administer all license examinations on a full-scope simulator representative of their facility.
3. Require periodic retraining and recertification on a full-scope simulator representative of their facility.
4. Require an individual who has not been performing licensed duties for a period of 4 months or greater to be recertified on a full-scope simulator representative of his facility.

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5. Specify a minimum list of emergency procedures which must be successfully completed during initial simulator training and periodic simulator retraining.
6. Provide additional training and periodic retraining for the present NRC examiners, including the part-time examiners. In order to remain as a part-time examiner, the individual must make himself available for this training, in addition to the time previously required for the normal examining workload.
7. Establish a cadre of "Check Senior Operators" drawn from utility and training center staffs who are licensed and periodically recertified by the NRC.
8. Adjust the OLB staffing level so that headquarters examiners can take on the additional duties of recertifying the "Check Senior Operators" and auditing the simulator training and retraining programs.
9. Maintain specialization within groups of the OLB examiners. Eliminate examination assignments at reactors outside of the area of specialization or provide specific cross-training, including simulator training, if such an assignment must be made.

Coordination: This action has been coordinated with the Office of the Executive Legal Director.



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