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SITUATIONAL EMERGENCY TRAINING:

F-15 EMERGENCY PROCEDURES TRAINING PROGRAM

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The objective of this ongoing research is to evaluate the current emergency procedures training program used for the F-15 and compare it to Boldface emergency procedures training programs. As a result of this comparison, possible improvements in the current F-15 program will be evaluated. The report documents

Phase I of this research is the documentation of the current F-15 program. This program is a non-Boldface program. The traditional emergency procedures, common to other USAF weapons systems featuring Boldface procedures which must be committed to memory, do not exist for the F-15. Only three rules, applicable in all emergency/abnormal situations, are specified for F-15 operations: maintain aircraft control, analyze the situation and take the proper action; and land as soon as practicable. (Over)

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This report

The objective of the present research effort is to develop and evaluate an optimum emergency procedures training program for the F-15. Phase I, presented in this technical report, is the documentation of the current non-Boldface program. This documentation provides the basis for a comparison of the F-15 training program with Boldface training programs. The strengths and weaknesses of both approaches are noted. Five conclusions are derived from this comparative analysis: (a) the traditional Boldface approach has several deficiencies which may reduce the probability that judgment will be exercised when needed. The rapid execution of Boldface procedures demanded in training is probably effective for many emergencies where the Boldface solution applies, but since there are times when Boldface does not apply, Boldface training could inhibit good judgment; (b) the current F-15 emergency procedures training program, named Situational Emergency Training (SET), is more comprehensive than Boldface, encourages the development of judgment, and centers training around the three emergency rules listed above; (c) the underlying concept of SET is situational training, an approach which systematically manipulates the important dimensions of the emergency situation. The pilot is taught to discriminate the relevant from the irrelevant dimensions of the situation, a discrimination process which is fundamental to exercising judgment; (d) pilots report a positive attitude towards SET training sessions, which in turn has resulted in what supervisors feel is a more productive training program; and (e) by using a scenario development procedure, it is hypothesized that SET can be more effective. An evaluation of such a procedure will be conducted during subsequent phases of this research. Also to be evaluated will be the use of video recording of training sessions to improve instructor technique.

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Phase II of this research will evaluate concepts and improvements suggested as a result of the Phase I analysis.

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SUMMARY

Only three rules, applicable in all emergency/abnormal situations, are specified for F-15 operations: (a) maintain aircraft control, (b) analyze the situation and take the proper action, and (c) land as soon as practicable. The traditional emergency procedures common to other USAF weapons systems featuring Boldface procedures which must be committed to memory do not exist for the F-15.

The objective of the present research effort is to develop and evaluate an optimum emergency procedures training program for the F-15. Phase I, presented in this technical report, is the documentation of the current non-Boldface program. This documentation provides the basis for a comparison of the F-15 training program with Boldface training programs. The strengths and weaknesses of both approaches are noted. Five conclusions are derived from this comparative analysis: (a) the traditional Boldface approach has several deficiencies which may reduce the probability that judgment will be exercised when needed. The rapid execution of Boldface procedures demanded in training is probably effective for many emergencies where the Boldface solution applies, but since there are times when Boldface does not apply, Boldface training could inhibit good judgment; (b) the current F-15 emergency procedures training program, named Situational Emergency Training (SET), is more comprehensive than Boldface, encourages the development of judgment, and centers training around the three emergency rules listed above; (c) the underlying concept of SET is situational training, an approach which systematically manipulates the important dimensions of the emergency situation. The pilot is taught to discriminate the relevant from the irrelevant dimensions of the situation, a discrimination process which is fundamental to exercising judgment; (d) pilots report a positive attitude towards SET training sessions, which in turn has resulted in what supervisors feel is a more productive training program; and (e) by using a scenario development procedure, it is hypothesized that SET can be more effective. An evaluation of such a procedure will be conducted during subsequent phases of this research. Also to be evaluated will be the use of video recording of training sessions to improve instructor technique.

As a result of Phase I, several additional concepts were proposed as improvements to the current program. Phase II will evaluate some of these concepts in the training environment of the 555th TFTS, Luke AFB, AZ.

PREFACE

This report represents a portion of the research program of Project 1123, USAF Flying Training Development, Dr Edward E. Eddowes, Project Scientist; Task 112303, Instructional Innovations in USAF Flying Training, Mr Gary B. Reid, Task Scientist.

The progress described in this technical report would have been impossible without the support and cooperation of Brig Gen Fred A. Haeffner, 58th TFTW/CC, Luke AFB, Arizona, and Col John F. O'Donnell, 58th TFTW/CV.

The authors are grateful to Major Joe Merrick, Chief of the F-15 Instructional Systems Development (ISD) Team, Luke AFB, who has acted as principle liaison between AFHRL/FT and the Tactical Air Command personnel involved. Major Merrick contributed substantially to the technical findings of this report as well as coordinating all on site work that occurred during this period of investigation.

A number of other individuals with the 58th TFTW provided valuable assistance to the progress made during this period. Captains Dave Rickert and Bill Mack, F-15 ISD Team, were responsible for the initial involvement of AFHRL/FT in this project. Captains Lo Pugh, Jeno Bean, and Rick Eplett (F-15 ISD) along with Captains Rickert and Mack met with the authors on a number of occasions and provided valuable direction to this research.

At the 555th TFTS, the "Triple Nickle," Col Ted Laudise (Squadron Commander) established an atmosphere of interest and cooperation which has been carried on by his successor, LtCol Gene Thweatt, and LtCol Jack Petry (DO). Substantial insight into the problem was provided by Captain Dennis Mangum, who met with the authors on several occasions, and by Captains Mike Francisco, Burt Myers, Bob Ellis, Jim Poier, Carl Baker, Tom Sokol, Bob Harcrow, and Major T.C. Skancy, all of whom collaborated on at least one of several tasks, including the video taping of CPT sessions, the analyses of emergency responses in various situations, the assessment of Boldface emergency procedures training, and the editing of earlier drafts of this technical report.

The authors also received valuable comments on earlier drafts of this report from LtCol Jerry Floyd, 82nd FTW/DOR, Dr. Norman King and Captains John Fuller, and Steve Rust, AFHRL/FT. Dr Anchard Zeller, Directorate of Aerospace Safety, Norton AFB, provided comments on an earlier draft and on Boldface implementation in the 1950's.

The training of aircrews to handle emergencies must receive high priority in the design of flying training programs. The innovative training program developed by the 555th TFTS is documented in this report, with an analysis and further modifications suggested by the authors. Because of the importance of this topic to the safety of aircrews, the authors rigorously solicit ideas, critiques, comments and suggestions. Communications should be sent to AFHRL/FT, Williams AFB, Arizona 85224.

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SITUATIONAL EMERGENCY TRAINING:
F-15 EMERGENCY PROCEDURES TRAINING PROGRAM

I. INTRODUCTION

The dangers inherent in flying demand highly effective aircrew training for emergency situations. In a search for an optimum emergency procedures training program for F-15 pilots, the F-15 Instructional Systems Development (ISD) Team, Luke AFB, Arizona, began consulting with the Flying Training Division, Air Force Human Re ces Laboratory (AFHRL/FT), in December 1974. Following several meetings ISD submitted a Reques or Personnel Research (RPR 75-7), Development and Evaluation of an F-15 Emergency Procedures Training Program, which was validated in July 1975. A research effort by AFHRL/FT was initiated in mid-July.

Two major projects were completed during the first four months of this investigation: the documentation of the existing F-15 emergency procedures training program and the development and application of a matrix approach for systematically analyzing the cognitive requirements of specific F-15 emergencies. The documentation effort is reported in this technical report. The matrix analysis of emergencies is continuing, with technical reporting planned at a later date.

The documentation of the current program involved the observation of a number of training sessions in the cockpit procedures trainer (CPT) and the video taping of seven more sessions which permitted in-depth study. From this, the strengths and weaknesses of the current program were documented and are reported herein. From the observed weak areas come suggested improvements which can be implemented immediately into the current program. From the strong points come the key elements of an advanced program in emergency procedures training. In addition, the integration of several stages of training is outlined.

This report begins with a description and critique of the training approach used to teach emergency procedures in all USAF weapons systems (except the F-15) called the Boldface approach. A literature search by the Defense Documentation Center and Air University did not produce any scientific or historical references about Boldface training. In a personal communication with Dr. Anchard Zeller, Directorate of Aerospace Safety, Norton AFB, California, it was indicated that Boldface was implemented in the late 1950's as a result of a meeting on the format of flight manuals. No specific study had been conducted to determine the impact of emphasizing certain critical emergency steps. To the best of Dr. Zeller's recollection, no studies have been conducted to determine the effectiveness of the Boldface training approach.

Boldface is described in the following section. No specific squadron programs are referenced, and it is recognized that some individual programs are more effective than others. The authors realize that the transition to a Boldface approach represented a dramatic improvement over earlier training programs. Whether further advances in training emergency responses can be made at this time is one of the questions raised in this report.

II. BOLDFACE EMERGENCY PROCEDURES TRAINING

For many years the Air Force has used a Boldface training approach for emergency procedures. Boldface refers to the large bold print in flight manuals which identifies critical emergency procedures, which, by directive, must be committed to memory.[1] For each aircraft, Boldface procedures exist for reasonably frequent, serious emergencies which must be acted upon immediately without reference to a checklist.[2]

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[1] *Military Specification – Manuals: Flight,* MIL SPEC MIL-M-7700A; also AFR 60-9 (paragraph 8).

[2] These are the three criteria given in MIL SPEC-M-7700A for determining if a procedure should be made Boldface. There is some argument as to the definition and application of these criteria, but such a discussion is beyond the scope of this report. Also, in previous editions of the MIL SPEC, specific emergencies were listed for which Boldface procedures had to be written for an aircraft of a given type, for example, jet fighter aircraft. In a November 1975 conference on flight manuals, it was recommended that the mandatory lists of Boldface emergencies be deleted. Instead, Boldface items would be suggested by the aircraft manufacturer for his specific aircraft and implementation would be at the option of the System Program Office and using command. This proposed change to the MIL SPEC is presently being staffed.

In addition to Boldface procedures, Section III of each flight manual lists non-Boldface procedures for less critical emergencies. Memorization of these non-Boldface procedures is not required, although the pilot is instructed to study and understand the potential emergency conditions and how to take corrective action.

Throughout all phases of pilot training, emphasis is placed upon the memorization of Boldface procedures as the fundamental component of emergency training. While the introduction to Section III cautions the pilot to use judgment to modify procedures when necessary, the overwhelming focus is upon the rapid and precise execution of Boldface procedures to insure the safety of the crew and aircraft.

The present analysis, however, leads to the conclusion that there are at least two limitations in the Boldface approach which act to reduce its applicability and effectiveness. The first is theoretical, found within the conceptual scope of the approach itself. The second is practical and lies within the methods used in training and evaluating the pilot's Boldface knowledge.

Conceptual Scope. The most serious deficiency in the Boldface approach is its disproportionate emphasis on a small part of the pilot's overall task during an emergency. As set forth in the introduction of Section III in all flight manuals, there are three rules fundamental to every emergency response: (a) maintain aircraft control, (b) analyze the situation and take the proper action, and (c) land as soon as practicable.

Of these three, Boldface addresses only the initial actions in the second part of the second rule, "Take the proper action." Maintaining aircraft control, analyzing the situation, and planning ahead for a successful recovery are not directly treated. Yet accomplishing these objectives is obviously essential to a successful response.

Even in the area of "taking the proper action," Boldface is somewhat limited. Although it is not the intention of the formal training program to portray the Boldface solution as the only solution for all cases, nonetheless it is often *taught* and *interpreted* as such. Under most circumstances this is inconsequential, as the Boldface solution will be appropriate for the majority of the emergencies encountered, representing a mini-max solution to the emergency. But in those cases where the unique combination of mission and environmental conditions render the Boldface solution *less* appropriate than some other response, the application of the Boldface procedure could have a catastrophic outcome. For most single seat fighter aircraft, a FIRE light on short final illustrates this point. The experienced pilot would concentrate on his approach and touchdown before trying to suppress the fire, rather than risk a bad landing because he was rapidly executing the Boldface procedures for an engine fire.

It is at such unique points that the pilot must rely on judgment to overrule inappropriate Boldface procedures. But if his judgment has not been expanded by training programs or the amount or type of his flying experience, Boldface training will not contribute to his ability to recover. Conceptually, an effective emergency training program should prepare the pilot to accomplish the three basic rules for responding to emergencies.

Training and Evaluating Boldface Knowledge. The second area of deficiency in the Boldface approach is the training methodology typically used. In fact, the manner in which Boldface is trained may compound the problems noted previously. There are three main limitations: judgment is not allowed, diagnosis is provided in the problem statement, and only Boldface procedures are regularly treated. The following paragraphs describe these limitations as they might be found in a typical training program.

As a pilot transitions into a new aircraft he is given a copy of the flight manual and told to read, study, and learn Boldface and non-Boldface material in Section III. He is told to memorize all the Boldface items. His training continues through interactions with instructors, in pre-flight briefings, from material in academic courses, and from sound-slide programs. Before his first flight in the aircraft, he is tested on his knowledge of emergency procedures, but this is really a test of his Boldface knowledge. The instructor typically goes through all the Boldface emergencies. He states: "Engine fire;" "Abort;" "Hydraulic failure;" "Eject." The pilot must respond with the exact Boldface sequence. Errors can result in postponement of his first flight until satisfactory Boldface performance is demonstrated.

For the remainder of his transition training and as part of his continuation training at the operational squadron level, the pilot will receive weekly or biweekly paper and pencil tests on Boldface procedures.

These written quizzes typically state about ten Boldface emergencies. The pilot is graded on his ability to write down the Boldface steps exactly as presented in Section III. Any error results in being grounded until satisfactory performance is attained.

In addition to these quizzes, the pilot is usually required to take semiannual simulator checks on Boldface procedures. During these checks the flight examiner establishes a mission segment (e.g., "You are taking off") and states a Boldface emergency (e.g., he states "engine fire" or he makes the FIRE light come on). The pilot is expected to take the appropriate Boldface steps. Then a new mission segment and emergency are created. As with the written tests, incomplete Boldface responses can result in being grounded.

In the present analysis it seems that this training and evaluation methodology lacks effectiveness. For example: (a) Emergency conditions are openly stated in the written tests and often in the simulator checks, eliminating the need for diagnostic analysis by the pilot. "Left engine stagnation" requires no diagnosis, no information seeking or decision making as to the cause of the problem. Yet in the cockpit, symptoms or cues of an emergency condition can be ambiguous and can require intensive diagnostic analysis. (b) The quick draw execution of Boldface steps tends to reduce the probability that judgment will be used when needed. It is reaction without thinking, the bare minimum information processing activity involving recall from memory and psychomotor execution. Such an approach could be successful if Boldface procedures worked every time, but since they do not, judgment must be trained into, not out of, the diagnostic and decision making processes during emergencies. (c) Only critical, Boldface emergencies are regularly covered during training. For non-Boldface emergencies the pilot is directed to his checklist. The abbreviated cockpit checklist contains only the procedural steps for dealing with the emergency, omitting the discussion presented in Section III of the flight manual.

Advantages. Inspite of these limitations, there are strengths to the Boldface approach. The format is easily standardized, the evaluation process is clear-cut, and the pilot knows precisely what is expected and how to prepare. Boldface procedures committed to rote memory are relatively resistent to stress effects; the ability to rapidly recall a procedure is though to aid the pilot who might otherwise "freeze" or become confused in the face of a demanding situation. The evaluation process covers cognitive skills in the weekly written tests and psychomotor skills in the simulator. And the incentive for learning the procedures is provided by making flying contingent upon passing these evaluations.

Even with these advantages, however, the Boldface approach is limited. An analysis of the pilot's activities during an emergency demonstrates the scope of cognitive processing which should occur.

Requirements of an Emergency Situation. During the course of any emergency situation, refer again to the three rules which the pilot should accomplish: (a) maintain aircraft control, (b) analyze the situation and take the proper action, and (c) land as soon as practicable.

Now consider the likely course of events: the pilot is somewhere along in the mission, attending to the mission requirements, and unexpectedly an emergency occurs. The emergency may be indicated by warning lights, an abnormality in instrument readings, abnormal flight control responses, strange noises, vibrations, or any combination of a number of these or other cues. Some of these cues are easily detected, others are more subtle and may not be immediately perceived. Once the pilot detects the cues, he must do two things simultaneously: continue to fly the aircraft, and analyze the situation. Accomplishing these in a multicrew aircraft may not be as taxing as in a single place aircraft, provided crew coordination does not break down. But in a single place aircraft under some conditions, maintaining aircraft control alone will be a demanding task. Likewise, analyzing the situation may be a simple diagnostic process or it could be considerably more complex, involving complicated information seeking. The appropriate response could be a simple response sequence, or it could be an extended sequence of inputs.

After recognizing and analyzing the emergency, while maintaining aircraft control, the pilot must determine the consequences of various responses on the rest of the mission. Usually this will require a plan of recovery. The pilot must anticipate the interaction of his corrective actions with the immediate problem solution and with the safe landing or conclusion of the mission. Thus, he must know where he is, where he is going, and how he is going to land safely when he gets there. Failure to think through these phases of the recovery can compound the emergency.

The fundamental cognitive activities of the pilot during the emergency are the detection of the cues or symptoms which signal the onset of the emergency, the diagnostic determination of what is wrong, the decision making processes which consider viable alternative courses of action, the selection of the most suitable response, and the execution of that response. The need for good judgment during these activities is obvious. Yet, if Boldface training discourages judgment or makes it harder to exercise, it follows that an alternative training approach should be considered. Is it possible to train good judgment as well as procedural accuracy? One attempt to do so is described in Section III.

III. F-15 EMERGENCY PROCEDURES TRAINING

In the early stages of F-15 acceptance testing it was decided to design an emergency procedures training program which trained all aspects of the three rules of handling emergencies with an emphasis on developing judgment. Test pilots felt that the unique characteristics of the F-15 mad the weaknesses of the Boldface approach particularly undesirable. This was supported by the task analysis of pilot responses to emergencies showing that many responses were contingent upon the results of previous responses, requiring cognitive processing as well as overt actions by the pilot. Many of the cognitive processing activities required pilot judgment or a complex of information seeking actions. A Boldface approach appeared incompatible with these contingencies. The training program which evolved is described below.

Situational Emergency Training (SET)

The 555th Tactical Fighter Training Squadron (TFTS), presently the only F-15 training squadron, developed a training program for emergency procedures which has been named Situational Emergency Training (SET). The reason for this name will become apparent later in this section. In some respects SET is similar to a Boldface training program. There is self-paced study of the flight manual, academic instruction, and sessions in a cockpit procedures trainer (CPT).[3] In other ways, however, the approach differs: there are no Boldface procedures; the organization and content of Section III in the flight manual has expanded narrative; and the training and evaluation methodology employed in CPT sessions concentrates on developing judgment.

Flight Manual. Section III of the F-15 flight manual is organized like other flight manuals, with sections on starting, ground operations, takeoff, in-flight, and landing. However, it contains no Boldface.

The narrative portions of Section III were deliberately expanded to include more discussion of symptoms and consequences of certain system failures. Where appropriate, procedural responses are itemized, but considerably more discussion is presented than is normally seen in a flight manual. The pilot is expected to read, study, and understand this material and be able to discuss and practice it in CPT training sessions. It is this more comprehensive treatment of emergency conditions which characterizes the SET program, especially in the CPT.

CPT Sessions. Comprehensive training sessions in the CPT are the major component in the 555th TFTS emergency training program. The CPT has several benefits as a training device: (a) It is an accurate reproduction of the F-15 cockpit, so training occurs in a highly realistic environment; (b) There is a substantial amount of incidental learning of systems operations and other non-emergency procedures (for example, local flight procedures) by the student during emergency training sessions; (c) The CPT can be located in an environment which facilitates learning, such as a quiet room; (d) The small physical size of the CPT permits close instructor-student proximity, making instruction, communication, and demonstration by the instructor much easier than in other training devices (e.g., some simulators or in the aircraft); (e) the scheduling constraints of a CPT are negligible compared to high use devices such as simulators; and (f) the location of the CPT at the squadron has made it much more accessible, substantially increasing its use. But the value of the SET training program is based on how the CPT is used.

[3] The CPT currently used by the 555th TFTS is a nonpowered mock-up of the F-15 cockpit with authentic switches, handles, and control grip, but with graphic representation of all gages and instruments. No lights work nor are control movements interactive with control loading dynamics or instrument readings. CPTs are located at a learning center and one is located in the squadron area.

CPT training sessions have replaced the biweekly Boldface paper and pencil tests. However, this is not simply a change in testing media. The CPT sessions are markedly more comprehensive than the straightforward procedural responses to given emergency problems in Boldface quizzes. Typically, each CPT session covers the entire contents of Section III.

For example, in the conversion course for experienced pilots transitioning into the F-15, ten training days precede the first aircraft flight. On the fourth day, the pilot is scheduled for an emergency procedures CPT session with his instructor. The session is exclusively learning oriented characterized by a fluid interchange of information. The student seeks clarification of questions he has about the material in Section III and he practices his emergency responses under the supervision of the instructor. A day or two later, as a prerequisite for his first flight in the F-15, the pilot has a CPT check covering the same material. This session is primarily evaluative, although the instructor continues to offer clarification and corrects incomplete or erroneous answers. All emergencies and abnormal operations are discussed.

For the remainder of the course the transitioning pilot has a CPT session every two weeks. These sessions mix evaluation with continuing sophistication and refinement of systems knowledge. Once the pilot is reassigned to an operational squadron the biweekly sessions become a part of his continuation training. A pilot who has not had a CPT session in a 30-day period is grounded until one is accomplished.

The strength of the CPT session is in how the instructor presents emergency situations and in the discussive nature of the student's responses. Normally the cues which indicate the emergency are described by the instructor rather than the instructor stating the problem outright. For example, the instructor might describe the problem as occurring inflight when a loud bang occurs and the left fan turbine inlet temperature (FTIT) gage begins to show a rapid increase in temperature. The problem is a stagnation in the left engine which in Boldface training the instructor would openly state "STAGNATION." But in the CPT the instructor only gives the cues which are encountered in real flight, forcing the student to diagnose the problem in the same manner as if he were in the F-15 at 20,000 feet. Then the student must describe his analysis of the problem and why certain responses will be more appropriate than others. He goes through the actions of these responses, flipping switches and pushing buttons as required. He discusses his decision making strategies and the consequences of implementing certain courses of action. The instructor can require a detailed description of the student's decisions, insuring that the student thoroughly comprehends his own actions.

As some instructors conduct these sessions, this approach has many of the elements of what might be called situational training. Thus the name situational emergency training (SET) is used to describe this training methodology. In such an approach an attempt is made to create a learning environment which has as many of the essential dimensions of the real world context as possible. The student deals with these dimensions as he goes about solving the problem, much as he would do in a real emergency situation. The only difference is the pacing of his actions which occur more slowly than in a real emergency since he is discussing his response strategy.

Expanding the 555th TFTS application of this situational approach, the authors have abstracted the fundamental behavioral principles operating in SET and discuss each of the dimensions of situational training in the following section. As SET applies to initial training of transitioning pilots, as well as the continuation training of qualified F-15 instructor pilots and pilots at operational squadrons, the term "student" will be used to describe the pilot who is being given the SET training session and the term "instructor" will designate the pilot administering the session.

IV. SITUATIONAL TRAINING

Situational training focuses on the interaction between the pilot and the dimensions of the situation in which he is operating. The theme is that the pilot functions within a situational context and it is hypothesized that the more a training program abstracts the important dimensions *out* of context, the less effective training will be. Thus, situational training is designed to have the pilot learn and practice in as much situational context as is optimum for training effectiveness. Since contextual completeness or representativeness varies on a continuum, an optimized training program selects the level of context appropriate for given stages of training.

Elements of Situational Training

There are three elements of situational training which the instructor can manipulate to build training sessions and instructional materials: situational detail, relevancy, and content.

1. *Situational detail.* Situational detail refers to the number of items which are "given" in the problem statement. For emergency procedures training, situational detail can be given in the three areas that define a situation: (a) The *cues* which signal the onset of the emergency; (b) The *point in the mission* where the emergency occurs, including what has already transpired preceding the emergency (flight time, fuel expended, remaining ordnance, etc.); and (c) The *aerodynamic conditions* at the time of the emergency, which are broken down into environmental factors, such as weather and runway conditions, and the aircraft's configuration which affects aerodynamic response, such as external tanks. For each of these parts of the situation, the instructor can select some amount of situational detail to define the emergency problem.

For example, the instructor can establish a mission point in low detail, such as "taking off" of "in flight," or he can use high detail such as "takeoff roll, 126 knots, nose wheel rotated, mil power." Similarly, the instructor can specify aerodynamic conditions in low detail such as "standard aircraft configuration, weather clear and dry," or in more detail such as "high gross weight, centerline tank, two AIM-7 missiles, weather is turbulent, thunderstorms in vicinity, hot and humid, 15 Kt crosswind, wet runway." The cues which signal the onset of the emergency can be presented in low detail, such as "loss of thrust" or in high detail, such as "loud bang" or "AMAD fire light" (AMAD: airframe mounted accessory drive).

Situational detail is one of the two moderators of the complexity of a problem, and as such determines the amount of cognitive processing necessary for a successful solution. The other moderator is the relevancy of each detail item.

2. *Relevancy of situational items.* The ability to discriminate relevant from irrelevant items in actual emergencies is probably the single most important requirement for a successful response. In most training programs, however, the statement of a problem contains relevant dimensions only; solving the problem is a straightforward application of the rules for dealing with these dimensions. In the cockpit, on the other hand, emergencies occur amidst irrelevant as well as relevant features of the situation. The pilot's first critical task is to decide what is relevant and should be attended to, and what is irrelevant and should be ignored. Until this is done, he cannot properly apply diagnostic and decision rules to solve the problem. He could mistakenly focus on a totally irrelevant cue or he could dismiss a highly relevant and critical aspect of his mission point which affects his possible options of response.

In setting up the problem situation the instructor can manipulate the relevancy of cues, mission profile point, and aerodynamic conditions. After the student has separated the relevant and irrelevant items and has completed his response, for example responding to an engine fire in flight, the instructor can extend the problem situation by introducing potentially compounding events or conditions for which the student must determine the relevancy. For example, if the problem resulted in the shutting down of one engine and this was properly executed by the student, the instructor could then introduce a no-barrier runway condit. n, or a 20-knot crosswind on landing coming from the side of the bad engine, or a GENERATOR warning light on the side of the good engine. The first contingency is probably of no relevance to the problem, depending on the initial conditions established by the instructor. The second two contingencies, however, are relevant and should be addressed by the student. In the crosswind condition, a yaw caused by the combination of the crosswind and asymetric thrust would require a modified touchdown strategy. In the GENERATOR condition, possible loss of power or perhaps double AMAD failure could be forthcoming.

In the setting up of the initial problem conditions and the follow-up sequences, the instructor can actively interject irrelevant dimensions to the problem as easily as he can interject relevant dimensions. The more sophisticated the student becomes, the more competent he will be at discriminating the relevant and irrelevant dimensions of the problem.

3. *Content.* The final element of situational training is the content of a specific unit of instruction. For emergency training, content is defined by the type of emergency and its criticality.

The three types of emergencies are simple, complex, and compound. *Simple* emergencies include most abnormal operations and are those which are easily detected and corrected. A hot start and failure of the gear to retract fall into this category. *Complex* emergencies are those which are either difficult to detect or difficult to correct, or both. Engine stagnation and pitch ratio failure are examples of this type of emergency. A *compound* emergency is the occurrence of two or more emergencies simultaneously or sequentially.

The criticality of the emergency depends upon the amount of time the pilot has to correct the problem and the probability that a recovery can be successfully executed. Emergencies close to the ground and those where redundant systems fail (e.g., double AMAD failure) rank high in criticality.

The instructor selects content to satisfy the training needs of the student. The type and criticality of the emergency along with situational detail and relevancy are manipulated by the instructor in determining the "situational mix" of specific training sessions.

Situational Mix. The concept of the situational mix refers to the structure of training sessions or instructional materials built by the instructor to meet the training requirements of the student. The objective is to match the training task to the readiness of the student. Contributing to the mix is the level of situational detail, the balance of relevant and irrelevant items, and content. One way of using the situational mix is illustrated in the following paragraphs.

Consider a young pilot with low flying time. In his first training session the student's level of development is relatively primitive so the instructor might give him simple situations which are all low in detail with totally relevant items. This first session might consist of simple emergencies presented with diagnostics and without mission profile or aerodynamic contingencies. For example, the problem is stated, "What do you do for a hot start?" "What do you do if your gear fails to retract?" "How do you extinguish an engine fire?" Complex emergencies can be included also, but the session emphasizes basics.

During the second session all the simple and complex emergencies are covered again, still in low detail and with all relevant dimensions. Then the instructor begins to expand the situational context. He mixes the level of situational detail by presenting some problems in a mission context. For example, an engine fire is described as occurring at 15,000 feet while in route to the weapons range. All the dimensions remain relevant. In the third session, mission context is expanded, relevant aerodynamic conditions are introduced, and diagnostic statements are replaced by cues. Each session is a more diversified mix with low to high level detail on cues, mission context, and aerodynamic conditions for several different problem situations.

By this time the student has mastered the basic emergency response knowledge and he is fairly competent at applying it in "clean" situations. The instructor now introduces irrelevant dimensions. "You are at 15,000 feet in route to the range. You are carrying the standard ordnance and have a centerline tank. Visibility is unlimited and weather is negligible. You are lead in a two-ship but wing has not rejoined yet and at the last communication he was two miles at your five o'clock. Simultaneously you get a steady left engine light on your fire panel and a master caution with an ANTI-SKID caution light. Describe your diagnosis and response." The only relevant aspect of the problem is the fire light. Altitude, weather, and configuration are not relevant since they will not affect the response. The fact that wing is closing is not critical to the problem, but the more sophisticated pilot will alert his wingman to the problem and request assistance in detecting the extent of the fire and confirmation that it has been extinguished. An intentionally confusing dimension to the problem, the simultaneous ANTI-SKID caution, is only a distractor and should be disregarded by the pilot. If there is an anti-skid problem, it is certainly secondary to the engine fire.

Depending on the sophistication of the student, the instructor can extend the problem after the student responds. For example, a second fire, bad weather, or diversion to another base can be introduced. Again, some of these added dimensions can be genuine complications and others can be irrelevant to recovery.

In the remaining sessions (and in continuation training) the instructor would continue to use the situational mix building scheme, increasing the amount of irrelevant items in some problems. For these sessions content difficulty would drive the levels of detail and irrelevancy. For abnormal ground operations simple situations are adequate for training. For complex, critical emergencies, on the other hand, high detail problem situations with a large number of irrelevant items would maximize training. A typical CPT session might have a mix of six simple problems, three moderately detailed problems, and two extensively detailed problems with high irrelevancy and several compounding circumstances.

The mix of a training session not only satisfies an instructional strategy, but it also results in a varied format of training sessions or instructional materials making them more attractive for the student. The concept of the situational mix can be applied to CPT sessions, workbook and textbook organization, sound slide and video presentations, and classroom instruction.

Judgment

Situational training is considered a positive approach to developing judgment. In the present analysis judgment has been defined to be the result of a discrimination process. From the entire set of stimuli with the potential of impinging upon the pilot, some subset is attended to and processed. This subset functions as "discriminative stimuli," defining the situation, and can result in a re-sorting of the original stimuli or a sampling of new stimuli which are relevant to the situation. This process of sorting or attending to specific stimuli is a fundamental component in the development of judgment.

The stimuli, once processed and sorted into categories of relevancy, must be attached or signal the occurrence of a response or set of responses which are appropriate, that is, which are correct--given the stimuli present at the time. This is the process of determining a correct course of action in the emergency, assuming that all the stimuli necessary to make such a decision are present and available for the pilot to perceive and process. This response development and selection is the second fundamental component of judgment.

It is obvious that to make a correct response the pilot must accurately discriminate the problem. The level of refinement of his discriminations, however, will vary with the type of emergency. For some emergencies the response is always the same regardless of the situation. For others, the correctness of a response is a function of more ambiguous stimuli which must be sorted. The experience of the pilot (to some extent) mediates the ability to make these finer discriminations.

In designing a training program one primary question must be answered: What is it in the pilot's experience which develops the behavior known as judgment? Part of the answer is that during the period of accumulating flying hours the pilot operates his aircraft in a wide variety of situations and in later flying he will again encounter the same or similar situations. Similarly, as he exchanges his own experiences with those of other pilots he learns about new situations and how they were handled by others. Presumably, he also gains confidence that he can handle more complicated problems and this should aid him in resisting stress effects when confronted with an emergency situation.

Situational training attempts to develop judgment by having the pilot exercise discrimination and response selection in training sessions. This surrogate flying experience permits the student to accrue judgmental skills by discriminating relevant and irrelevant dimensions of various emergency situations, and then to use the relevant information in the selection of a correct response. It is a systematic way of exposing the pilot, especially the less experienced pilot, to a wide variety of judgment building situations.

The Situational Approach in Other Emergency Procedures Training Programs

Some versions of situational training have been used, or are being used now, in other emergency procedures training programs, although rarely in the systematic way described previously. For example, in undergraduate pilot training (UPT) an instructor pilot will address a flight of student pilots with a situation. A student is then called upon to stand and give the correct Boldface solution for that situation. In some circumstances incomplete or incorrect responses are pointedly brought to the student's attention.

While this appears to be an application of situational training, the requirement that the answer must be a Boldface solution changes the learning outcome. One senior pilot described the student's activity in this setting as being a narrowed information seeking task: The student listens for those cues which identify the problem by its Boldface category so that the correct Boldface response can be made, thus avoiding the embarrassment of an incorrect reply in front of his fellow students and instructors. What the student does not listen for are cues which might identify a situation where a non-Boldface response is more appropriate. The student is engaged in a classroom activity that in some instances has little application to the flight environment.

Situational Emergency Training in the Instructional Setting

The situational approach appears to be most effective in a loosely structured instructional setting where the instructor and student can freely engage in lengthly dialogue. At the 555th TFTS this setting is the CPT, but it could take place in any setting where the instructor has the flexibility to pace his own inquiries and require detailed responses. Several advantages of CPT sessions are described in Section V.

As a result of this type format the training sessions are quite thorough, much like the comprehensive oral examinations required of a graduate student. When this thoroughness is combined with situational material, several benefits occur:

1. *Practicing Cognitive Skills.* The situational approach permits the student to practice his cognitive skills by verbalizing his problem solving strategies while acting out his responses. He talks through the emergency problem presented by his instructor, discussing the detection of cues, diagnosis, information seeking, decision making, and consequences. The cognitive processes he is exercising in the session model are those he will use in a real emergency, simply without the narrative.

2. *Comprehensive Evaluation by the Instructor.* The alert instructor can probe the student's competency in several different ways and over a wide range of emergency conditions. Generally, much deeper exploration of the student's knowledge can take place. The one-on-one relationship between the instructor and the student makes it difficult for a student to cover up a lack of knowledge or understanding.

Such a format is also excellent for multiple-instructor evaluation of a student who has been presented various emergency problems by a group of instructors. These group sessions have been the most comprehensive documented to date due to two main reasons. First, while one instructor presents a problem other instructors can prepare a new problem or an extension to the current problem. Second, the range of experience is greater with a group of instructors resulting in more comments about the student's answer and added material relevant to the problem.

3. *Flexibility.* Training sessions using the situational approach offer the instructor a wide range of flexibility, from selecting content to determining depth of answers. The instructor can begin a session with a particular situational mix geared for his student, but can change it as the session proceeds should the student show an unexpected strength or weakness in one area. The instructor can conduct the session as wholly tutorial, with little evaluation of the student and without great comprehensiveness, or he can require exhaustive treatment of each problem. When conducted in the CPT, the low time demand on the CPT makes training sessions easy to schedule, much more so than usually found for the more expensive simulators.

4. *Student Attitude.* In training sessions at the 555th TFTS, students, who at this time are mainly experienced fighter pilots transitioning from F-4/A-7 aircraft, report a positive attitude towards SET. This seemed to be in comparison with paper and pencil tests and other forms of academic instruction to which they had been exposed in other Air Force training programs. This positive attitude towards SET has increased the learning benefits of the program.

5. *Information Transmission.* The transmission of new information about the aircraft, which had not yet been widely disseminated in the squadron, was observed in several training sessions. New procedures and sequences of activating certain equipment, among others, were often tried for the first time during the period covered by this report, although this type of experimentation and discovery has been ongoing since the initial flight testing of the F-15 and is expected to continue for some time. The situational training session provides a convenient forum for discussing these discoveries.

After the strengths of the situational approach and its application in the CPT were examined, the present investigation looked for areas which were not as strong and which needed improvement. These areas are included in Section V.

V. POTENTIAL PROBLEM AREAS IN THE APPLICATION OF SET

Several excellent instructional techniques were observed throughout the documentation of the 555th TFTS SET program. There were a few areas, however, where the instructional approach could have been strengthened. As these problem areas are likely to be found in any dynamic learning environment, the following guidelines are suggested:

1. *Clear, useable criteria for acceptable performance must be developed and applied if situational training is to be successful.* In SET, emergency problems can be complex, they can involve a number of elements and dimensions, and they can contain some decision points where more than one solution could be appropriate. The student's response to the problem can be a lengthy narrative and entail complex control sequences. The instructor is faced with the difficult task of assessing performance over the whole range of the student's response. To do this effectively, the instructor must predetermine the criteria for acceptable performance.

In Boldface, the criterion is straightforward: All Boldface steps must be reproduced errorlessly. But for SET, when several performance elements exist and judgment is often exercised, the definition of a good problem solution is taxing. Instructors report that they can discriminate good performance from poor performance, but this is usually a subjective assessment. For the long range integrity of this training approach, attempts must be made to define satisfactory performance for each of the emergency problems presented and for the entire session. These criteria could vary according to the student's level of training.

One way of accomplishing this would be to have a group of instructors discuss the emergency problem and decide on the key elements that a student must include in his answer to obtain a passing mark. A set of secondary elements, which are not essential to the solution but represent a more sophisticated response, could also be determined to identify the performance of an advanced student.

Clearly defined performance standards are essential for two reasons. First, the student judges the quality of his own performance by his instructor's assessment. If the student omits an important dimension of the problem and the instructor fails to comment, the student leaves the session and climbs into the cockpit thinking his incomplete or inaccurate answer was correct. Second, the object of any training program is to prepare the student to perform properly. In emergency procedures training the preparedness of the pilot is tested only in the rare occurrence of an actual emergency. Therefore, those who are responsible for training must have some other means for guaranteeing that their training program has done its job. The clean metric provided by well-defined criteria satisfies this requirement for the managers of the training program, as well as for those who evaluate the program's effectiveness from outside the squadron.

2. *The instructor should give constructive feedback to the student.* Within the framework of well-defined criteria, the instructor can provide meaningful feedback to the student about the comprehensiveness of his response. Some of this feedback should come during the session. For example, if a portion of an answer is completely overlooked the instructor should comment on the omission or error and the correct response. Following the session, the instructor should critique the student's performance and indicate areas that need extra study.

For problems that are answered incorrectly or incompletely the instructor will have to decide if the session should be repeated at a later time or if reviewing the problems following the session is adequate. In either case, problems which are not answered satisfactorily during the session should be presented again at the end of the session.

3. *The instructor should not assume the student's knowledge.* A main strength of the CPT session is the comprehensiveness the instructor can demand of the student's answers, insuring thorough understanding of the problem solution. However, this comprehensive evaluation of the student can be subverted when the instructor begins to assume that the student knows the solution or parts of the solution to particular problems. Material which the student handled successfully three days prior is easily assumed to be known today. Unfortunately, there are two reasons why this could be an inaccurate assumption. First, a seemingly competent treatment of a problem during an earlier session could have been a lucky guess or simply the result of relaxed criteria on the part of the instructor. Second, the student's knowledge is undergoing increasing sophistication. What seemed to be understood by the student in earlier training might be less clear in the context of more complex systems knowledge or could take on a completely new meaning.

When the instructor begins to assume the student knows parts of the solution he can cut the student's answer off before it is completed or he can prompt or coach the student, especially if the student is taking a fair amount of time in answering. In both cases, the student could leave the session assuming an incomplete answer was the correct answer since it appeared to satisfy the instructor.

The instructor should always let the student complete his answer. When lengthy pauses occur the instructor should be patient. What he should not do is give verbal or non-verbal indications to the student that he should terminate his answer. The student should terminate the answer on his own.

The instructor should also be careful not to prompt or coach. In both cases the instructor makes some kind of verbal or non-verbal indication as to the next step in the solution or some other aspect of the answer which the student has overlooked. This is most likely to occur when the emergency is one which has been covered in earlier sessions and the instructor sees his role as simply cueing the student on material he already knows.

Prompting or coaching can be done verbally or non-verbally. Verbal hints or clues can be questions, as in "what about cycling your generator?" Or statements, ". . . . and don't forget to turn antiskid off." Nonverbal hints come in many forms, from glances towards the next switch that should be thrown to pointing at an instrument. Nervous fidgets, yawns, and marking off the checklist before the question is completed are all methods of communicating a message to the student, no matter how unintentional.

For all of these reasons, it is good instructor practice to not assume the student knows the solution, to let the student complete his answer, and to refrain from prompting or coaching.

4. *The instructor should prepare for a CPT session.* Within the activity of a training squadron, it is easy for an instructor to enter a training session less prepared than he should be, especially when the session is a repeat of something he has done a large number of times before. While the instructor's experience will normally permit him to accomplish most of his training objectives for that session, it remains that some preparation is necessary if the maximum training effectiveness is going to be realized. Such preparation would entail a review of the student's progress to date and noting any weak areas. The material the instructor selects for the session should be reviewed and any special deviations or additions from that material should be prepared. This type of preparation is not at all time consuming and will insure a more effective session.

5. *During the course of training, a student should have CPT sessions with more than one instructor.* Since each student has his own instructor it is often convenient for that instructor to give the biweekly CPT sessions throughout training. The instructor should have the best feel for his student's capabilities and, therefore, should be the best person to tailor sessions to strengthen the student's weaknesses.

On the other hand, too much familiarity with the student can partially impair the instructor's evaluation of strengths and weaknesses. To offset this, it is suggested that occasionally other instructors conduct the CPT sessions. The new instructor can be more objective in his evaluation of the student. He might present old material from a different perspective, lending a better understanding to the student and thus broadening the student's background.

6. *The student should "fly" the CPT.* One of the benefits of the CPT noted earlier is its relative realism. Practice in the CPT has more transfer potential than paper and pencil tests. To maximize this transfer, the student should sit, move, study, search, and make control inputs in the CPT as if he were flying it. This does not mean that he must be rigid in his execution of his responses, nor should the informality and dialogue of the CPT session be reduced. Rather, at the beginning of a problem the student should configure the switches and controls to match the requirements of the problem, and he should have his hands on the controls as he would normally have them in flight. As the problem is described and his response begins, he should make the same movements he would in the cockpit. If a switch is to be thrown, he should move that switch. He should not be casual in his cockpit procedures.

By practicing in this manner, the student strengthens his knowledge of cockpit layout. His practice is monitored by the instructor who can detect erroneous or potentially erroneous control movements or switchology. In addition, unusual cockpit movements can be demonstrated by the instructor and practiced by the student, such as using the left hand to jettison a jammed canopy so as to avoid injury.

"Flying" the CPT will build good cockpit procedural habits. It will increase the probability of positive transfer to the aircraft.

7. *The instructor should expand the content of problems where necessary.* For some emergency conditions there are additional tasks for the pilot to complete for an optimum response. These add-ons are

not essential to the skeleton response, but certainly should be completed to increase the likelihood of a successful recovery. Some of these add-ons are radio calls, navigation requirements, position awareness, and systems management (for example, fuel). Each of these can increase the task load effect under certain circumstances and reduce pilot capability in a real emergency. As such, they should be included in problem solutions for these emergencies.

A fire on takeoff illustrates this point. If the pilot elects to continue the takeoff, his first concern is to gain altitude, try to extinguish the fire, then try to land. A student who responds to the problem with this solution cannot be faulted. However, the experienced pilot would probably add a radio call declaring an emergency and, being aware of his position relative to the runway, would be turning back towards the runway while trying to gain altitude and suppress the fire.

It is suggested that the instructor include these types of additional tasks for emergency conditions where they are necessary and potentially task loading. Being aware and practicing these extra tasks will help the student refine his emergency response.

8. *Solutions should include all aspects of the recovery for those emergencies which affect the remainder of the mission.* Some emergencies alter the recovery phases of the mission, for example controlability problems. For these cases the student should include a complete plan of recovery. When a particular in-flight emergency is going to require a subsequent minimum angle of attack landing approach, the student should so specify. When an overhead precautionary approach is called for, its execution should be described. These extensions of the problem solution are simply the necessary follow-throughs which would be required in an actual emergency and should be addressed in training.

9. *The instructor should make sure the student is preparing personal decision rules.* For some envelopes of flight, each pilot should have personal decision rules which dictate specific responses should emergencies occur. For example, takeoff, abort, and ejection are situations where the pilot must assess the probabilities of accomplishing certain actions before he finds himself having to do them. Prior to starting his takeoff roll he should know at what speed, attitude, and runway point he would choose to abort or continue the takeoff, and these should be known for different runway conditions and how these factors interact with different types of emergencies.

Personal decision rules require substantial mental discipline to establish. It is a difficult exercise to think through a series of critical circumstances and establish a decision strategy. It is the responsibility of the instructor to probe the student and determine if he is forming decision rules. Since these rules often vary between pilots, the instructor is not searching for one correct solution. Rather he needs to insure that the student is forming rules and that some rationale is used. The objective of the instructor's probe is to help the student begin to form rules regularly on his own.

10. *The instructor should keep accurate records of the student's progress.* The instructor should keep a "real time" record during the session of how well each problem is completed. Mistakes or omissions in grading are more likely if the instructor waits until the conclusion of a CPT session to mark off the checklist of problems answered successfully, especially if the session is 45 to 60 minutes long. It is good instructor practice to wait until the student completes a problem and then grade his performance on the checklist for that problem.

The graded checklists become part of a record of the student's progress over the course of training. The instructor can use them to identify weak areas and, subsequently, design the situational mix to supplement training in these areas. Such records also satisfy requirements for training records specified by Air Force regulations.

11. *Instructor performance should be critiqued to improve instructional techniques.* The role of the instructor in the CPT session is central to the effectiveness of training. He must use good instructional technique as illustrated in the preceding paragraphs. As one means of improving instructional technique, the instructor should be periodically critiqued by his fellow instructors. Multiple instructor sessions provide this type of feedback, as well as allowing the newer instructors to observe the techniques of more experienced instructors.

One excellent way of supplementing critiques by other instructors is to video-tape the instructor's conduct of a CPT session. By recording his performance on videotape, the instructor can critique his own style and at the same time watch the student's reaction to his instruction during the session. Mistakes, prompting or coaching, and lax criteria become strikingly apparent during the replay of a session. For the time involved, reviewing a video-taped performance is a highly efficient way of detecting areas of instruction which need improvement. It is recommended that during instructor training programs a medium (like videotape) be used for improving instructor technique.

Those are the major areas where a situational training program can experience problems. Within the guidelines presented above and the advanced concepts suggested earlier, it is possible to sketch an expanded or idealized SET program. Section VI outlines such a program, recognizing that the details are subject to change as the main concepts of SET evolve.

VI. AN EXPANDED SET PROGRAM

This section outlines the application of SET in an integrated program including academics, a workbook, the CPT and a simulator. Throughout the program the common message to the student is to "think situations," that is, the program elements are all designed to establish and reinforce a situational orientation. The end objective is that the pilot will continuously examine and analyze everything he knows and will learn about his aircraft within a situational context, and by doing so he will be maximally prepared to cope with any emergency he encounters.

In this most ideal of training outcomes the pilot would learn a new fact about his aircraft and then systematically trace it through a number of situations. He would think through various mission profile points and aerodynamic conditions to see if the special combination of these points made a standard response less appropriate. And, if the training program is successful, he will go through these mental analyses quite naturally.

The elements of the program are listed below. Most are elements which exist in present day programs, with the added emphasis of the situational approach. The reader is advised that the expanded SET program (described next) is speculative and would undoubtedly be refined as the program evolved.

Instructor Pilot Training

The first conversion to a totally situational approach begins among the instructors themselves. Since they will normally be highly experienced pilots, they should be able to develop a situational frame of reference with little trouble.

The conversion to SET begins with the pilot who is training to be an instructor pilot. During his training course his main exercise in SET will be the creation and scripting of a number of emergency situations. The instructor-trainee will take each possible F-15 emergency and consider its consequences over a wide range of flight profile points, and environmental and aerodynamic conditions.[4] For those circumstances where the standard emergency response requires modification, he will construct a situation scenario.

Each scenario will describe the mission point, environmental and aerodynamic conditions, and onset cues of the emergency. The diagnostic process will be described and the decision making steps will be listed. Possible alternative courses of action and their consequences will be discussed.

Each of these scenarios would be reviewed for completeness by the pilot's own instructor and several would probably be used in the pilot's own CPT training sessions. As the pilot adds to his scenarios, he is actually building a resource file of situations which he can use later in training sessions and instructional material for his own students. In addition, each instructor's scenarios would be pooled into a common source file, giving the squadron a resource pool of scenarios. Eventually, individual scenarios created in this manner will be used in academics (classroom), a workbook, sound slide programs, the CPT, and the simulator. Figure 1 is a flow diagram which shows how this might work.

Presuming that all instructors have been converted to the maxim "think situations," the training of the student is now considered.

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[4]There are different aids which an instructor might use to make sure he has covered all possible situations. These aids will be evaluated in Phase II of this research.

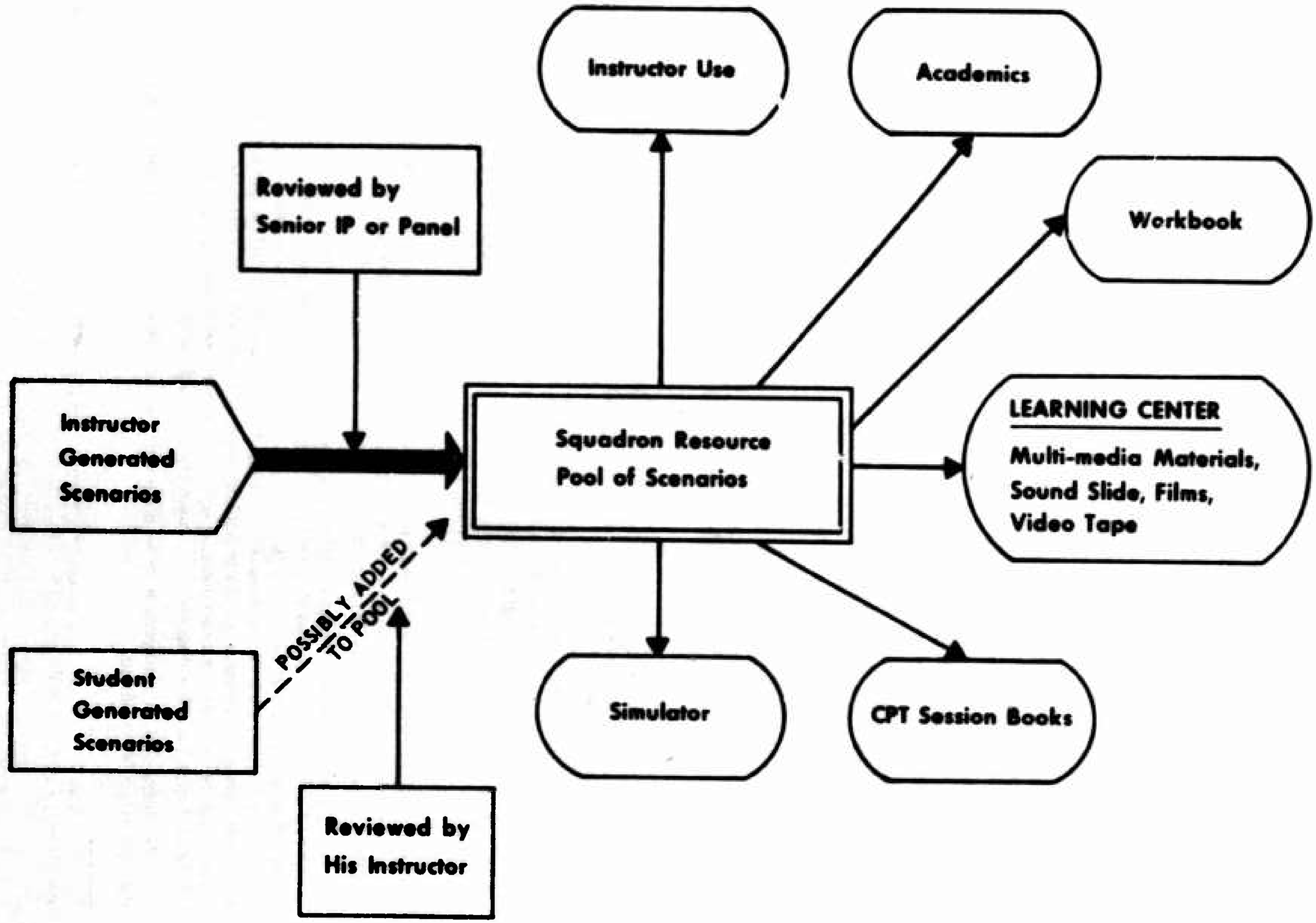

Figure 1. Resource pool of scenarios.

Academics

The student's first text is the F-15 flight manual. Because its format is compatible with SET, Section III would remain unchanged. In initial classroom sessions, however, the student would be instructed on the objectives of SET and would be told to use the flight manual to develop his situational approach.

The classroom sessions themselves would have much the same content as before, discussing emergencies, the symptoms, and corrective responses. The emphasis on situation development would be added, however, and the student would be introduced to the process of creating his own situations. In the classroom the instructor can demonstrate the creating of situations for specific emergencies. He can probe the class to make sure the concepts are understood and then break the class into small groups where three or four students would work together and write sample scenarios, presenting them to the class later for critique.

Eventually the student would create a number of situation scenarios, much like the instructor-trainee. It is expected that the depth of these situations would vary with the experience of the student, with the less experienced pilot developing a less comprehensive situation simply because he has little or no experience with the possible variety of circumstances he may confront. Nonetheless, the generation of these scenarios is seen as a valuable learning experience.

Other ways of introducing the situational approach can be developed by the academic instructor. Several other ways of having the class practice this approach incorporate basic classroom techniques and will not be discussed here. One instructional aid, which bridges the gap between the flight manual and instructor-directed training, is a student workbook.

Workbook. The flight manual is comprehensive but also succinct. The extensive narrative involved in describing situations is incompatible with its format. On the other hand, the student should have a text which discusses the material in Section III in greater depth and in a situational context, and which he can take home to study. This text should offer information, problems, and sections to compile study notes, with emphasis on local procedures and conditions.

The workbook format is envisioned as having several problem situations for the student. Since a cockpit mock-up would normally not be available when the student uses the workbook, the page facing the problem statement would have a drawing of all the cockpit instruments and controls. As a student works through the problem he could mark his response steps on the drawing; for example, placing "1" on the throttles to show his first response to an engine fire light is to retard the throttles. Following the problem would be the solution with a comprehensive explanation of why certain responses were selected.

The material for the workbook would logically come from the squadron's resource pool of problem scenarios. The workbook would be loose leaf, permitting easy updating with current information on aircraft modifications, newly discovered systems information, and latest safety cautions. As the student wrote his own problem scenarios he could file them in the workbook.

The situational framework of the academic sessions and the workbook problems would lead into CPT training.

CPT. The CPT sessions would synthesize all of the guidelines and advanced concepts presented in the earlier sections of this report. Initial training sessions would be basic and then increase in complexity with the student's development. The instructor would design sessions with a situational mix that complements the student's progress.

Since CPT sessions will occur regularly for students in training and for pilots at the operational squadron, some systematic variation in the composition of each session is desirable. One way to achieve this is to build a large number of sessions which the pilot can work through one at a time. For a one-year period, a squadron could construct 26 unique sessions (one session every two weeks). Each session would be in its own small loose leaf binder identified by number. For a given session the instructor would select the session following the one he gave two weeks earlier and would review the content of the binder before the session began, preparing any additional material he needed. Then the pilot would arrive and the session would begin. The content for each of the 26 sessions would come from the squadron's resource pool of problem scenarios making preparation of the binders an easy task. This feature, combined with the variation in situations over a period of time, adds to the attractiveness of this approach. Whether such an approach is feasible will be one of the topics of Phase II.

CPT sessions would eventually be supplemented by simulator exercises. Since an F-15 simulator is not in operation at this time, this portion of the program is somewhat speculative.

Simulator. In the simulator, control movements are interactive with instruments and warning signal devices are operative, whereas neither of these features exist in the CPT. The mathematical flight equations which interface the controls and instrument readings are designed to accurately duplicate the aircraft.

In the expanded program emergency procedures training in the simulator would occur in each training session, not just in one semiannual lump. Present syllabi call for a number of simulator training sorties and during each sortie at least one emergency would occur.

The context for emergencies in the simulator would be situational, as in the CPT, except most cues would occur automatically. That is, lights would come on or instrument readings would fluctuate or sounds would vary automatically. The pilot would respond to the emergency in more of a real time than in the CPT since the narrative would be eliminated. As the simulator is currently designed it would be difficult for an instructor to closely observe and communicate with the student. Most instructor monitoring will be done from an outside operator station. The simulator offers automatic objective performance measurement, so quantitative assessment of the pilot's ability to maintain aircraft control (while taking corrective action) can be obtained.

The simulator will be a good device to practice the skills taught in the CPT; however, the CPT will remain the central training device in a SET program.

Modification of Problem Scenarios Due to Change in Location. Initially, most problem scenarios will be generated at the 555th TFTS. The environment at this Arizona desert location can be characterized as hot, dry, and clear. It is expected that most problem scenarios created at the 555th TFTS will reflect this type of operating environment.

As squadrons are established in other operating environments, however, scenarios should reflect the unique characteristics of those locations. For example, the environment at the first F-15 operational squadron at Langley AFB, Virginia, will be hot and humid during the summer, and cold and wet with occasional snow during the winter. Visibility will be limited by haze, smoke, fog, and rain with ceilings down to 100 feet. Situations where these conditions are factors in the problem should be written into scenarios to be used at the Langley squadron. Other unique operating factors, like available runway facilities, approaches, weapons deliveries ranges, etc., will be written into Langley scenarios.

With scenarios being responsive to the operating location, training will achieve a maximum transfer for local pilots. As the Langley scenarios are created they would replace those scenarios in each of the 26 CPT session binders which were exclusively designed for the Arizona environment.

Phase II: Evaluation of Program Concepts

Plans for evaluating the training concepts in this section are currently being developed and will constitute approximately one-half of Phase II of this research. A small number of pilots training to be instructors will construct scenarios as described earlier and the feasibility of a squadron resource pool will be tested. A particular criterion of success will be the amount of effort required to maintain such a program. High levels of administrative overhead will reduce the attractiveness of the program among operational pilots, an undesirable and unacceptable outcome.

The second half of Phase II will examine other aspects of SET implementation. First, the effectiveness of SET for the novice pilot will be examined as the first graduates from undergraduate pilot training transition into F-15 training. Second, the use of video recording equipment, as an instructor critiquing tool, will be evaluated. Third, SET will be examined in the operational setting at the 27 TFS, Langley AFB, Virginia, currently the only operational F-15 squadron. Of particular attention will be any degradation of the program within the operational setting.

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