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SYSTEM ANALYSIS OF PRACTICAL EXERCISE INSTRUCTION.(U)

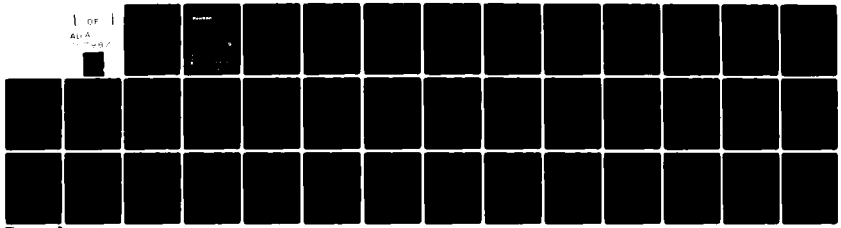
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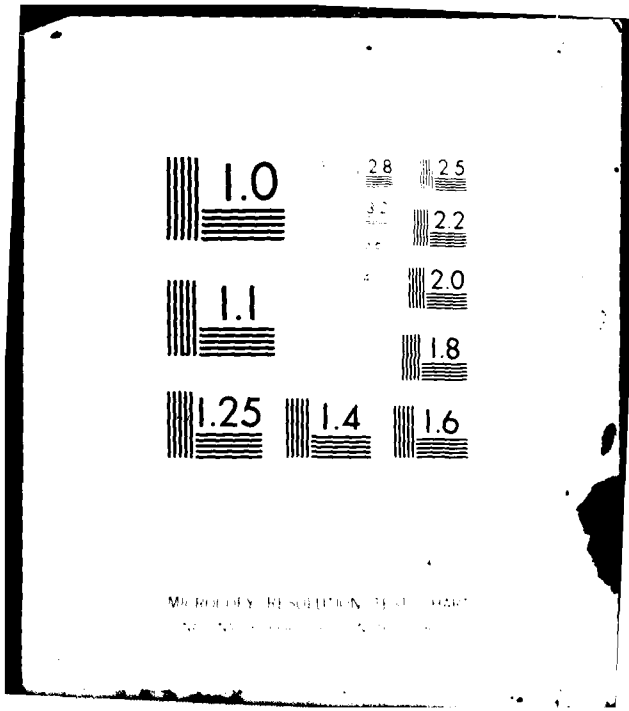
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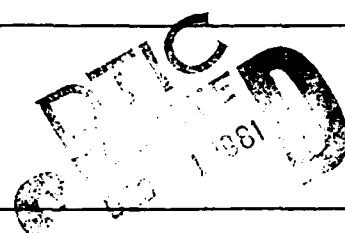
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER IR-D5-73-1	2. GOVT ACCESSION NO. AD-A107 982	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) System Analysis of Practical Exercise Instruction	5. TYPE OF REPORT & PERIOD COVERED Interim Report	6. PERFORMING ORG. REPORT NUMBER
		7. AUTHOR(s) Elmo E. Miller
8. CONTRACT OR GRANT NUMBER(s) DAHC19-73-C-0004	9. PERFORMING ORGANIZATION NAME AND ADDRESS Human Resources Research Organization (HumRRO) 300 N. Washington Street Alexandria, Virginia 22314	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Department of the Army	12. REPORT DATE April 1973	13. NUMBER OF PAGES 34
	14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) <b>LEVEL</b>	15. SECURITY CLASS. (of this report) Unclassified
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Practical Exercise (PE) Hawk Maintenance		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report is written to suggest improvements in the system of practical exercise (PE) instruction in Hawk Maintenance, but it also may be useful for others with similar training problems. The specific program of instruction (POI) studies is for MOS 24B20, an entry level maintenance man for part of the Hawk System, requiring 15 weeks, 2 days of instruction. The report is for those who are in a position to implement the suggestions, so rationale, procedure and training methodology are omitted except insofar as they are relevant to the suggestions.		

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INTERIM REPORT  
SYSTEM ANALYSIS  
OF  
PRACTICAL EXERCISE INSTRUCTION

Elmo E. Miller  
April 1973

WORK UNIT: INTERFACE

This Interim Report has been prepared to provide preliminary information on the results of a research effort. It has been issued by the Director, HumRRO Division No. 5. It should not be quoted nor cited without permission from HumRRO.

HumRRO, Division No. 5  
Fort Bliss, Texas

HUMAN RESOURCES RESEARCH ORGANIZATION

IR-DS-73-1

#### PREFATORY NOTE

This report was prepared as a product of Work Unit INTERFACE, "Simulation and Training Methods for Maintenance and Operation of Advanced Military Electronics Systems." The project was sponsored by the U.S. Continental Army Command and conducted under Army Contract DAHC19-73-C-0004.

The objective of Work Unit INTERFACE was to develop a methodology for determining appropriate characteristics of low-cost simulation devices and training aids for use in Army air defense systems, and to develop effective training methods for use with the simulators and aids which minimize cost and increase the effectiveness of available instructional staff.

Another product of Work Unit INTERFACE is a how-to-do-it manual entitled Designing Printed Materials: Content and Format, by Elmo E. Miller (RP-WD(TX)-75-4, December 1974 (AD-A052 761)).

This report is written to suggest improvements in the system of practical exercise (PE) instruction in Hawk Maintenance, but it also may be useful for others with similar training problems. The specific program of instruction (POI) studied is for MOS 24B20, an entry level maintenance man for part of the Hawk System, requiring 15 weeks, 2 days of instruction. The report is for those who are in a position to implement the suggestions, so rationale, procedure and training methodology are omitted except insofar as they are relevant to the suggestions.

#### THE PROBLEM

In the practical exercises, most of the time is spent performing checks, adjustments, and fault-isolation procedures. The prominent activity involves one pair of students at a time practicing the procedures on the equipment under the supervision of their instructor. The other students in the group are directed to observe the performance, but it is dubious that they benefit much from the passive observation. For one thing, it is often impossible for the whole group to get a good view of all the critical cues in the task. Consequently, considerable time is wasted, which they can ill afford. It was postulated that the students who were not practicing on the equipment might better use their time in active practice on low-cost simulators. The present research effort was initiated to study the effectiveness of such simulation.

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The desired terminal performance is a chain of activities that is well represented in the performance examinations in the practical exercises. The crux of the training problem is: which aspects can be trained separately as sub-skills, and which aspects are essential to effective practice? Experience indicates that using the test instruments is a separate skill (e.g., using a TS-505 multimeter to measure voltage is pretty much the same thing regardless of the equipment tested). Low Altitude Air Defense (LAAD) Department's experience with the instrument test lab also indicates that using test equipment can be learned effectively as a separate skill. On the other hand, performing checks, adjustments, and fault-isolation entails frequent location of points on the equipment, to establish precisely how the schematics and tables relate to the equipment. Going through practice "exercises" without any equipment is simply not the same process, especially for novices whose experience provides no basis for their visualizing the equipment. As a working hypothesis, then, we presume that effective practice of these skills would not necessarily involve actual test equipment, but it would be absolutely essential to have some kind of simulation or the real equipment.

Preliminary observations and analysis also indicate that simulation has promise, but by itself, is no solution to the problem. There would also have to be planned activities with the simulators, materials or media to guide the activities, and instructors who are prepared to direct such activities effectively. Often there are very effective simulators already available, in the form of real equipment which is

deadlined or otherwise out of service. (The fact that such equipment is not being used further indicates that simulators alone are not sufficient.)

Prototype materials for guiding practice have been developed for one segment. The corresponding simulators are available, either in the form of real equipment (turned off) or photographic mock-ups. Task analysis, reinforced by past research (1, 2, 3, 4, 5, 6, 7, 8, 9) indicates great promise. But the materials need to be tried in actual practical exercises and adapted to the situation. Such tryouts and revisions of the materials also seem to be the best way to prepare the instructors to use them effectively. Then, if the method proves to be effective, it can be extended in similar fashion to the rest of practical exercise instruction.

This report examines the system of practical exercise instruction to see how the simulation developments could be realized in practice. Certain other improvements are also suggested. In considering any changes, we must recognize the implications of a heavy load of students and the limited facilities available, to avoid putting a heavy extra load on the staff. Convulsive changes must be avoided; any changes are to be evolutionary rather than revolutionary. Effectiveness should be demonstrated on a small scale before the methods are adopted on a broad scale.

## SYSTEM ANALYSIS

### Written Materials

The vault file is the principal instrument for guiding instructors in their conduct of particular practical exercises. Through the vault file the instructors are to pass on to others the needed content, allocation of time, and instructional methods.

The vault file is organized into blocks of instruction (averaging about 12 hours per block), with practice problems, needed references, facilities, safety practices, and available handouts. The instructional activities for each block are described in a lesson plan. The lesson plan is an elaboration of the program of instruction (POI) as approved by CONARC. Senior instructors are assigned the duty of writing lesson plans and keeping them current. Each lesson plan must be approved by LAAD Department and reviewed once a year. No Systems Engineering (as described in CON Reg 350-100-1) is required for this instruction, although the suggestions made herein are entirely compatible with that regulation.

An instructor's comment sheet provides feedback on how the lesson plan works in practice. Such comments must be answered and appropriate adjustments made within 24 hours. Virtually every observed comment was concerned with the technical accuracy of the facts in the lesson plan; rarely, if ever, were any comments concerned with the effectiveness of the training activities, although the comment sheet clearly is intended for both kinds of comments.

The general import of these features is that the lesson plans (and associated resources) are designed somewhat apart from practice, and are rather impervious to further practical experience. The suggested changes would sharply abbreviate the original lesson plans, which would gain substance from instructor feedback when used with classes.

We analyzed all practical exercises taught by Continuous Wave Radar (CW) Division for MOS 24B20, in order to determine the time allocated

to various activities (Table 1). Almost all the time is given to a few kinds of activity. Each kind has distinguishing features which suggest an effective approach to training.

### Introduction and Closing

The "bridging" functions, including introduction, review, summary and closing, take a total of 3.1% of the time (571 minutes). The lesson plans provide word-for-word examples of introductory and closing statements. These statements are uniformly stilted and uninformative; they are merely an elaborate way of stating the title of the block. They could be eliminated without apparent loss, thereby saving both reader and writer a tedious chore. It seems these statements have become an empty formalism; as such, they would tend to reduce motivation of both instructor and student by acting as an obstacle in teaching or learning the needed skills.

Sometimes a good, informative introduction or closing can be found; then it should be suggested in the lesson plan. For instance, one instructor said he introduced the AFCC display system by turning on the equipment and describing where the several indications came from and what they meant. This seems a good, concrete way to introduce these fundamental aspects, and should be suggested in the lesson plan if it proves to be effective in the exercises. The instructor can test its effectiveness by asking probing questions during and after the presentation.

As for relating the current exercise to the rest of the POI, perhaps this could be done more effectively and more quickly by giving each student a printed course outline in addition to his weekly schedule (which

TABLE I. TIME DISTRIBUTION OF PRACTICAL EXERCISE INSTRUCTION  
for MOS 24B20

	Type of Activity										
	Introduction, Review	Summary, Closing	Block Diagram	Functional Diagram	Block Diagram & Functional Diagram	Checks and Adjustments	Fault Isolation Procedures	Trouble Shooting	Examination	Other <sup>2/</sup>	TOTAL
minutes <sup>1/</sup>	174	397	801	1810	620	3125	1620	7093	2160	515	12315
percent	0.9%	2.2%	4.4%	9.9%	3.4%	17.1%	8.8%	38.7%	11.8%	2.8%	100.0%

<sup>1/</sup> 45 minutes = one class period.

<sup>2/</sup> "Other" includes some explanations of administrative business, explanations of certain conceptually difficult sub-systems, and physical maintenance forms and procedures.

is all the information he gets now on course components). An effective course outline could be copied directly from the annexes in the POI.

Recommendations on the introduction and closing:

- (1) that the formal statements be eliminated;
- (2) that the behavioral objectives be retained;
- (3) that a course outline be extracted from the POI for a student handout;
- (4) that time allocated for these functions remain as stated, but only as a general guideline (with no prejudice for omission, even during evaluation);
- (5) that specific introductory and summary treatments be suggested wherever they prove to be effective with classes.

#### Block Diagrams and Functional Diagrams

Using block diagrams to explain the system takes 4.4% of the time (801 minutes). This generally comes right after the unit is introduced. The intent, presumably, is to impart an "understanding" of the system (i.e., identifying the sub-systems, their functions and inter-relations). However, most block diagrams seem more likely to confuse than to clarify. The block diagrams are not used in checks, adjustments, or in fault isolation procedures, and several instructors commented that they never use block diagrams on the job.

In using block diagrams, not only are the behavioral objectives somewhat vague, but there is a corresponding vagueness about how the instructor is supposed to use them. The lesson plan typically lists

the blocks to be considered, but gives no guidance on how the material should be presented. Should the instructor describe the indications of a fault in each block? For each block, should he point out the corresponding parts on the actual equipment? These are critical questions of instructional strategy which are scarcely approached in the lesson plans.

Such specific and detailed guidance on training strategy probably would require too much development to describe effectively in each lesson plan. Instead, it is suggested that there be developed a general strategy which resolves questions like those listed above, with significant variations for particular circumstances. For instance, if a given block diagram is particularly confusing, it would be better to skip it altogether. The general instructional strategy and variations should be based upon apparent effectiveness with classes; that is, the trainees should be able to answer searching questions as a result of the presentation. Until such experience with classes is considered, it is probably better to allow each instructor to use his discretion in selecting a strategy for each lesson, and to encourage him to feed back his experience into the system via written suggestions.

In developing new courses, the generalized strategies would provide needed specificity in the systems engineering process (CON Reg 350-100-1). On the Training Analysis Information Sheets (TAIS), column d is for "METHODS OF INSTRUCTION" which currently is used for specifying PE or C (for conference). If the proposed strategies were developed, then the method might be designated by "PE, bd 3," referring to an established strategy for discussing block diagrams of that particular sort. Similarly, particular strategies could be specified for the other components of the blocks, as discussed in the next sections.

Discussing functional diagrams, separate from fault isolation, takes 9.9% of the time (1810 minutes). This generally comes right after discussion of block diagrams. Another 3.4% of the time (620 minutes) is spent discussing block diagrams and functional diagrams together (in these blocks there is no separate discussion of each kind of diagram). As in the case of block diagrams, it is unclear how this instruction is related to the behavioral objectives. The functional diagrams are used in fault isolation, but in a much different way. Both kinds of diagrams yield similar problems in establishing instructional strategies. Functional diagrams do correspond to the physical system in some respects, but generally, it is unclear from the lesson plan whether knowing the correspondence is one of the objectives.

Sometimes there will be a more effective alternative to the block diagram for developing "understanding" of the system, perhaps using visual media. This would be consonant with the CON Reg 350-100-1 guideline on promoting new media (the so-called "supporting strategies") in the introduction and presentation. The presentation would have to be carefully sequenced because the relationships are generally complex. A promising approach is the "progressive differentiation" strategy, a whole-to-part presentation in which the analysis is so gradual and well illustrated that everything is understood as it is presented. The presentation also needs thorough validation with classes; an effective presentation would enable trainees to answer relevant questions immediately. Perhaps HumRRO could work cooperatively with LAAD in exploratory development of this sort, although thorough development would be beyond the scope of this effort.

Another issue in "understanding" the diagrams is knowing the standard components and their symbols. Certainly the trainee can use the functional diagrams more easily if he knows some of the standard components, their electrical functions, their symbols, and general appearance. It is sometimes most efficient to identify these elements, organize them logically, and teach them first as enabling skills. Currently 59 hours of basic electricity are given for this purpose. But if the "basic electricity" is not developed from a systematic analysis of the functional diagrams, there seems little chance that the content would be on target.

Recommendations:

- (1) That the time allocated for covering block diagrams and functional diagrams remain as stated, but only as a general guideline (no prejudice if an instructor omits one entirely).
- (2) That general instructional strategies for using block diagrams and functional diagrams be developed, based upon experience in teaching classes, with variations for particular situations.
- (3) That alternatives to block diagrams be explored for imparting "understanding" of Hawk sub-systems, for selected promising areas.
- (4) That the functional diagrams be analyzed for commonly occurring components, and that the resultant list be used to check the relevance of content in the basic electricity course.

## Checks and Adjustments, Fault Isolation

Demonstration and practice of the checks and adjustments takes 17.1% of the time (3125 minutes). Demonstration and practice of fault isolation procedures (including "troubleshooting") takes 47.6% of the time (8713 minutes). These activities are clearly and directly related to the behavioral objectives, and constitute the bulk of the instruction. Any substantial improvements in training methods for these sections would be important for the course. Generally, checks and adjustments are followed by fault isolation, and these are the last activities in each block.

The lesson plans usually give the instructor only very general guidance. The instructor demonstrates the procedures as he explains various points which are needed but which the student is unlikely to know before instruction. For example, a boxed-in area on a functional diagram means an actual, physical chassis or other unit; the title of that box (in the upper left-hand corner) is the clue as to where to find it on the equipment. We shall use the term "system-specific information" to describe such conventions. If the student misses any of these points, or if he forgets one, he is likely to be lost at that point in his practice, wasting considerable time before he can get back on the track.

Instructors generally are well aware of most needed system-specific information, but there are many such items, so the instructors are likely to forget to mention some of them unless they have some kind of explicit reminder. It is suggested that these steps be listed in sequence both

for checks and adjustments and for fault isolation procedures. Examples for the power distribution system, AFCC are given in Appendix A.

Such a list of system-specific items probably could be drafted quickly by almost any experienced instructor by reviewing what he does in class. But initially an experienced interviewer probably would have to elicit the desired information, until the instructor developed a firm idea of what is needed.

The instructors usually have many handwritten notes in their technical manuals (TMs); these notes are the main written vehicle for guiding their conduct of a class. It is suggested that the instructors enter the needed system-specific information in their TMs, perhaps written in a distinctive color to distinguish it from other notes.

Some of the system-specific information in the fault isolation procedures is likely to be forgotten after the demonstration. It is suggested that printed procedural guides be developed as student handouts to ensure effective practice without the instructor, when he is busy working with other students on the equipment. Practice activities also should be specified (see Appendix B).

To be effective, the fault isolation guides and problems need to be used with simulation of some kind. The best would be real equipment, but turned off to ensure safety. Photographic mock-ups may have to be developed for some blocks. At other times the equipment may be pictured with blow-ups of the chassis and other components involved. The critical thing is to provide for effective visualization of the equipment at the appropriate times. In using the simulation, trainees would be told

particular trouble indications; they would then follow the fault isolation procedures down to getting the readings, and would describe what they would do on the basis of their readings. We can test for effectiveness of simulation during practice by asking a student to locate corresponding points on the real equipment. If he locates the critical points without hesitation or fumbling, then sufficient fidelity has been provided to ensure transfer of skill to the real equipment.

The techniques should be tried on a small scale first, to evaluate their effectiveness in practice and to develop better methods of applying them. It is suggested that the prototype materials for the AFCC be applied first. This is a rather simple block, and it comes early in the course when the trainees have most to learn about the conventions in the manuals. HumRRO would conduct a one-hour orientation for a primary instructor and associated instructors who are about to teach this unit, perhaps with the participation of other LAAD Department personnel. Then the materials would be validated while instructing this unit. After conducting the demonstration, the primary instructor would help validate the fault isolation guides with the simulated equipment, while each of the other instructors supervise successive pairs of students on the live equipment. During this validation, the primary instructor would be observing detailed performance of the students, getting such clues as hesitations, errors, and questions, in order to revise the guidance materials. Such observation also seems to be the best orientation on how to use the materials in their instruction. The primary instructor's status should facilitate adoption of the techniques

by the other instructors. The other instructors will also be questioned about the students' facility with the real equipment, and any shortcomings will be noted. If the initial application proves to be effective, then LAAD Department may decide to apply the methods on a broader scale.

Later, peer instructors (taken from advanced classes) could be used along with the printed performance guides. Peer instruction has been found to be extremely effective in other courses (10), but the method needs to be adapted and validated for the more complex skills of electronic maintenance. Implementing peer instruction is considerably beyond the scope of the present research project, although there is a common performance-based methodology, and many of the recommendations would lay the foundation for a peer instruction system. Perhaps one peer instructor could be provided for each pair of students. His responsibility would be to ensure that his students would not be lost and fumbling for extended periods of time; whenever the students were stuck, he would guide them to the next step in the procedure. Peer instructors would be more readily available if a learn-to-mastery system were adopted, as described in the next section.

Recommendations for conducting demonstrations and practice of checks, adjustments, and fault isolation:

- (1) That the prototype guides for students and the points-to-cover list for instructors be tried and validated with students in practical exercises.

- (2) That the method be applied on a broader scale if it proves to be effective in the initial trial.
- (3) That student tutors be considered later as a means of ensuring effective practice conditions.

### Examinations

Conducting examinations takes 11.8% of the time (2160 minutes). Each examination requires either four or eight hours, and covers a few blocks of instruction. All examinations are hands-on performance evaluations. They faithfully reflect the terminal objectives, and should be an effective measure of student skill if administered appropriately. An instructor is not allowed to test his own students, in order to minimize the chance of bias in testing.

However, the tests could be used more effectively to promote learning if the system were modified so that trainees learn to a mastery criterion. This would also save considerable time for the student. The testing methods would remain generally the same, but the content would be divided according to blocks of instruction. Then each trainee would be permitted to take the test on any particular block as soon as he and his instructor both feel he is ready for it.

The change is recommended in order to save considerable time and to improve performance. Currently, most of the examination time is sheer waste as the students wait their turn to be tested. If a student makes a few mistakes, the staff faces a very awkward decision: whether to let him go on anyway, or whether to send him back (thus disrupting scheduling

for the whole class). The decision to return a man to the preceding block is not to be taken lightly, so men are likely to be passed with dubious levels of skill. With a learn-to-mastery system, the standards of performance could be raised considerably, perhaps from the current 70% to a 90% minimum, because the consequences of returning a man to training are not nearly so severe.

A mastery-criterion testing system is most responsive to CON Reg 350-100-1. It specifies (on page 40) a criterion test, primarily "to determine whether the student has attained the training objectives." Clearly, "attained" means something close to mastery, and testing is a pointless exercise if there is no practical option when the criterion is not attained.

Since three or four instructors conduct practical exercises concurrently, students from one group could be tested by an instructor from another. The testing would not have to be available continuously, but could be scheduled periodically. The time saved could be used various ways: helping other students, attacking more difficult problems, or previewing the next unit. The advanced trainees may even be able to join more advanced classes if scheduling problems can be solved. The essential thing is to have early achievement rewarding, not aversive.

**Recommendation:**

- (1) That a learning-to-mastery-criterion system be developed from the current test content.

## Instructor Development and Utilization

### Staff Composition

There are 16 civilian instructors and 13 enlisted instructors in the CW Division. None of the enlisted men are first tour men, and all have had field experience. The civilians tend to be relatively senior as instructors because instruction is their career field. The military instructors tend to stay only about a year, on the average, making it incumbent upon LAAD Department to develop them rapidly. However, many instructors have repeated tours as instructors in LAAD, which contributes some degree of continuity to the training.

### Training

All of the civilians and enlisted instructors have successfully completed the two-week Instructor's Training Course (ITC) given by the Department of Instruction (DOI) which is required for teaching conference classes (but not for PE classes). This requirement unintentionally throws emphasis upon the public speaking skills characteristic of conference instruction, at the expense of the special skills which characterize PE instruction, for several reasons. First, although the ITC credits practice with either conference or PE instruction, the participants almost invariably choose conference instruction because it can be practiced without any real students, and hence is much easier to practice in the formal course. Second, only conference instruction has a formal course requirement and it tends to be assigned to the most experienced people; the implication is that it requires greater skill and will be

more highly rewarded, and this is probably apparent to every instructor. Finally, there is no good model for PE instruction comparable to the public speaking model of conference presentation. The particular skills of PE instruction need clarification and emphasis.

### The PE Instructor Model

An effective PE instructor is skilled in managing his group's practice activities, including use of the training methods suggested in this report. First, he insures that all of the students are using their time effectively, not just those on the equipment at the moment. This will entail effective use of the procedural guides and simulation. Second, once he begins explaining a procedure, he goes straight through to the end of that response chain; he does not take needless detours through block diagrams and nice-to-know information. It should be abundantly clear at all times how the activity fits into the job. Third, in the demonstration, he gets as much student participation as he can; he has the student take the next step whenever possible, and he takes time to point out the cue for each step. Fourth, he interacts with the student to diagnose his problems whenever he seems unable to continue. Finally, he analyzes his student's problems so as to contribute effective suggestions on developing and improving the training methods and materials. He can do this most effectively through written comments. The instructor's comment sheet is supposed to serve this function, but it is not being used this way. Perhaps instructors would use the comment sheet to note instructional strategies if they were

encouraged or directed to do so. Or perhaps we need another kind of comment sheet, on which the suggestions are justified, not on the basis of technical accuracy, but on the basis of instructional effectiveness.

In PE instruction, the important functions involve interaction with students. These interactions cannot be practiced in the traditional ITC. Appropriate preparation would include a brief workshop closely coordinated with early supervised experience in conducting practical exercises, leading to full qualification as a PE instructor. But first, the functions and strategies of PE instruction should be better developed.

Recommendations:

- (1) That the characteristics of effective practical exercise instruction be further articulated as the other recommendations are implemented.
- (2) As various instructional strategies are found to be effective in practice, they be incorporated in a practical exercise instructor's workshop which would then be required for qualification as a PE instructor. The workshop would be coordinated with supervised practice instruction.
- (3) That instructors be encouraged to report students' problems with the materials and procedures and to suggest improvements.

Instructor Innovations

A viable instructional system requires that instructors have considerable freedom to try new approaches, and realistically, their

performance cannot be rigidly controlled. Everything they do should make sense to them. The suggested practices assume that each instructor, once qualified, is free to make any responsible change he wishes in the method of instruction. A responsible change is introduced for a reason, and the instructor should note the results of the change with his classes. By passing on the results of his experience, he uses teamwork for continuous course improvement.

### Supervision

The instructors are divided into two teams, each with a team leader. A group of about four instructors are assigned to teach a class for a period of time. The senior man, called the primary instructor, gives all conference presentations.

To teach any particular block of instruction or piece of equipment, an instructor undergoes a qualification procedure (this is an ideal which sometimes may be compromised in practice). For two weeks he prepares by studying all relevant material available and by talking to other instructors. Then he presents a one hour class (dry run) for a senior instructor. When his dry run performance is approved, he presents it to a class while being observed by his team leader, who may then qualify him for teaching the unit.

This qualification procedure seems appropriate for content. Skill with PE instructional methods could also be developed, as suggested in the previous section, if the first supervised teaching experience were supplemented accordingly.

## Assignment

PE instructors are assigned to blocks of instruction based upon their qualifications and scheduling considerations. They usually teach a particular group within a class for short blocks (e.g., 14 hours PE on the Power Distribution System of the CWAR), although sometimes scheduling difficulties lead to changing instructors during the block. Most instructors are qualified for a wide variety of blocks, and seldom do they teach a particular unit repeatedly in a short period.

On an experimental basis some instructors are staying with one group the entire fifteen weeks. This has the advantage of the instructor seeing the cumulative effects of his efforts, and he can get to know his students. But such closeness might become monotonous or even trying, and trainees having a less proficient instructor might suffer a serious cumulative disadvantage. It is too early to evaluate the effectiveness of the practice.

It is desirable for an instructor to teach repeatedly a particular block or series of blocks so that he can continuously improve his performance by observing the particular difficulties his students are having on that block. In a sense, he would become a specialist on teaching that series. Yet overspecialization may be detrimental to his general proficiency on the system. A suggested compromise would divide the program into blocks or short sequences of blocks, and have an instructor repeat a sequence with several classes (perhaps four or five repetitions); then subsequent assignments would be made to maximize the breadth of experience. Such a procedure would also reduce the burden

of qualifying short-tour instructors. Replacements should be phased so as to provide continuity in a team (about four instructors).

Recommendation:

- (1) That instructors teach a particular sequence repeatedly on a trial basis, beginning with the sequences in which the other suggestions are first implemented.

Incentives, Monitoring and Evaluation

Each instructor is monitored for one period at least quarterly. Once a year a monitor/evaluator from DOI observes one class period and evaluates the presentation of primary instructors; the instructors on the lab stations may never be evaluated outside the Division. The other evaluations are by an evaluator within the Division.

The sum of ratings are the most important source of information for the supervisors to write each instructor's efficiency report, which in turn, determines his promotion or dismissal. This is the system's most direct influence on his motivation.

The Division uses Monitor Report Form (1474) on which the evaluator merely identifies the class, instructor, and his supervisor; most of the page is open for "Remarks," and there is an overall evaluation grade. This open-ended form seems most appropriate since effort is minimal, and the evaluation is not forced into artificial dimensions. The rater has at least the opportunity of making the comments relevant to critical behavior. For example, one comment criticized an instructor for spending a long period of time guiding fault isolation for only one pair of students while ignoring the others. As an appropriate model of the PE

instructor becomes better articulated, these ratings could become progressively more specific and accurate. For instance, the ratings should take into account any useful suggestions by an instructor on how the course could be taught more effectively; this would be a strong incentive to pass on the results of his experience.

The DOI and LAAD Department evaluations, on the other hand, use a structured rating form, Form 303a (USAADS). Although this form is supposed to be adapted for practical exercise instruction, most of the items still emphasize the public speaking skills of conference presentation. Of the 575 possible points, about 375 apply equally well to conference presentation. The major function of practical exercises is to induce student behaviors that are readily observable, in contrast with conference instruction; these readily observable behaviors could and should be reflected in the rating forms. Significantly, in the conversion to the PE rating form, all mention of behavioral objectives was dropped.

Recommendation:

- (1) That the use of Form 303a (USAADS) for rating PE Instructors be discontinued. The open-ended Form (1474) would be more effective. Perhaps an effective structured rating form can be developed as the instructor model becomes better articulated.

Printing Facilities

Instructional materials are routinely reproduced at Field Printing which typically requires two months. On occasion the instructors

have used local duplication, which may take a day or so, or even less in an emergency. The fast service is critical to effective instruction, especially with the proposed instructional techniques which rely upon printed materials and continuous adjustment based upon actual experience with classes.

Recommendation:

- (1) That fast printing service be made available to the instructors.

### Implementation and Evaluation

There are roughly three phases for implementing those recommendations which are accepted.

#### Phase I

The performance guides for fault isolation, checks and adjustments, designed for use with some form of simulation, offer the greatest potential for improving instruction and will require the longest development time. First, a group of instructors who see the possibilities in the techniques must be identified. It is desirable that this group be assigned to repeatedly teach the AFCC block for which prototype materials are available (LA4.24116). During the one-hour orientation their suggestions could be incorporated in the materials. Then repeated trials with classes could provide for revisions, improved methods for other developments, and preliminary evaluation.

In the evaluation, the first, most direct evidence is whether the materials keep the trainees busy with relevant activities with minimal

help from the instructor. As the trainee finds reference points on the simulation, he also may be asked to find the corresponding points on the real equipment, indicating that the simulation is adequate for effective visualization. This may be taken for granted when the real equipment (turned off) is used, but is much more tenuous if the simulation is a two-dimensional photographic display.

When the trainees get their turn with their regular instructor on the real equipment, the instructor may be asked to rate their proficiency with the procedures. These impressions are likely to be especially influential with other instructors. Such ratings may yield objective comparisons if the instructors are not told which trainees have had the special procedural training.

Finally, we may note the impact of the training upon the routine performance tests. For many blocks, and particularly, for the AFCC Power Distribution System, the test is so remote from practice that any effects are likely to be thoroughly attenuated. But if a learning-to-mastery-criterion system were adopted, the tests would be considerably more sensitive to training effects.

Another first step, along with tryouts of the performance guides, is to gather baseline data for later assessment of total programs. Grades on tests provide a general indication, but the specific problems used are not kept for long, so comparisons are somewhat suspect because we can not determine whether comparable problems were used. When LAAD Department has no further use for these test problems, it is suggested that they be given to HumRRO for establishing a baseline on particular problems for later comparisons.

## Phase II

If LAAD Department views the results of Phase I as encouraging, comparable guidance materials can be developed for other parts of the program. The simulation can be extended to systems requiring more reliance on pictures. Further validation and evaluation studies will need to be run, using methods like those used in Phase I. More effective methods should be developed for getting instructor comments on the training activities.

It would be desirable also if a learning-to-mastery-criterion system of examinations could be adopted by this time. Instructors may explore the feasibility of general teaching strategies for presenting block diagrams, with HumRRO facilitating when possible. There also should be consideration of alternatives to the diagrams for imparting needed concepts, including audio-visual presentations.

## Phase III

Finally, pending success in previous efforts, the developments should be extended to all of the POI. An appropriate workshop for qualifying new PE instructors could be implemented. Evaluation of total effectiveness would be made.

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9. Grimsley, D. L. Acquisition, Retention, and Retraining: Training Category IV Personnel with Low Fidelity Devices, Technical Report 69-12, Human Resources Research Organization, Alexandria, Virginia, June 1969. (c)
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APPENDIX A

INSTRUCTOR POINTS TO COVER

1. Fault Isolation Procedures
2. Checks and Adjustments

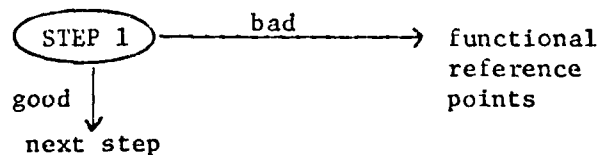
## AFCC Power Distribution System

### Points to cover in demonstrating Fault Isolation Procedures

INSTRUCTOR: Note these steps in you 12/3 manual, using a distinctive color pen or pencil. If you should skip any of these steps, later some of your students are likely to be lost and floundering. Take plenty of time and watch to see that every student follows every step. If you find critical steps that are not on the list, note it on the Instructor Comment Sheet. Let's get reliable performance from every class!

1. Hand out Fault Isolation Guides, and have students follow them as you demonstrate.
2. Table 2, page 28.2. Note: you might get here either from checks and adjustments or from being told there is a fault in the AFCC.
3. Step 1. Any bad reading sends you to Table 3 (cue in parenthesis).
4. Table 3

The system is:



5. Skip column 2--it refers to block diagram, and normally isn't used in actual fault isolation. Have them draw a light line down through column 2.
6. Start tracing functional reference points: everyone go to Figure 20.
7. Figure 20. First find zone C3, like a map (some students won't know this, at first). Then find Console Power CB1.
8. Note that boxed in part is a real, physical part of the system. Use title "Power Distribution Panel" to locate it on the equipment.
9. Bring in Locational View Diagram. Note reference in parenthesis is out of date, should be Figure 47.
10. Show where probes would go on equipment, CB1. Ask what reading to expect, and why. (416 VAC)  
If they don't get it, what then?  
If they do get it, what then?

AFCC Power Distribution System

11. Now that first series is complete, have students correct all the outdated references for the power distribution system, as follows:

	ZONE	CROSS OUT	WRITE IN
a. page 59:	A4	<del>34</del>	47
b. page 60:	A2	<del>35</del>	48
c. page 61:	A10	<del>35</del>	48
d. page 62:	A1	<del>35</del>	48
e. page 63:	A8	<del>34</del>	47
f.	A12	<del>28</del>	42
g. page 66:	A2	<del>29</del>	43
h. page 67:	A8	<del>34</del>	47
i. page 69:	B15	<del>28</del>	42
j. page 70:	A1	<del>29</del>	43
k.	A4	<del>34</del>	47
l.	C6	<del>28</del>	42

Then return to Table 3, page 28.3.

12. Table 3. Similarly trace out second reference point and show how it divides the system into sections.
13. Table 3, step 5. Note to students that both readings (+250 and +100) have to be bad to indicate trouble in this circuit. If only one is bad, they go on to steps 6 and 7.

## AFCC Power Distribution System

### Points to cover in demonstrating Checks and Adjustments

INSTRUCTOR: Note these steps in your 12/2 manual, using a distinctive color pen or pencil. If you should skip any of these steps, later some of your students will be lost or floundering. Take plenty of time and watch to see that every student follows every step. If you find critical points that are not on the list, note them on the Instructor Comment Sheet.

1. Note significance of Grey and White areas (dailies and weeklies).
2. Starting Table 2-6, p. 2-4, the "note" is the first thing to do, so go to Table 2-2, and demonstrate these preparatory steps.
3. Step 1a. can't be done in training because power is supplied from another source.

Continue routine demonstration, making special note of the following points:

4. Step 2. Illustrate what 1/3 of the meter scale means.
5. Step 3. Also what "indicates the center line" means. A good working definition, for dailies, is to have no white space between needle and mark. For weeklies, should be able to adjust needle to either side of mark, and then should center needle.
6. After first demonstration, repeat demonstration more smoothly.

APPENDIX B

STUDENT HANDOUTS

1. Practice Activity Fault Isolation
2. Fault Isolation Procedures Guide

STUDENT HANDOUT  
AFCC Power Distribution System

Practice activity with Fault Isolation Procedures

Two students will work together while waiting their turn with the instructor on the live equipment. Using the 12/3 manual, Table 3 (p. 28.3), the first student will perform Step 1 while his partner checks him. Your Fault Isolation Guide sheet will help you. Presuming that the blower is not operating, trace each of the functional reference points through the functional diagrams to the real equipment (turned off for safety). At each point, show where to place test probes on the equipment, what reading you would expect, and what you would do if you got it, or didn't get it. Then the second man will do the same on the second step (+28V) presuming the first step was good and the second gave a bad reading. Work your way through all seven steps of Table 3, taking turns at each step.

# FAULT ISOLATION PROCEDURES GUIDE

## AFCC POWER DISTRIBUTION SYSTEM

TM 9-1430-505-12/3  
Table 2  
Abbreviated fault isolation procedures  
Step 1. Power Distribution System  
A "bad" reading sends you to Table 3  
*page 28.2*

Table 3  
Power Distribution System Fault Isolation Procedures  
perform each check in sequence  
BAD → go to functional reference points on schematics, *Figures 20-24.*  
GOOD ↓ continue checks  
*page 28.3*

FUNCTIONAL DIAGRAM:  
one of  
Figures 20-24  
Title of block  
Locate functional reference points on diagram; decide which will give useful input or output reading.  
*pages 59-70*

Schematic symbols defined:  
TM 9-1430-505-12/3, p. 75  
TM 9-1430-505-20, pp. 4 & 5

### Actual AFCC equipment:

1. Find reference points. To do this you must know:  
power distribution panel, unregulated power supply -- in lower right drawer  
regulated power supply (positive) ----- in lower center drawer  
monitor panel, regulated power supply (negative) ---- in lower left drawer
2. If you can't find the component, refer to Locational View Diagrams.
3. Take readings and interpret them.

Expected values are from Functional Diagram

Locational View Diagrams

Schematic symbols defined:

TM 9-1430-505-12/3, p. 75

TM 9-1430-505-20, pp. 4 & 5

Actual AFCC equipment:

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3. Take readings and interpret them.

Expected values are from Functional Diagram

Locational View Diagrams

TM 9-1430-505-20, pp. 65-71

NOTE: Logic behind checks is illustrated in

TM 9-1430-505-12/3, Figure 7.2