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16. Abstract

This document describes the results of a research effort undertaken to detail the tasks of freight train conductors and brakemen. Included with text are detailed operational sequence diagrams for both conductor and brakeman. This task analysis is subsequent to a similar study conducted by McDonnell Douglas describing the tasks of freight train engineers.

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PREFACE

This report identifies and describes the principal tasks performed by conductors, rear brakemen, and head brakemen during over-the-road freight operations utilizing diesel-electric locomotive equipment. Forty-four tasks and subtasks were analyzed and grouped into six categories: basic handling tasks, pre-run preparation and starting off tasks, over the road tasks, terminating tasks, operating emergency and malfunction tasks, and auxiliary equipment operating tasks.

Each task or subtask is described from a system's perspective. The descriptions depict the tasks' initiating stimuli, the information processing and decision making, the response made by the operator and the feedback received. The tasks are also analyzed to determine task difficulty, potential hazards and the criticality of each task. The task descriptions are translated into operational sequence diagrams with additional information given concerning the decisions depicted on each operational sequence diagram.

An annotated bibliography of selected literature dealing with job analysis is presented as an appendix. Illustrations of common train documents filled out by the conductor are also included.

Recommendations are made in the area of improving the safety of train operations.

This study was performed in support of Project PPA RR 309, Department of Transportation, Transportation Systems Center (TSC). The technical assistance of Dr. Donald B. Devoe of TSC is gratefully acknowledged.

We wish to thank the Illinois Central Railroad, the Chicago, Rock Island, and Pacific Railroad, and the Atchison, Topeka, and Santa Fe Railway Company for allowing us to interview their employees and observe their operations. The crew members to whom we talked were extremely cooperative and patient with us. The information we received was invaluable. Special thanks goes to Mr. Floyd Adkins and Mr. Nealon Young of the Atchison, Topeka, and Santa Fe Railway Company for their assistance in clarifying much of the information gathered.

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1. INTRODUCTION

This report describes the principal tasks performed by conductors, rear brakemen, and head brakemen during over-the-road freight operations utilizing diesel-electric locomotive equipment. The format of this report is patterned after that used in FRA-OPP-73-2, Railroad Engineman Task and Skill Study (August, 1972). Task descriptions are presented in a systems perspective (i.e., input--throughput--output--feedback). The descriptions depict the tasks' initiating stimuli, the information processing and decision making, the response made by the operator, and the feedback received. The tasks are also analyzed to determine task difficulty, the potential hazards associated with each task, and the criticality of each task.

In addition to the task descriptions, an operational sequence diagram has been prepared for each task. Additional information is given concerning the information required to make the decisions depicted on each operational sequence diagram.

Two appendices are included. First, samples and descriptions of the most common forms used by conductors to document activities during an operation are included. Second, an annotated bibliography of references dealing with task analysis is included.

This report will supply required data to support continued research in the area of improved safety of train operations. From the task data, training requirements, selection criteria, and performance evaluation measures can be ascertained.

1.1. Task Analysis Data

The information used to assemble this report came from three major sources. First, a review of source data such as operating manuals, handbooks, and railroad rules and regulations was made. In addition, on-the-job observational interviews were conducted. A total of twelve shifts or trips was observed. On four of these trips, two observers were present, one riding in the caboose and the other in the locomotive. On the remaining trips a single observer was present. Lastly, off-the-job interviews with two conductors and two brakemen were conducted in an effort to clarify and amplify the observations previously made.

The principal tasks of the conductor and brakemen were summarized by task groupings. These groupings are:

A. Basic Handling Tasks

B. Pre-run Preparation and Starting Off Tasks

C. Over-the-Road Tasks

D. Terminating Tasks

E. Operating Emergency and Malfunction Tasks

F. Auxiliary Equipment Operating Tasks

The format for presentation of the task descriptions is shown in Figure 1. This is essentially the format used in the Engineman Task and Skill Study (FRA-OPP-73-2). Analysis and assessment of task difficulty, potential hazards, and task criticality were performed for each task and are recorded on the data sheets. The classification systems used are identical to those used in FRA-OPP-73-2. It was felt that this would ease integration and comparison of the present study

TASK NO.
SUB-TASK NO.

TASK TITLE
SUB-TASK TITLE

DIFFICULTY
HAZARD
CRITICALITY
DURATION
FREQUENCY

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		

FIGURE 1. TASK ANALYSIS SHEET USED TO SUMMARIZE EACH TASK AND/OR SUBTASK

with the results for the engineman in FRA-OPP-73-2. The scales are reproduced below so that reference to FRA-OPP-73-2 is not required.

1.1.1. Task Difficulty.

A quantitative difficulty index was assigned to each task or subtask. A five point scale from least difficult (1) to most difficult (5) was selected. The definitions for the five points on the scale are as follows:

CODE	DEFINITION
1	A task that only requires the operator to recognize devices, determine go/no-go situations, understand non-precision indications, recall limited information, distinguish primary colors, perform menial or simple tasks, or perform gross motions to achieve acceptable results.
2	A task that includes requirements to recognize and understand the purpose and principles of operation of devices and systems, make non-precise determinations, recall pertinent information, recognize shades of color, or to perform tasks requiring some planning and manual dexterity to achieve acceptable results.
3	A task that includes requirements to troubleshoot at a gross level, perform non-technical repairs (e.g., change a fuse), or to perform such tasks as checking, inspecting, installing, and removing; requires knowledge and skill necessary to detect differences of weights and relative motions, or to perform accurate, coordinated and timely motion to achieve results.
4	A task that requires the operation of devices, systems, subsystems, or components, or requires complete system troubleshooting; requires accomplishing detailed procedures, making accurate measurements, or operating devices in an accurate, coordinated and timely manner for desired results.
5	A task, activity, function, or operation that requires repeated experience in the operation of devices, systems, subsystems, components, and associated equipment; requires extensive recall, understanding, precise knowledge, or correlation, computing, organizing, or controlling

hazardous situations or situations affecting the run timetable. May also require making precise, critical, and coordinated movements that are necessary for desired results.

1.1.2. Task Hazards

Rather than using a quantitative scale, hazards are evaluated by generic type. In assessing hazards, it is our opinion that the proper question to ask is:

> "Does the performance of the task, per se, expose the engineman to any set of conditions which could cause bodily harm?"

This approach is more germane to the problem of task hazards than attempting to assess whether or not improper execution of the task will result in a hazardous situation. The latter is better treated under the classification of task criticality. An alphabetical categorization of task hazards was utilized. A hazard listing is as follows:

A. Exposure to high voltages (e.g., electric shock or burn)

B. Exposure to body or appendages to high impact forces (e.g., collisions).

C. Exposure to excessive accelerations and decelerations.

D. Exposure to excessive acoustical noise.

E. Exposure to falling objects (e.g., derailment)

F. Slippery or dangerous footing

G. Impaired visibility

H. Exposure to fire or explosion

I. No hazard involved

1.1.3 Task Criticality

A quantitative criticality rating was assigned to each task or subtask. A five point scale is utilized, from least critical (1) to most critical (5). Criticality is assessed within the context of impact upon successful completion of the assigned run. The definitions of the five points on the criticality scale are as follows:

CODE	DEFINITION
1	Failure to perform task or improper performance will not impair the successful completion of the run or expose either equipment or personnel to a hazardous situation.
2	Failure to perform or improper performance may cause run completion to be behind schedule but not so as to result in damaged cargo or may result in a situation which is in itself not potentially hazardous but which if improperly handled will lead to a hazardous situation (i.e., "ripple through" effect).
3	Failure to perform or improper performance will result in minor damage to railway equipment (i.e., repairable in field) or will place the train in a situation requiring precise and rapid corrective action in order to prevent major damage.
4	Failure to perform or improper performance will result in major equipment damage requiring repair at central shop facilities or will result in significant cargo damage (e.g., loss of a percentage of the load) or in minor injuries to operating personnel.
5	Failure to perform or improper performance will result in a catastrophic situation involving major equipment damage, major cargo loss or damage, major injuries or death or significant disruption or destruction of by-standing personnel or property.

The following table summarizes the difficulty, hazard, and criticality evaluations given each task and/or subtask. The same information is contained on each particular task description sheet.

GROUP	TASK	SUBTASK		DIFFICULTY	HAZARD	CRITICALITY
A	1	1	Initiate hand, flag, or lamp signals	2	-	3-5
A	1	2	Relay hand, flag, or lamp signals	2	-	3-5
A	2		Align switches	1	-	5
A	3	1	Engage Knuckles	2	BF	2
A	3	2	Connect Air Hoses	2	BF	2
A	4		Uncouple Cars	1	BF D	2
A	5		Set or Release Hand Brakes	1	F	4
A	6		Set Brake Retainers	1	-	2
A	7		Bleed Air Tanks	1	-	1
A	8		Monitor Radio	1	-	1-5
B	1		Register on Duty	1-2	-	1-2
B	2		Connect Power Consist to Train	1-2	-	1-2
B	3		Pre-Trip Inspection	2	-	2-4
B	4		Move to Main Track	1-2	F	2,5
B	5		Determine Length of Train	1	-	1
C	1		Register at Intermediate Station	1	-	5
C	1	1	Inspect Own Train	3	G	3-4
C	1	2	Inspect Passing Trains	3	-	2-4
C	3		Report Track and Signal Conditions	2	-	3-5
C	4		Protect Train at Red Block or Other Emergency	1	-	5
C	5	1	Remove - Set Derails	1	F	5
C	5	2	Align Switch	1	-	5
C	5	3	Uncouple-Couple Cars	1-2	BF D	2
C	5	4	Block-Unblock Wheels	1	EB	3

GROUP	TASK	SUBTASK		DIFFICULTY	HAZARD	CRITICALITY
C	5	5	Set-Release Hand Brakes	1	F	4-5
C	5	6	Control Auto and Pedestrian Traffic	1	B	5
C	5	7	Conduct Air Brake Test	3	-	3
C	6		Maintain Record of all Cars Set Out or Picked Up	2	-	1
C	7		Check Speed of Train	1	-	2
C	8		Run Train with Back-Up Hose	3	BC	4-5
D	1		Herd Train into Yard	2	FB	4
D	2		Submit Train Documents	1	-	1
E	1		Cope with Derailment	1	BE	3,5
E	2		Cope with Runaway	3	BF	5
E	3		Cope with Hot Journal Condition	1	H	4,5
E	4		Respond to Locomotive Alarm Bell	3	AFH	3
E	5		Secure Loose Cargo	1	BF	3
E	6		Cope with Personnel Injuries	1	-	1-4
E	7		Cope with Fire Emergency	1	G	4
F	1		Operate Radio Telephone	1	-	1-5
F	2		Operate Wayside Telephone	1	-	1

1.2 Operational Sequence Diagrams (OSD)

An operational sequence diagram is essentially a graphic depiction of the task analysis information. It is structured around the hardware and operators in the task situation. It is useful in identifying the inter-relationships between hardware and operators during the performance of a task.

Many of the tasks are performed by either conductors or brakemen, as will be discussed in Section 5. On many of the OSD's, therefore, the specific position is not identified but, rather, is referred to under the indefinite title of "crew member". The crew member can be either brakeman or conductor. Where a definite title can be specified it is done.

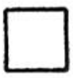
1.3 Decision Analyses

The traditional method for depicting the information processing and decision making elements of a task is with decision flow or information flow diagrams. The nature of the tasks performed by brakemen and conductors does not, however, involve complex information processing or decision making. The operational sequence diagrams depicted in this report can then be viewed as essentially decision diagrams. Rather than present redundant decision diagrams it was decided to augment the operational sequence diagrams with more narrative concerning the information required to make the decisions depicted on each operational sequence diagram. It is felt that such information will be especially useful for developing training programs and for evaluating the knowledge and skill of the operators. Each

The following are the symbols used to construct the operational sequence diagrams in this report:

 Decision

 Operation

 Inspect And/Or Monitor

 Store And/Or Memorize

 Transmission And/Or Transportation

 Discussion

 Continuous Or Automatic

 Receipt

 Delay

 Continued

<u>Energy Sources</u>

M - Mechanical Or Manual

E - Electrical

V - Visual

S - Speech Or Sound

SES - Speech To Electrical To Speech

T - Tactual/Kinesthetic

decision diamond on an operational diagram is numbered. The page following each operational sequence diagram contains a list of the decisions and the information required to make each decision.

1.4 Task-Operator Matrices

In principle, the conductor and brakemen have distinct posit with different responsibilities (as well as shared responsibilities). In practice, however, many of the tasks which may be the primary responsibility of one position may be performed by another person. For example, it is the primary responsibility of the conductor (i.e., a duty he is personally responsible for) to maintain records of all cars set out or picked up. In practice, however, the rear brakeman may fill out the forms for the conductor if the conductor is busy or occupied with another task.

In order to summarize this state of affairs a task-operator matrix is presented below. In it are listed for each task and subtask (and in some cases the individual steps) the crew members who perform them, have primary or shared responsibility for their performance, or are involved indirectly in their performance.

In way of an overview, the job of the conductor involves planning the tasks to be performed on a mission, maintaining required records and forms, and communicating with the yard master or dispatcher. His primary responsibility is the operation and conduct of the train. Although it is the engineer who physically runs the train, he does so under orders from the conductor.

TASK OPERATOR MATRIX

Symbols:

- ◼ Primary Responsibility
- ◢ Shared Responsibility
- P Performed when necessary
- I Indirectly Involved

Group	Task	Subtask	Step		Conductor	Rear Brakeman	Head Brakeman
A				BASIC HANDLING TASKS			
A	1			Signal Instructions by Hand, Flag, or Lamp			
A	1	1		Initiate Hand, Flag, or Lamp Signals	◢	◢	◢
A	1	2		Relay Hand, Flag, or Lamp Signals	◢	◢	◢
A	2			Align Switches	P	◢	◢
A	3			Couple Cars			
A	3	1		Engage Knuckles	P	◢	◢
A	3	2		Connect Air Hoses	P	◢	◢
A	4			Uncouple Cars	P	◢	◢
A	5			Set or release hand brakes	P	◢	◢
A	6			Set brake retainers	P	◢	◢
A	7			Bleed air tanks	P	◢	◢
A	8			Monitor Radio	◢	◢	◢
B				PRE-RUN AND STARTING OFF TASKS			
B	1			Register on Duty			
B	1	1		Stamp Time Sheets	◢	◢	◢
B	1	2		Verify time piece	◢	◢	◢
B	1	3		Pre-Plan Operation			
B	1	3	1	Review Information Relevant to Operation	◢	◢	◢

Head Brakeman

					C	RB	HB
B	1	3	2	Pre-Plan Operation		I	I
B	2			Connect power consist to train			
B	2	1		Report to consist		P	
B	2	2		Direct power to train			
B	3			Pre-trip Inspection			
B	3	1		Walk around inspection			
B	3	1	1	Verify Train Make-Up Against Train List		P	P
B	3	1	2	Note location of hazardous materials		P	P
B	3	1	3	Note location of "high-wides"		P	P
B	3	1	4	Inspect Lights and Signals		P	
B	3	1	5	Inspect Coupling	P		
B	3	1	6	Verify that Hand Brakes are Released	P		
B	3	1	7	Verify Sufficient Supplies and Tools are Aboard		P	
B	3	2		Roll Out Inspection	P		
B	4			Move to Main Track			
B	4	1		Request Clearance to Proceed		P	
B	4	2		Radio Locomotive When Caboose Begins to Move			I
B	4	3		Align Switches to Herd the Train to Main Track			
B	4	4		Pick Up Train Orders from Order Stand	P		
B	4	5		Radio Caboose When Locomotive Leaves Yard	I		
B	4	6		Prepare Message (Soup Ticket) for Telegraph Operator		P	
B	5			Determine Length of Train			
B	5	1		Radio Locomotive When Caboose Passes Zero Marker			I
B	5	2		Note Location of Locomotive	I	I	
B	5	3		Notify Dispatcher		P	I

					C	RB	HB
C				OVER THE ROAD TASKS			
C	1			Register at Intermediate Stations			
C	2			Inspect Trains on the Road			
C	2	1		Inspect Own Train			
C	2	2		Inspect Passing Train			
C	3			Report Track and Signal Conditions			
C	3	1		Monitor Track and Signal Conditions			
C	3	2		Radio Locomotive When Caboose Passes Slow Boards			I
C	4			Protect Train at Red Block on Other Emergency			
C	4	1		Protect Ends of Train			
C	4	2		Contact Dispatcher			
C	4	3		Inspect Track Ahead While Moving Through Red Block			
C	4	4		Fill Out Delay Sheet		P	
C	5			Set Out or Pick Up Cars			
C	5	1		Remove Set Derails	P		
C	5	2		Align Switches	P		
C	5	3		Couple-Uncouple Cars	P		
C	5	4		Block-Unblock Wheels	P		
C	5	5		Set-Release Hand Brakes	P		
C	5	6		Control Auto and Pedestrian Traffic	P		
C	5	7		Conduct Air Brake Test			
C	6			Maintain Record of All Cars Set Out or Picked Up		P	
C	7			Check Speed of Train	P	P	
C	8			Run Train with Back-Up Hose		P	

					C	RB	HB
D				TERMINATING TASKS			
D	1			Herd Train into Yard			
D	2			Submit Train Documents		P	
E				OPERATING DIFFICULTY & MALFUNCTION TASKS			
E	1			Cope with Derailment			
E	1	1		Notify Dispatcher of Derailment		P	P
E	1	2		Determine Course of Action		I	I
E	1	3		Attach Rerailing Device	I		
E	1	4		Signal Engineer to Move	I		
E	1	5		Remove Rerailing Device	I		
E	2			Cope with Runaway Cars			
E	3			Cope with Hot Journal Condition			
E	4			Respond to Locomotive Alarm Bell			P
E	5			Secure Loose Cargo		P	P
E	6			Cope with Personnel Injuries		P	P
E	7			Cope with Fire Emergency			
F				AUXILIARY EQUIPMENT OPERATING TASKS			
F	1			Operate Radio/Telephone			
F	2			Operate Wayside Telephone			

The job of brakeman essentially involves switching, coupling and uncoupling, and protecting the train at stops. Both conductors and brakemen maintain a constant vigil over the train, track conditions, and passing trains in an effort to detect any unsafe conditions which may arise.

A-1 SIGNAL INSTRUCTIONS BY HAND, FLAG OR LAMP

A-1.1. Initiate Hand, Flag, or Lamp Signals

Examples of situations which would require a crew member to initiate a signal would be (1) to direct the engineer to move and stop the train during coupling-uncoupling or switching, (2) to direct an approaching train to slow or stop while protecting a train at a stop or other emergency, (3) indicating the status of a passing train to the crew of that train.

The crew member must first realize that signalling is required in the situation. He then displays the signal and observes if the receiver responds correctly to the signal. If not, the signal would be repeated or a corrective action signal given.

The crew member must know the meaning of all hand flag and lamp signals and be able to display them quickly and accurately. The most common signals and their meaning are contained in the book of Operating Rules.

In some situations, such as coupling or switching, the crew member must anticipate a delay between displaying the signal and the response of the train. In such as case a signal would have to be displayed before the action is required. This is especially acute when signals are relayed through an intermediary to the engineer. The use of direct walkie-talkie communications in such situations would increase the efficiency of the system.

TASK NO. A-1
SUB-TASK NO. A-1.1

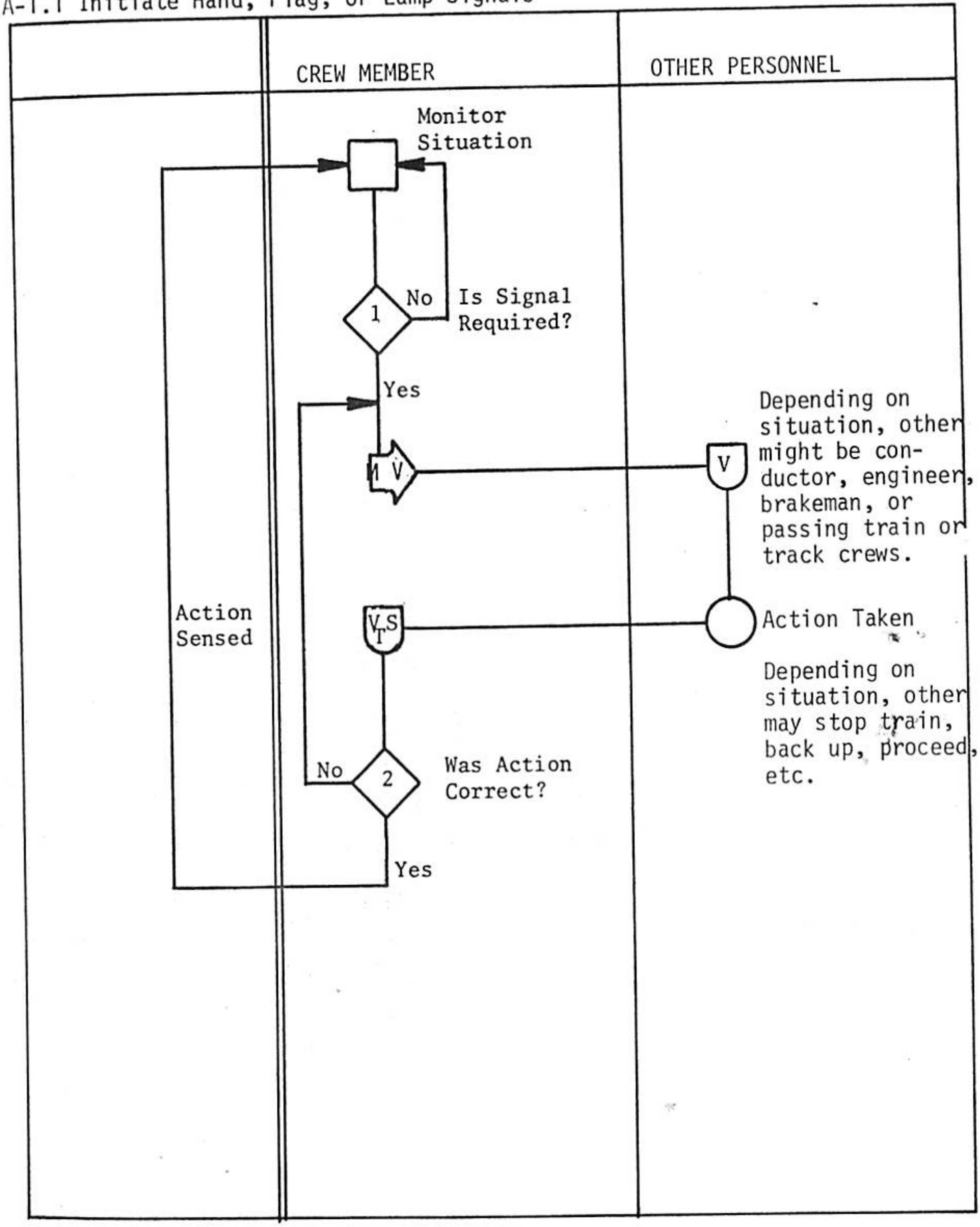
TASK TITLE Signal instructions by hand, flag, or lamp
SUB-TASK TITLE Initiate hand, flag, or lamp signals

DIFFICULTY 2
HAZARD -
CRITICALITY 3 to 5
DURATION 5 Sec.
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Initiate hand, flag, or lantern signals	Knowledge that situation requires signals to be used. Knowledge of the meaning of signals.		Match proper signal with requirements of the situation.	Signal	Flag, hand or lantern	Visual confirmation that action was initiated by receiver. Engineer may signal with whistle to confirm reception of message or to indicate need for repetition of signal.	

A-1 Signal Instructions by Hand, Flag, or Lamp   Operational Sequence

A-1.1 Initiate Hand, Flag, or Lamp Signals



A-1 SIGNAL INSTRUCTIONS BY HAND, FLAG, OR LAMP

A-1.1 Initiate hand, flag, or lamp signals

1. Is signal required?

This will usually be self-evident due to the specific task required, such as coupling or switching. At other times, such as observing a passing train, a wide range of stimuli might initiate the hand, flag, or lamp signal.

2. Was action correct?

This is merely a comparison between the desired response to the signal and the actual response made by the receiving crew member. No action would indicate the signal was not received and it would be initiated again.

A-1 SIGNAL INSTRUCTION BY HAND, FLAG, OR LAMP

A-1.2 Relay Hand, Flag, or Lamp signals

A crew member will typically relay a signal when the initiator of the signal is not visible to the receiver. For example, if cars are being set out or picked up around a curve, such that the engineer cannot see the operation being performed, the crew members will position themselves along the length of the train around the curve. A signal (e.g., proceed, back up, or stop) will be relayed from man to man to the engineer. Each time a signal is relayed, there is the danger of information loss and distortion. A walkie-talkie which would do away with the need to relay signals would have considerable safety value as well as reduce the time required to complete an operation.

The crew member positions himself to see the signal, he observes the signal and repeats the motion to the next crew member in the chain.

TASK NO. A-1
SUB-TASK NO. A-1.2

TASK TITLE Signal Instructions by Hand, Flag, or Lamp
SUB-TASK TITLE Relay Hand, Flag, or Lamp Signals

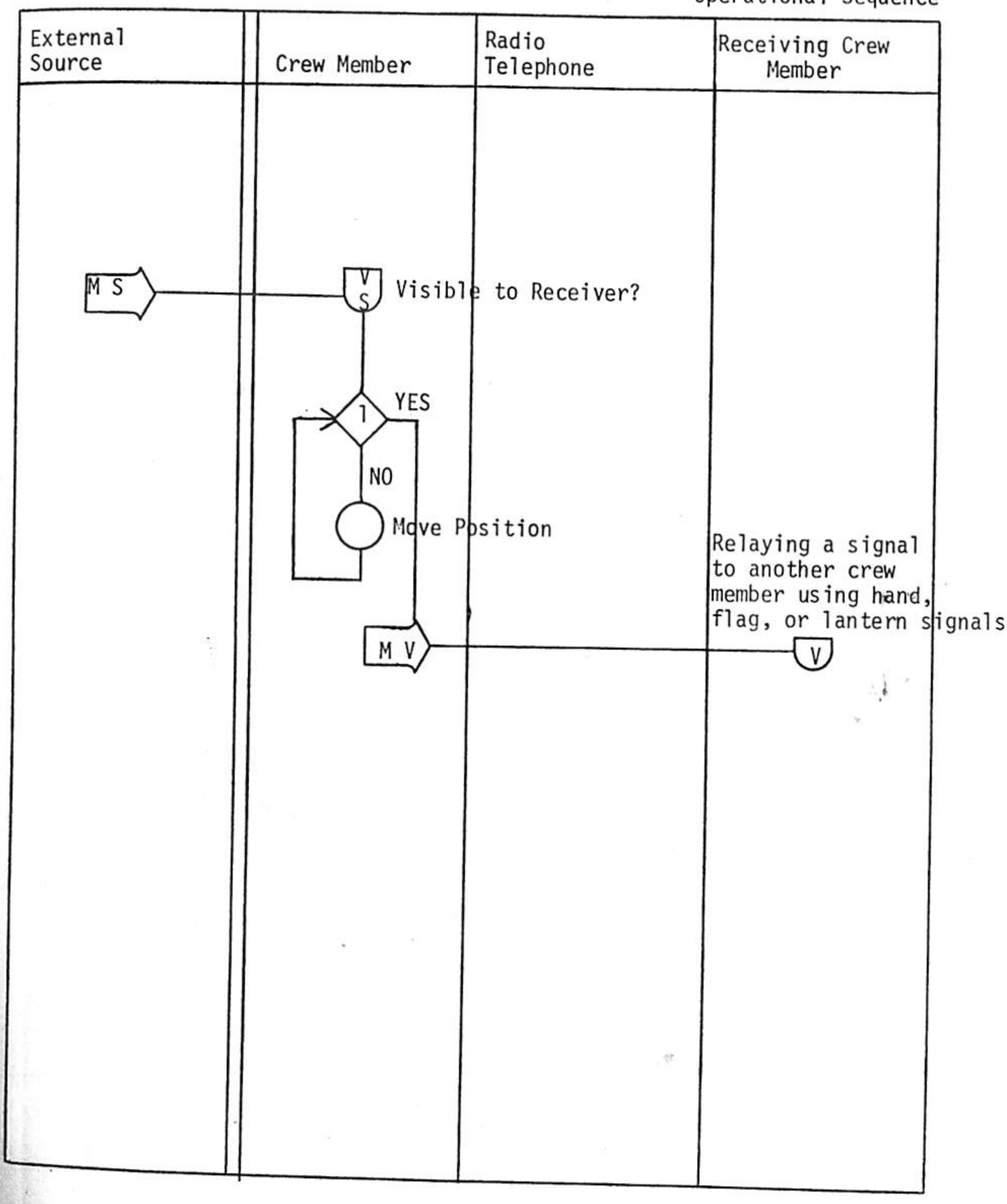
DIFFICULTY 2
HAZARD -
CRITICALITY 3 to 5
DURATION 5 Sec.
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Position to relay signals	Knowledge that situation requires signal to be relayed.		Will signal be seen by receiving crew member?	Physically change position		Visual confirmation that other crew members will see signal	
2	Relay signals	Knowledge of signals	Hand or lantern signal		Relay signal	Flag, hand, or lantern	Visual confirmation that action was initiated by receiver	

A-1 Signal Instructions by Hand, Flag, or Lamp

A-1.2 Relay Hand, Flag, or Lamp Signals

Operational Sequence



A-1.2 Relay Hand, Flag, or Lamp Signals

1. Visible to receiver?

The crew member must position himself so that the receiving crew member can see the signal he will relay. If the receiving crew member is visible to the relaying crew member, it is assumed the reverse is true.

A-2 ALIGN SWITCHES

This task is performed, for example, as part of setting out or picking up cars, herding the train into a yard, moving the train out of a yard onto the main track, or moving the train into siding to allow another train to pass.

A crew member aligning a switch first inspects the switch to determine if it has been tampered with. If so, it must be reported to the dispatcher. The switch is unlocked, aligned and inspected to insure it is properly set and the switch points and rails meet correctly. Depending on the operation, the switch may be realigned several times before the set-out or pick-up is complete. After the operation is complete, the switch must be locked. A switch that is defective or inoperative is "spiked". That is, a railroad spike is driven into the tie to prevent the switch from being moved. The dispatcher must be notified of any spiking operation.

An improperly aligned or defective switch can cause a derailment. It is important, therefore, that crew members be trained to recognize an improperly aligned or defective switch.

Many switches require the crew member to lift a heavy weight from an awkward position in order to align the switch. This could result in back strain and injury.

TASK NO. A-2
SUB-TASK NO.

TASK TITLE Align Switches
SUB-TASK TITLE

DIFFICULTY 1
HAZARD -
CRITICALITY 5
DURATION 1-2 Minutes
FREQUENCY As Required

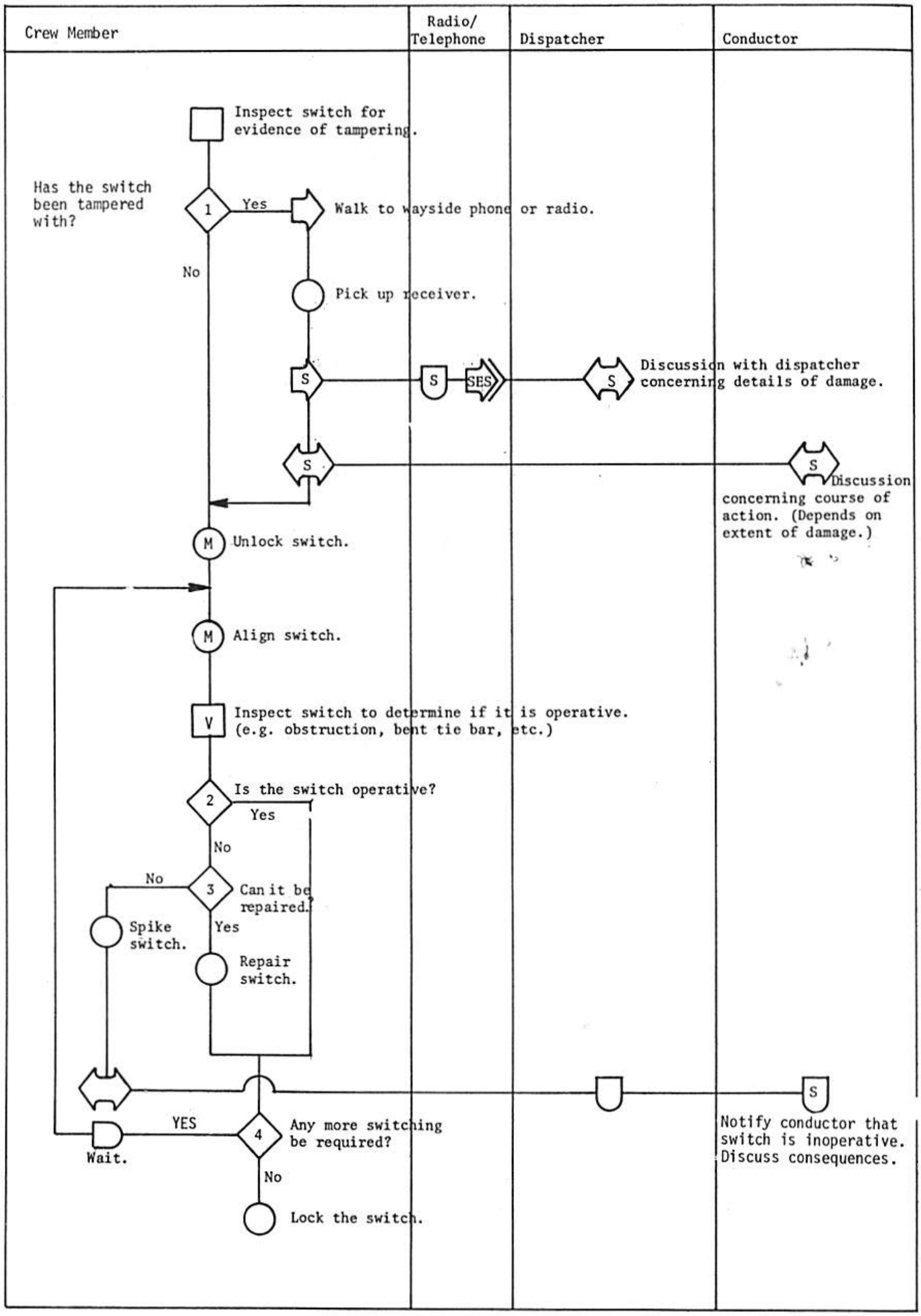
STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Inspect for evidence of tampering.	Broken lock, bent point, smashed reflector	Switch mechanism	Is switch operative	Call dispatcher or operator if tampered with.	Wayside phone or radio	Acknowledged by dispatcher or operator.	
2	Unlock switch.		Lock		Use key to unlock lock.	Key	Visual confirmation that lock is unlocked.	
3	Align switch.	Train is clear of switch, switch is unlocked.		Procedure for throwing switch and direction of alignment required.	Lift or turn handle.	Handle	Visual and tactual confirmation that handle is completely activated.	
4	Inspect for improper alignment.		Switch points and rails	Did the switch points and rails properly meet?	If an obstruction is present, remove it. If tie bar is bent or broken, repair or return switch to safe position. Spike the switch and notify dispatcher or operator. (See Step 6.)	Hammer Railroad spike and hammer Radio or telephone	Visual confirmation that switch points and track meet properly.	If inoperative, discussion with conductor and engineer on course of action with respect to the movement of the train.

TASK NO. A-2
SUB-TASK NO.

TASK TITLE Align Switches
SUB-TASK TITLE

DIFFICULTY 1
HAZARD -
CRITICALITY 5
DURATION 1-2 Minutes
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
5	Lock switch		Lock	Switching operation is complete. Track is properly aligned.	Close lock and pull lock.	Lock	Visual and tactual that lock is secure.	
6	Spike a defective switch	Defective switch	Switch points tie bars, handle, track	Is the switch operative and is it safe to pass over it?	Hammer railroad spike into tie to prevent the switch from moving. Notify conductor and dispatcher.	Spike and hammer. Radio	Switch secured from movement.	


Crew Member
Radio/ Telephone
Dispatcher
Conductor
Inspect switch for evidence of tampering.
Has the switch been tampered with?
1
Yes
Walk to wayside phone or radio.
No
Pick up receiver.
S
S
SES
S
Discussion with dispatcher concerning details of damage.
S
S
Discussion concerning course of action. (Depends on extent of damage.)
M
Unlock switch.
M
Align switch.
V
Inspect switch to determine if it is operative. (e.g. obstruction, bent tie bar, etc.)
2
Is the switch operative?
Yes
No
No
3
Can it be repaired?
Spike switch.
Yes
Repair switch.
S
Notify conductor that switch is inoperative. Discuss consequences.
YES
4
Any more switching be required?
Wait.
No
Lock the switch.

A-2 ALIGN SWITCH

1. Has the switch been tampered with?

The crew member inspects the switch for broken locks, broken switch lights, bent tie bar, obstruction in switch or damaged targets (banners), and latches.

2. Is the switch operative?

This decision is made by comparing the condition of the switch with past knowledge of what an operative switch looks like. Such things as whether the switch points meet the rail properly must be considered. A rock wedged between the points and rail could derail the train.

3. Can it be repaired?

This decision is based to a great extent on the experience of the crew member and his skill in repairing an inoperative switch.

4. Will any more switching be required?

This is determined by the scenario already agreed on by the crew before the switching operation began. It requires the crew member to recall the scenario.

A-3 COUPLE CARS

A-3.1 Engage Knuckles

To engage knuckles, the crew member pulls the pin lifter, enabling the knuckles to be opened by hand. Occasionally, the crew member climbs on the knuckles and kicks them open with his foot. This places him in a precarious and hazardous position. The entire coupling assembly is inspected for damage. The most common failures are broken knuckles and draw bars. If it is feasible and cost effective (in terms of delay) to make repairs they are done and both conductor and dispatcher are notified of the action. If repairs are not made the car is set out as a bad order car. The conductor notifies the dispatcher and fills out the proper forms declaring the car as a bad order.

If the couple assembly is operative, the crew member signals the engineer to move the train and engage the couple. The pin lifter must drop completely if the couple is to be successful. The engineer is signaled to reverse the previous movement and "stretch" the couple. If the couple was unsuccessful, the knuckles will disengage and the process must be started over again.

TASK NO. A-3 | TASK TITLE Couple Cars
SUB-TASK NO. A-3.1 | SUB-TASK TITLE Engage Knuckles

DIFFICULTY 2
HAZARD BF
CRITICALITY 2
DURATION 2 Minutes
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Pull pin lifter	Knowledge that coupling is required. Knuckle is closed.	Knuckle	Knowledge of operation of couple, location & operation of pin lifter	Lift pin	Pin Lifter	Visual confirmation that pin is lifted	
2	Open Knuckle	Visual observation that knuckles are closed & pin has been lifted.	Knuckle	Is knuckle open sufficiently?	Push knuckle open with hands.	Knuckle	Visual confirmation that knuckle is open.	
3	Inspect knuckle and draw bar for breakage	Cracked knuckle broken down draw bar	Knuckle and draw bar	Knowledge of appearance of common defects	If knuckle is broken, replace with another if available. Notify conductor and dispatcher. If knuckle cannot be replaced or if draw bar is broken, set out the car. If the defective knuckle is located.	Chain Radio	Visual	Discussion on where to set out car if couple is inoperative.

TASK NO. A-3 TASK TITLE Couple Cars
SUB-TASK NO. A-3.1 SUB-TASK TITLE Engage Knuckles

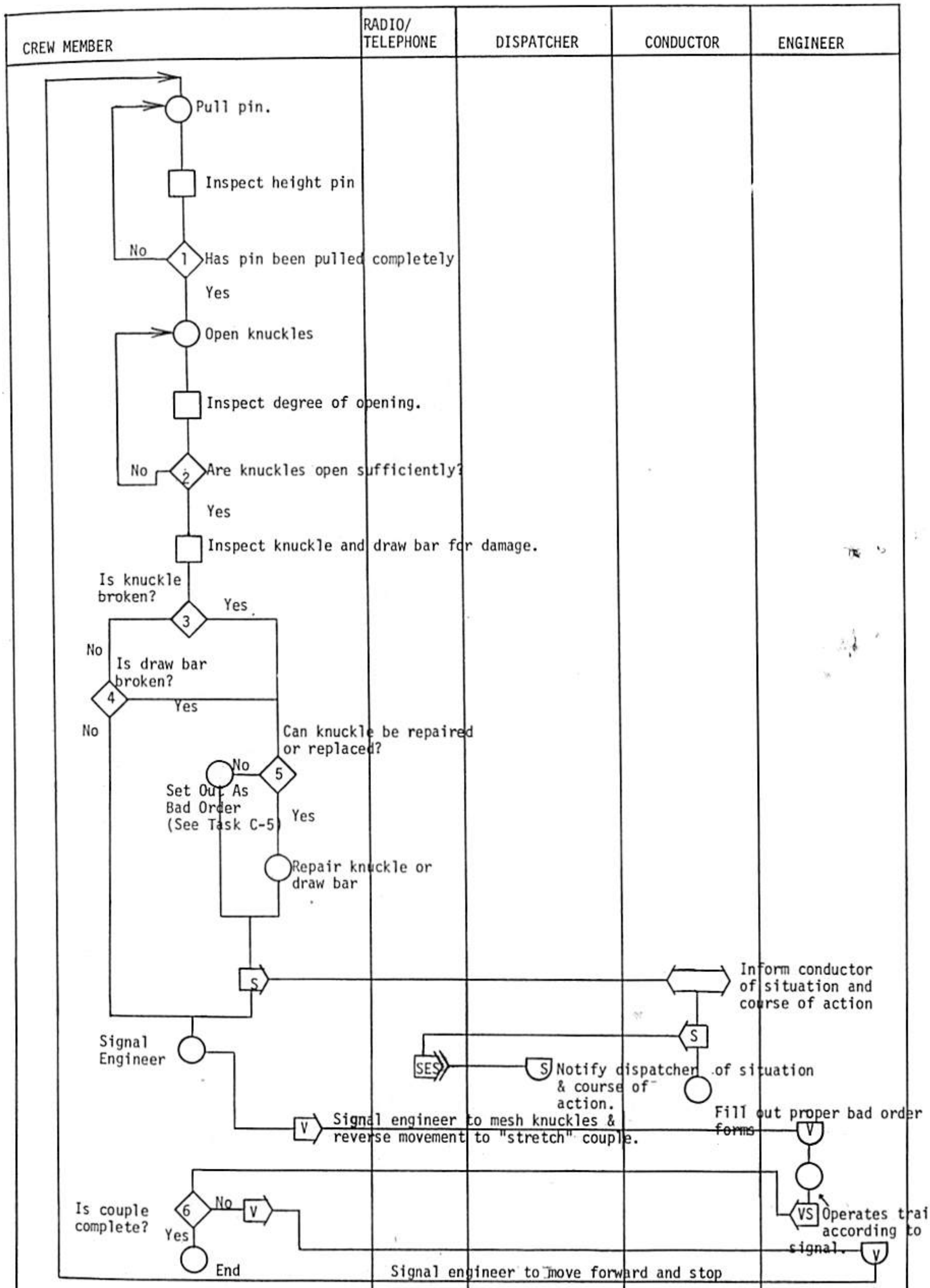
DIFFICULTY 2
HAZARD BF
CRITICALITY 2
DURATION 2 Minutes
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
					The "wrong end" it must be chained to move the car. Report to conductor and dispatcher.			
4	Signal engineer to move.	Couple is operative and prepared to couple.		Knowledge of signals (See Task A.1.1)	Signal (See Task A.1)		Visual confirmation of train movement, auditory-pin lifter drops visual appearance of couple.	After couple operator signals engineer to 'stretch' (i.e. test) the couple.

A-3 Couple Cars

A-3.1 Engage Knuckles

OPERATIONAL SEQUENCE



A-3 COUPLE CARS

A-3.1 Engage Knuckles

◇1. Has pin been pulled completely?

The height of the pin is the major cue to whether the pin has been completely pulled. If the pin has not been pulled the knuckle will not open.

◇2. Are knuckles open sufficiently?

This requires a comparison between the opening obtained and that required to engage the couple. Past experience supplies the referent.

◇3. Is knuckle broken?

Broken knuckles are readily apparent from just a cursory observation.

◇4. Is draw bar broken?

This is readily apparent from cursory observation, the entire couple assembly will pull off the car.

◇5. Can the knuckle be repaired or replaced?

The crew member must have information concerning the availability of tools and replacement parts. Experience and skill in repair will influence the decision made. Consideration may also be given to whether lengthy repairs are cost effective in terms of keeping the train on schedule.

◇6. Is couple complete?

The crew member observes the appearance of the knuckles and matches that against experience as to what a successful couple looks like. Some crew members report that a distinct auditory cue can be heard when a couple is successful.

A-3 COUPLE CARS

A-3.2 Connect Air Hoses

The crew member first inspects the air hose assembly for defects (e.g., hole in hose, missing gasket, or smashed connectors). If the assembly is defective, it is replaced by a crew member. The two ends of the air hose, called glad hands, are connected. If this is done improperly, the connection will fall apart. After the glad hands have been engaged, the angle cock is slowly opened to allow the air to fill the hose. This must be done slowly, for if the air rushes into the hose too quickly, the emergency brakes will activate. The sound of the air filling the hose is the only cue available to gauge the rate of air flow. If the emergency brakes are activated, there is no harm done, it only means a delay until they can be released and the air pressure built back up to the proper level. After the hose has been filled, the angle cock is opened completely.

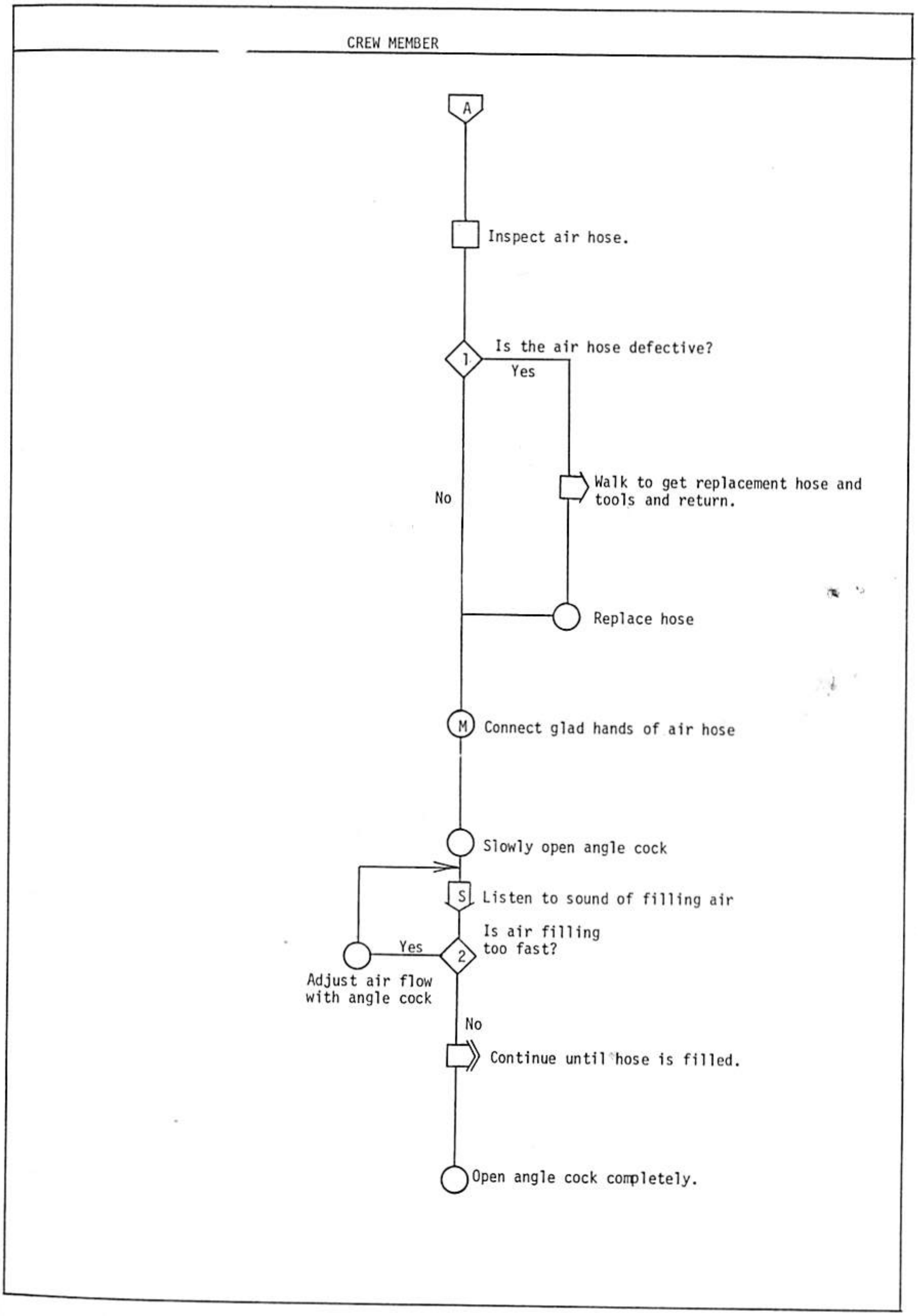
TASK NO. A-3 TASK TITLE Couple Cars
SUB-TASK NO. A-3.2 SUB-TASK TITLE Connect Air Hoses

DIFFICULTY 2
HAZARD BF
CRITICALITY 2
DURATION 30 Seconds
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Inspect air hoses	Hole in hose, missing gasket smashed glad-hands, etc.	Air Hose	Knowledge of common defects in air hoses	If defective, replace	Hose and wrench		
2	Connect glad-hands of air hose	No defects in hose or glad-hands		Knowledge of procedure for connecting glad-hands	Mesh gladhand connections	Glad-Hands	Visual, if improperly connected the connection will dis-connect	
3	Open angle cock slowly to release air.	Air hose is secured.		Must judge speed with which angle cock is opened, if too fast will result in emergency brakes being applied.	Turn angle cock	Angle cock	Sound of air filling hose. If opened too fast, sound of emergency brakes is heard.	

A-3.2 Connect Air Hoses

Operational Sequence



A-3.2 Connect Air Hoses

1. Is the air hose defective?

The major defects which are checked for are holes in the hose and smashed glad-hands.

2. Is air filling too fast?

It is critical that the air is not allowed to fill the hose too quickly because it will cause the emergency brakes to be applied.

The only cue to the rapidity with which the hose is being filled is the sound of air filling the hose. Experience is the only guide available to determine the proper flow rate.

If the emergency brakes should be applied, they can be heard engaging but, at that point, it is too late to prevent their activation.

A-4 UNCOUPLE CARS

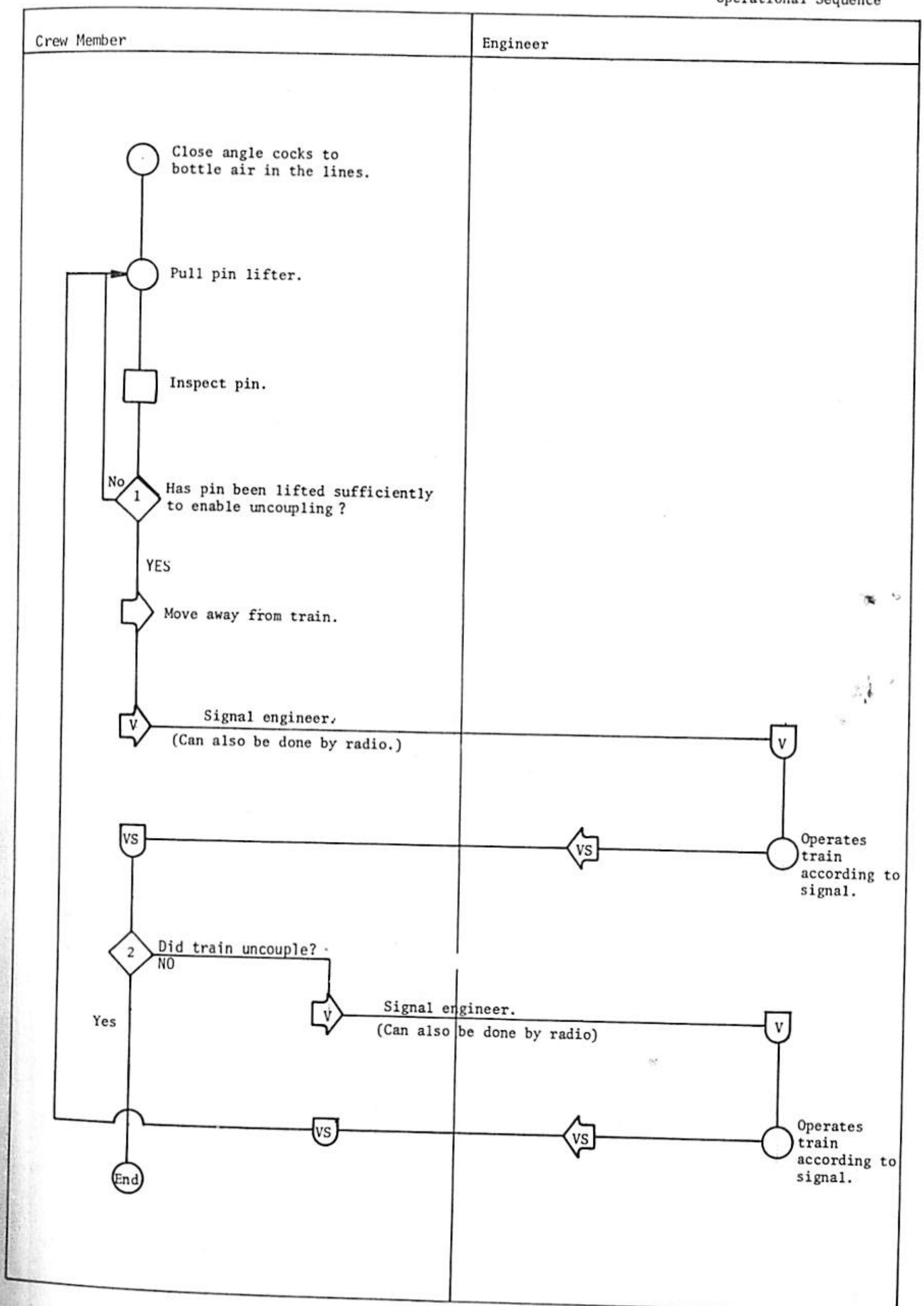
The crew member closes the angle cocks on both cars to bottle the air in the hose. The pin lifter is pulled and the engineer is signalled to move and stop the train. If the pin lifter was properly pulled, the knuckles will disengage and the air hose will disconnect. A major safety hazard exists. When the air hose disconnects, the pressure of the air trapped in the hose causes them to lash out. If the crew member is too close, the end of the air hose could strike him with enough force to break a bone. The disconnecting air hose also emits a high intensity impulse noise which could startle the crew member and cause him to lose his footing and fall.

TASK NO. A-4
SUB-TASK NO.

TASK TITLE Uncouple Cars
SUB-TASK TITLE

DIFFICULTY 1
HAZARD BFD
CRITICALITY 2
DURATION 1 Minute
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Close angle cocks to bottle air in the lines	Angle cocks open properly for car uncoupling	Angle cocks	Operation of angle cock	Turn cocks	Angle cocks		
2	Pull pin lifter	Angle cocks closed		Operation of pin lifter	Lift pin	Pin Lifter	Visual and auditory pin has been lifted	
3	Signal engineer to move train	Pin lifter pulled		Knowledge of signals, determination that there is a safe distance between himself and train.	Signal engineer by hand lantern or radio.	Hand lantern Radio	Visual confirmation that couple and air hose released. If uncoupling failed, engineer is signaled to stop and steps 2 and 3 are repeated.	The air hoses break automatically as the train uncouples and can lash out and strike the worker. The breaking air hose generates excessive, short term acoustical noise.


Crew Member
Engineer
Close angle cocks to bottle air in the lines.
Pull pin lifter.
Inspect pin.
No
1
Has pin been lifted sufficiently to enable uncoupling ?
YES
Move away from train.
V
Signal engineer.
(Can also be done by radio.)
V
VS
VS
Operates train according to signal.
2
Did train uncouple?
NO
Yes
V
Signal engineer.
(Can also be done by radio)
V
VS
VS
Operates train according to signal.
End

A-4 UNCOUPLE CARS

1. Has pin been lifted sufficiently to enable uncoupling?

This requires the crew member to compare the appearance of the pin height with that which is sufficient for uncoupling. Experience plays a role in defining the height thought to be sufficient. Some crew members report an auditory cue can be detected indicating the pin has been lifted.

2. Did train uncouple?

This is a trivial decision, it is readily apparent as the engineer moves the train. The glad hands on the air hose automatically break apart.

A-5 SET OR RELEASE HAND BRAKES

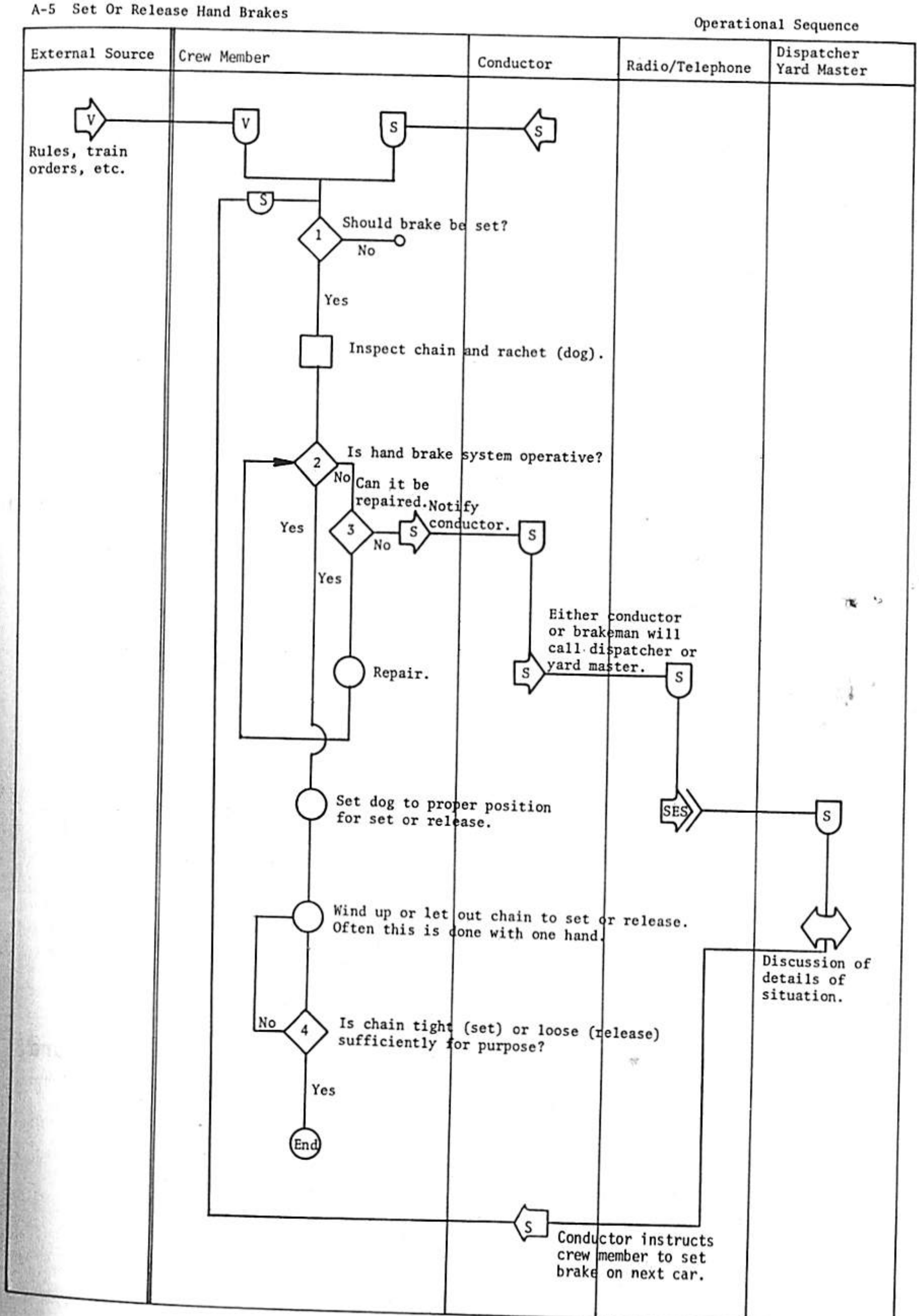
Company rules set forth the number of cars which must have brakes. Such things as the grade of the track and number of cars to be restrained must be considered. The brake assembly (chain and rachet) are inspected for damage. If they are damaged and the brake cannot be set, the brake on the next car in line is set instead, and the conductor and dispatcher or yard master are notified. The rachet ("dog") is set to the proper position for set or release. The chain is then wound up or let out as far as possible by turning a wheel. Some cars have the wheel located at or near the top at the end of the car, thereby requiring the crew member to climb to reach it. There is a danger of falling. Other cars have the wheel located on the side of the car. In some cases the crew member can operate the wheel while standing on the ground. In other cases he must climb a ladder, and while holding the ladder with one hand, attempt to turn the wheel with the other. Besides the obvious danger of falling, the wheel may not be turned sufficiently from this position to fully engage the hand brake.

TASK NO. A-5 | TASK TITLE Set or release hand brakes
SUB-TASK NO. | SUB-TASK TITLE

DIFFICULTY 1
HAZARD F
CRITICALITY 4
DURATION 2 Minutes
FREQUENCY As required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Inspect chain and rachet (dog) for damage	Visual observation The correct number of brakes that need to be set for the situation. Location of cars with brakes to be set or released.	Chain and dog Number of cars, grade	Does the brake appear to be in good order?	If chain is broken, it is repaired or if it cannot be repaired it is reported to the conductor and dispatcher or yard master.	Tools and replacement parts Radio	Visual confirmation that chain is repaired. Auditory confirmation of message received.	If the defect cannot be repaired, preventing the brake from being set, the brake on the next car is set instead
2	Set "dog" to position for set or release	Position of dog inappropriate for intended operation	Dog	Knowledge of proper dog position	Change position of dog	Dog	Visual confirmation that dog is in proper position	
3	Wind up or let out chain as far as possible	Dog set in proper position	Dog	Is the chain wound up or let out sufficiently?	Physically turn wheel to wind or unwind chain	Hand Wheel	Visual chain-tactical inability to turn handle any further.	Sometimes this must be done with one hand while clinging to a ladder with the other hand.
4	Inspect chain for damage	See Step 1						

A-5 Set Or Release Hand Brakes



A-5 SET OR RELEASE HAND BRAKE

◇1. Should brake be set?

Company rules set forth the number of cars which must have brakes set. Such things as the grade of track, the number of cars to be restrained and whether blocks will be used must be considered. On occasion, the conductor, basing his decision on experience, will direct the brakeman to set brakes on a particular car. This is rarely done, however.

◇2. Is hand brake system operative?

The information for this decision is obtained by visually inspecting the brake system. Things that would indicate an inoperative system would be a broken chain or rachet and whether the piston is in the proper position.

◇3. Can it be repaired?

The crew member must know that tools and replacement parts are available. The crew member's experience serves as a guide as to what is repairable. A determination must also be made as to whether it is necessary or worthwhile to repair it.

◇4. Is chain tight or hose sufficient for purpose?

The main information source for this is whether the crew member can turn the wheel any further. The crew member's strength, therefore, becomes a critical factor in determining whether the chain is tight.

A-6 SET BRAKE RETAINERS

The time table indicates whether retainers are needed in a specific situation based on the tonnage and number of cars in the train. The conductor directs the brakemen as to which cars should be set. To set retainers a lever on the end of the car is activated manually. There is no feedback indicating if the retainers are operative.

TASK NO. A-6
SUB-TASK NO.

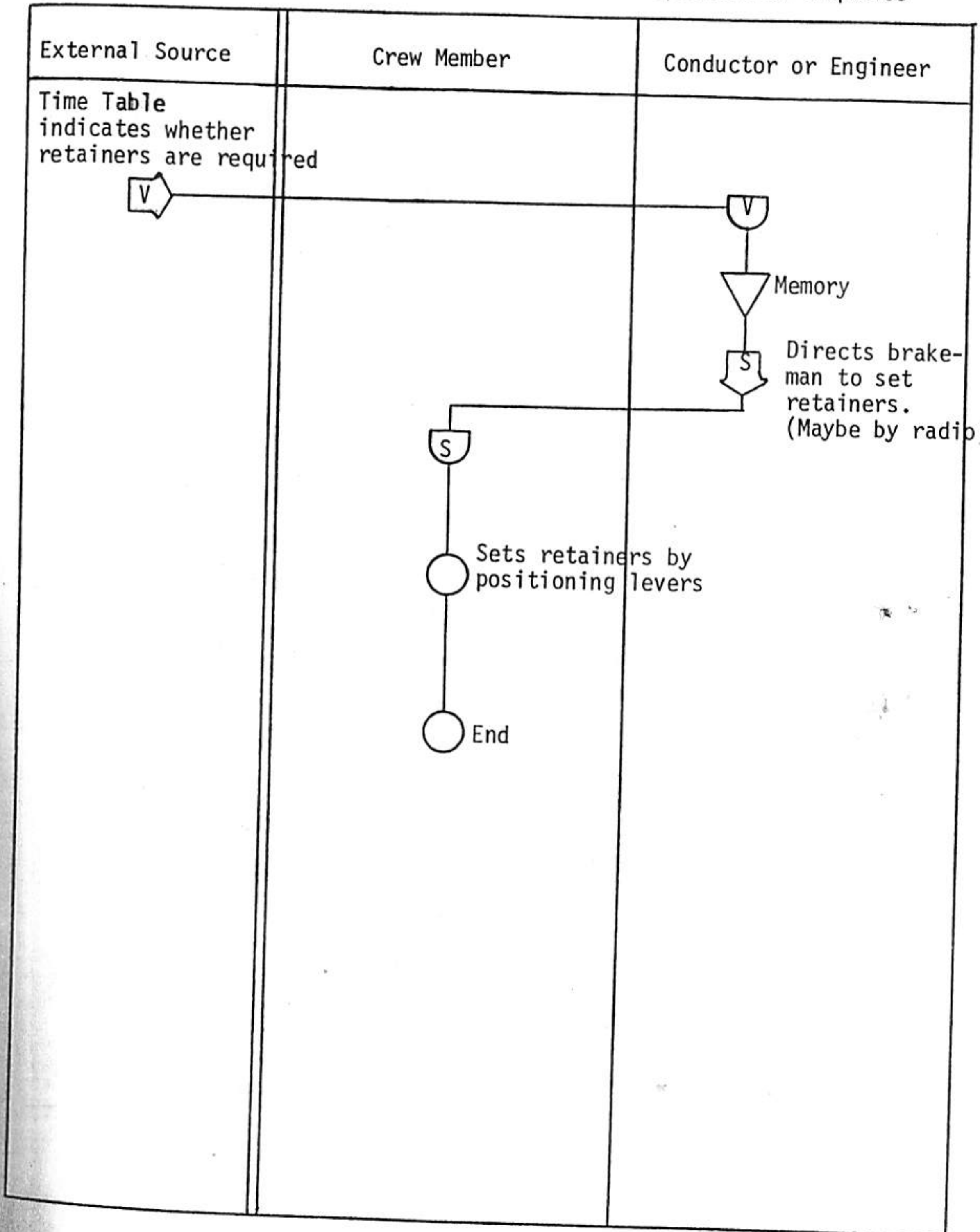
TASK TITLE Set Brake Retainers
SUB-TASK TITLE

DIFFICULTY 1
HAZARD -
CRITICALITY 2
DURATION 30 Seconds
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Set brake retainers to maintain brake pressure for a set time after they are re-leased by the engineer	Time table indicates whether retainers are needed and how many, based on the tonnage and number of cars in the train. Con-ductor directs which cars should be set.		Location of cars to be set. Know-ledge of position and operation of retainers.	Set position of retainer lever.	Lever	Visual confirmation that lever is set.	There is no feedback indi-cating if the retainers are operative.

A-6 Set brake retainers

Operational Sequence



A-7 BLEED AIR TANKS

This is not a common procedure and is only used when a lot of switching is to be done with a set of cars. The conductor, from experience, would determine that bleeding would be an efficient procedure and directs the brakeman to bleed the tanks. Bleeding is a simple procedure requiring the crew member to push or pull a valve located on the end of the cars. The air can be heard bleeding out of the tanks.

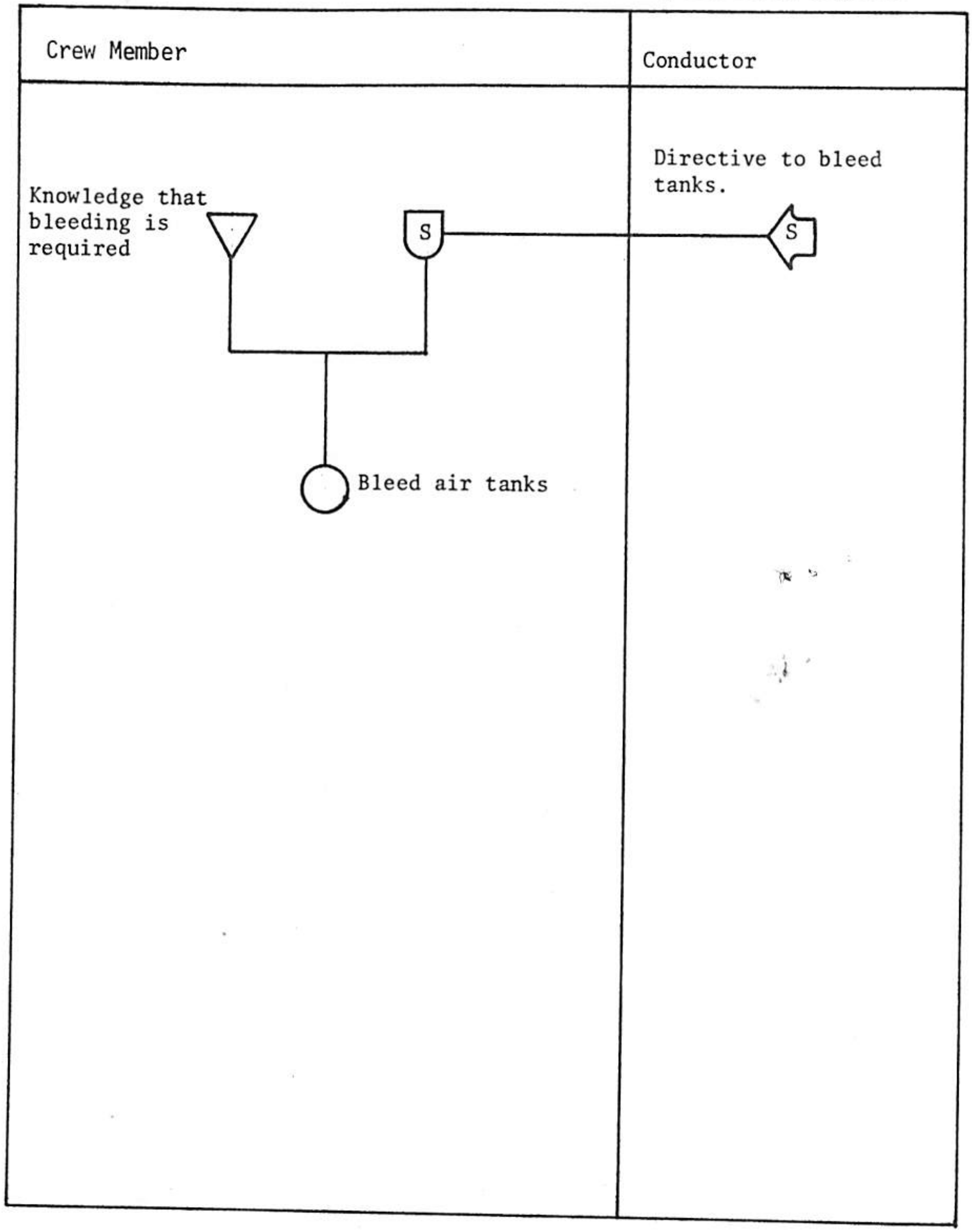
TASK NO. A-7 TASK TITLE Bleed Air Tanks
SUB-TASK NO. SUB-TASK TITLE

DIFFICULTY 1
HAZARD -
CRITICALITY 1
DURATION 30 Seconds
FREQUENCY Infrequent

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Bleed air tanks to release air brakes on a car.	Knowledge from experience that bleeding tanks is an efficient procedure in particular situations. Directive from conductor.		Knowledge of operation of bleeder valve.	Push or pull valve	Valve	Auditory confirmation that air is bleeding out.	This is done only when a lot of switching is to be done.

A-7 Bleed Air Tanks

Operational Sequence



A-8 MONITOR RADIO

This is a continuous task which is engaged in by all crew members. The monitoring performance of each crew member can, then, be less than perfect because the crew members monitor in parallel. The crew must be alert to message, which although not directed specifically to their train, may involve their operation. This would include, for example, notification of derailments, or vandals on the track ahead. The message is passed on to the engineer. Radio contact may be initiated with the calling party, if necessary.

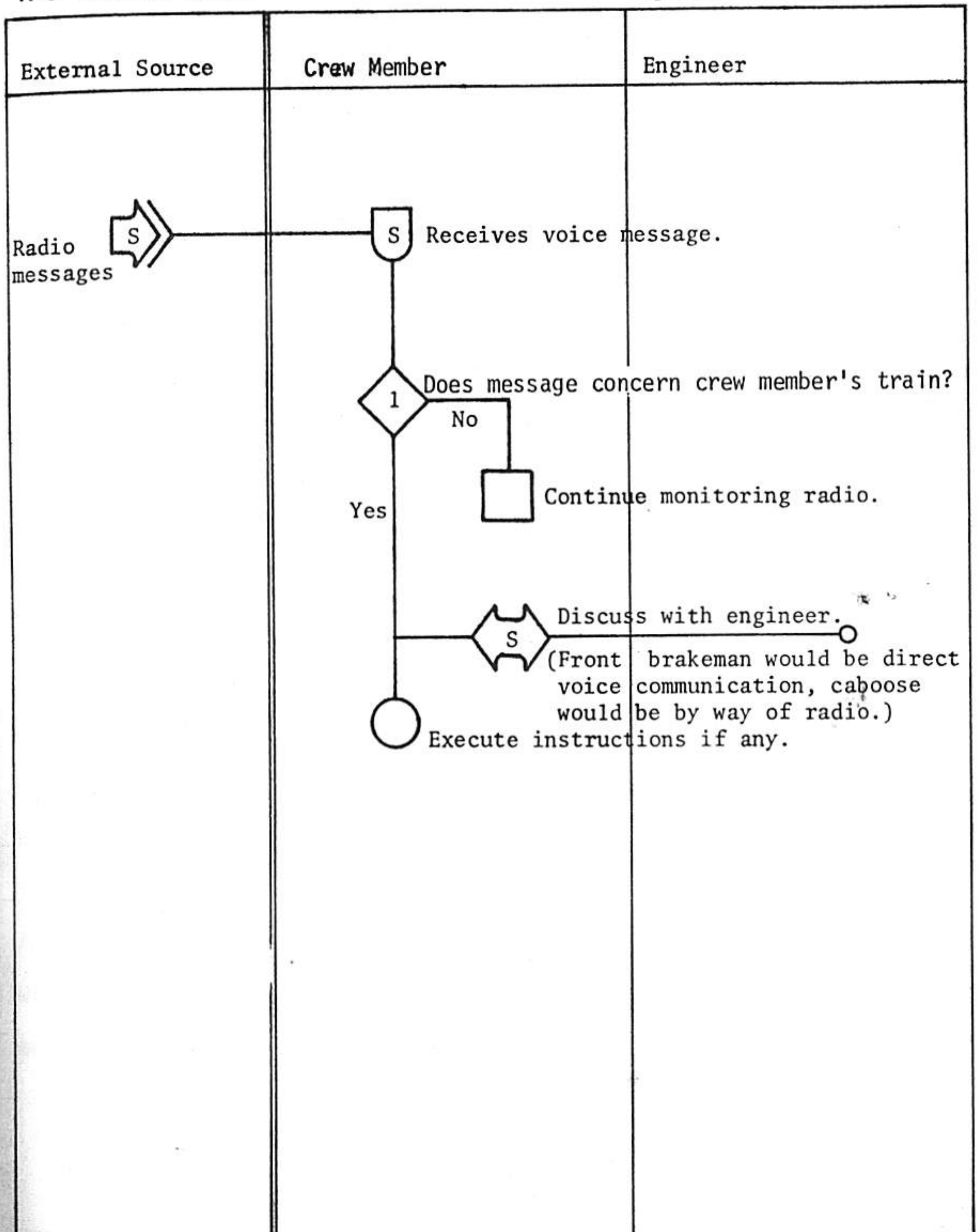
TASK NO. A-8
SUB-TASK NO.

TASK TITLE Monitor Radio
SUB-TASK TITLE

DIFFICULTY 1
HAZARD -
CRITICALITY 1-5
DURATION Continuous
FREQUENCY Continuous

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Monitor radio for calls relevant to mission.	Code for train	Radio	Whom does it concern?	Discuss message with engineer or initiate radio contact with calling party.	Radio	Acknowledgement of message	

A-8 Monitor Radio Operational Sequence



1. Does message concern present mission?

Usually messages sent to a specific train will be prefaced by a code designating that train. The crew member must, therefore, remember the appropriate code for the train.

In addition, the crew member must be aware of messages which, although not directed to his specific train, are of concern to the operation. Examples would include notification of a derailment or othe emergency occurring on the track ahead or calls for assistance.

B-1 REGISTER ON DUTY

Each crew member must sign a time sheet when coming on duty. This gives them a chance to meet the other crew members and review information relevant to the operation. This would include such information items as time table changes, track maintenance reports, weather conditions, special orders, the train list and way bills. The crew then discusses the operation. All members of the crew contribute ideas, suggestions, etc., but it is the responsibility of the conductor to make the ultimate decisions, formulate the plan and assign tasks. This is usually done informally. The overall efficiency of the operation depends in large part on the quality of the pre-operation planning. If crew members are not alerted to potential problems or special requirements, serious delays could result.

Before the crew leaves to meet the train, each member must verify that his personal time piece agrees with the railroad's standard clock. A form is filled out by the crew member verifying that his time piece is in agreement and noting any correction needed to bring it into agreement with the standard clock. It is the crew member's responsibility to repair or replace a time piece which does not keep accurate time.

TASK NO. B-1
SUB-TASK NO. B-1.1

TASK TITLE Register on Duty
SUB-TASK TITLE Sign Time Sheets

DIFFICULTY 1
HAZARD -
CRITICALITY 1
DURATION 30 Seconds
FREQUENCY Once When Coming on Duty

STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
1	Sign time sheets.	Knowledge that time sheets must be signed prior to start of mission.	Time Sheet	Knowledge of where to place sign	Sign sheet	Time sheet writing instrument	Visual observation that form is signed.	
2	Meet the other crew members	Crew names	Verbal	Memorize names and positions				

TASK NO. B-1 TASK TITLE Register on Duty
SUB-TASK NO. B-1.2 SUB-TASK TITLE Verify Time Piece

DIFFICULTY 1
HAZARD -
CRITICALITY 1
DURATION 10 Seconds
FREQUENCY When Coming On Duty

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Verify that watch agrees with railroad standard time	Time of day Knowledge that watch must be corrected.	Standard clock and watch	Is the watch accurate, fast or slow and if so, by how much?	Compare watch to standard clock. Adjust watch if required.	Watch	Time pieces are in agreement	
2	Fill out required form verifying that watch is in agreement with standard clock	Knowledge that form must be filled out.	Required form	Knowledge of how to complete the required form	Fill out form	Writing instrument and form	Visual observation that form is complete.	

TASK NO. B-1
SUB-TASK NO. B-1.3

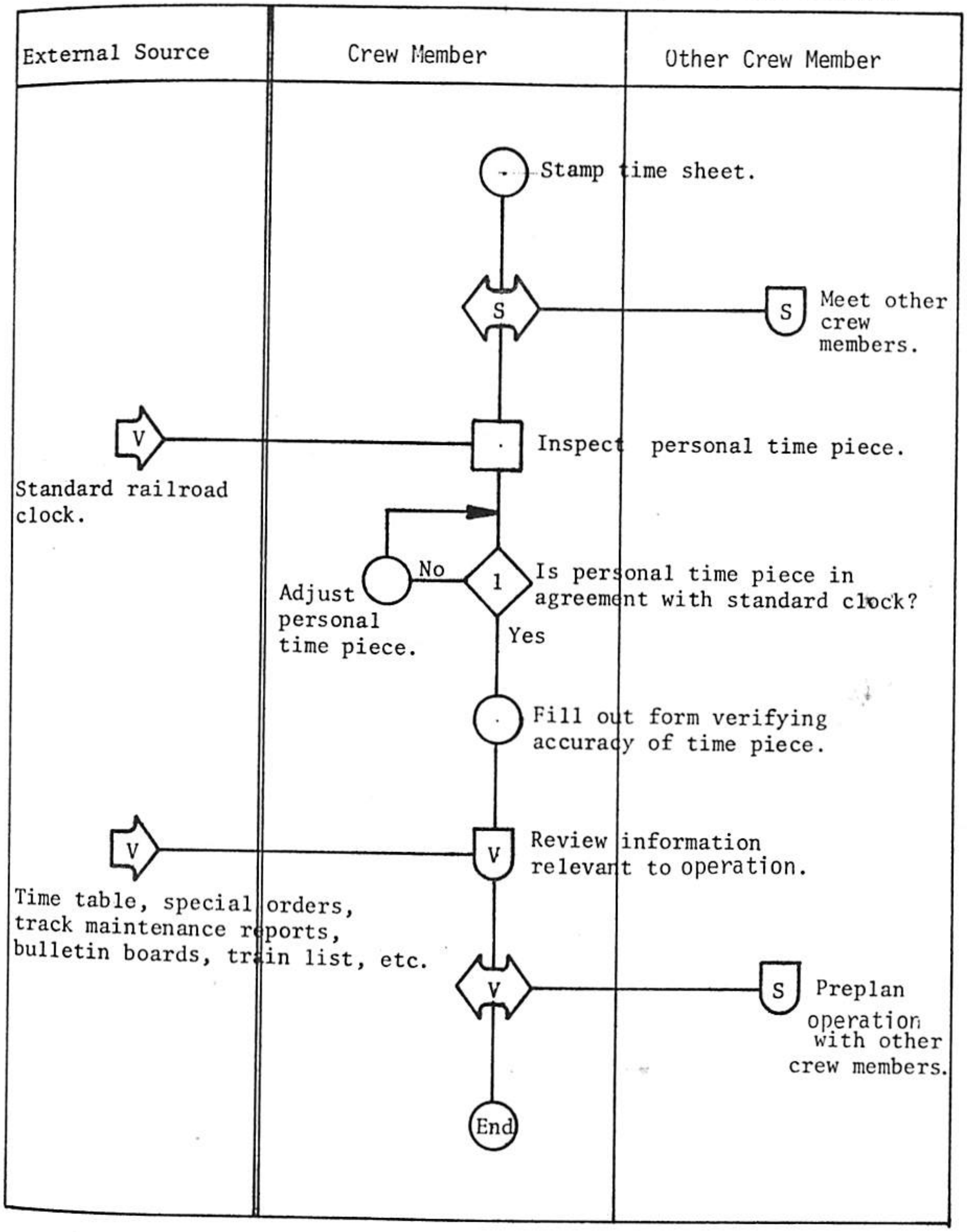
TASK TITLE Register on duty
SUB-TASK TITLE Pre-plan mission

DIFFICULTY	2
HAZARD	-
CRITICALITY	2
DURATION	5-10 Minutes
FREQUENCY	Before start of mission

STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
1	Review information relevant to the operation	Time table special orders track maintenance reports. Weather conditions. Special operating instructions, train list ("pickle sheet"), way bills, etc.	Maps, written orders, bulletin boards	Integrate input information and note potential problems and hazard areas.				
2	Pre-plan operation	Input information received experience	Verbal	Preplan operation for optimum operation based on available inputs.	Discuss with crew members anticipated problems. Special decisions.		Verbal confirmation that crew understands and concurs with plan.	All members of crew contribute ideas, suggestions, etc., but it is the responsibility of the conductor to make the ultimate decisions, formulate the plan, and assign tasks.

B-1 Register On Duty

Operational Sequence



B-1 REGISTER ON DUTY

1. Is personal time piece in agreement with standard clock?

This requires a simple comparison between the standard clock and the crew member's time piece.

B-2 CONNECT POWER CONSIST TO TRAIN

After the crew has registered on duty they walk or are driven to the consist (i.e., the string of locomotives which will power the train). The engineer, and occasionally the head brakeman, verify that the consist is the one assigned to them. This requires comparing the engine numbers to the number on a clearance card picked up at the time of registration by the engineer. If there is an inconsistency, the yard master is called and he corrects the error. Usually the consist has been prepared by the yard crew. Occasionally locomotives must be tied together. This is the responsibility of the engineer but he will sometimes ask the brakeman to assist in connecting the electrical cables. After the consist has been assembled and inspected by the engineer, he directs the head brakeman to request permission from the yard master to come out to move the train. The brakeman may then walk ahead of the train and align switches to direct the consist to the proper location. This task is usually performed by the yard crew however. When the consist arrives at the train it is connected. The brakeman will connect the air hoses and if directed to by the engineer will assist with the electrical connections. Again, however, the entire connecting operation may be handled by the yard crew.

In some cases, the brakeman does not go to the consist with the engineer but rather, after registering, goes directly to the train. In such cases, the brakeman is excluded from the entire operation described above.

TASK NO. B-2 | TASK TITLE Connect Power Consist to Train
SUB-TASK NO. B-2.1 | SUB-TASK TITLE Report to Consist

DIFFICULTY 1
HAZARD -
CRITICALITY 1
DURATION 10-15 Minutes
FREQUENCY At beginning of mission

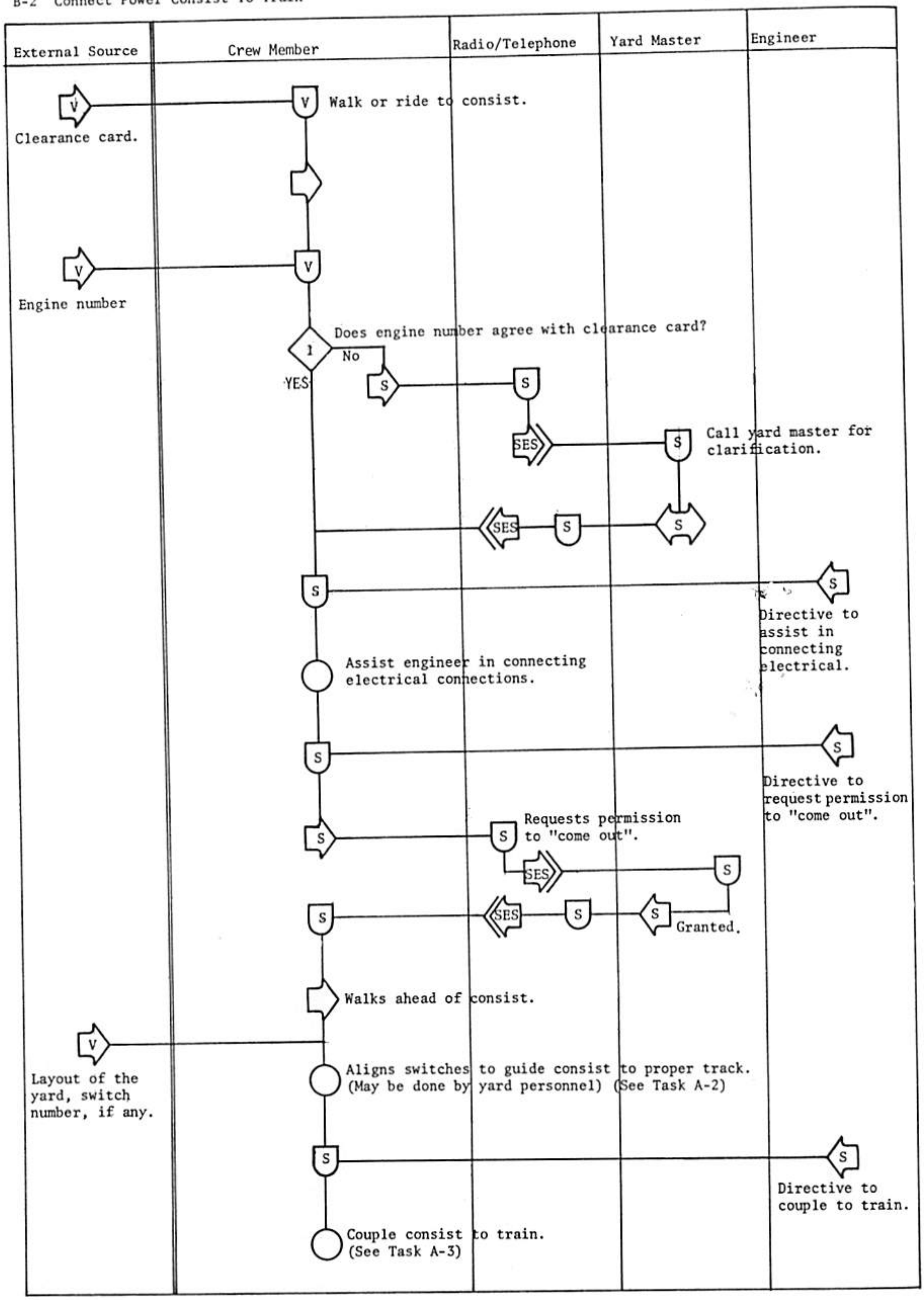
STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
1	Walk or ride to consist	Knowledge that registering is complete and plans are understood	Clearance card indicating consist number and location	Time to leave for consist	Walk or board bus			
2	Verify engine number		Engine number clearance card	Do engine numbers agree with those on clearance card?	If they do not agree, call yard master	Phone		
3	Assist engineer in connecting electrical connections between locomotives	Directive by engineer		Knowledge of operation of cables and insert male end. Interlock glad-hands on hoses.	Lift cap on female end of cable and insert male end. Interlock glad-hands on hoses.		Visual observation that connections are complete	This is not often done as electrical connections are the responsibility of the engineer

TASK NO. B-2 TASK TITLE Connect Power Consist to Train
SUB-TASK NO. B-2.2 SUB-TASK TITLE Direct Power to Train

DIFFICULTY 1-2
HAZARD -
CRITICALITY 2
DURATION 5-15 Minutes
FREQUENCY At beginning of mission

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Request permission to come out for train	Directive from engineer			Radio yard master or operator	Radio	Verbal confirmation of order	
2	Align switches	Movement of train directives from engineer	Alignment of switches	Present location and route through yard to where train is located	SEE TASK A-2		SEE TASK A-2	This may be done by yard personnel.
3	Couple consist to train	Arrival at proper train Directive from engineer		(SEE TASK A-3)				This may be done by yard personnel.

B-2 Connect Power Consist To Train



B-2 CONNECT POWER CONSIST TO TRAIN

◇1. Does engine number agree with clearance card?

This is a simple comparison of numbers. The number on the clearance card refers to one locomotive in the power consist, not necessarily the lead locomotive.

B-3 PRE-TRIP INSPECTION

There are two phases of this inspection, a walk around inspection and a roll out inspection. During the walk around inspection the car numbers are compared to the train list to determine if they are in the proper order and blocked (i.e., all the cars to be set out at one location are together) and no cars are missing or extra cars are in the train but not on the train list. Any discrepancies are reported to the yard master. The location of hazardous materials (e.g., cars carrying explosives) and "high-wides" (i.e., oversized cars) are noted. Any violation of company or federal regulations is reported to the yard master. Inspection is made of the lights and other signals on the consist and train, couplings are inspected, as are hand brakes and tools and supplies. Any problems are reported to the yard master. Any cars that must be removed from the train or repairs that must be made are done by the yard crew. Occasionally, the train crew will assist but this is not their responsibility.

After the crew is satisfied that the train has passed the walk around inspection. The engineer is signalled to move the train (after he has been cleared to move by the yard master). A crew member positions himself beside the track and inspects the train as it rolls past him. If he notes any problems (e.g., sticking brake, sharp wheel flange, dragging equipment, open box car or shifted load) he signals the engineer to stop and notifies the yard master. A yard crew will then take remedial action as directed by the yard master.

The inspection is an important safety precaution. It often uncovers potential safety problems which can be corrected before they become serious. An interesting question is whether each crew member should attend to a limited number of possible defects and inspect the entire train or should each crew member attend to all possible defects and inspect a limited number of cars, or several crew members inspect the entire train in parallel for all defects. The cost effectiveness of each alternative should be investigated.

TASK NO. B-3 TASK TITLE Pre-trip inspections
SUB-TASK NO. B-3.1 SUB-TASK TITLE Walk around inspection

DIFFICULTY 2
HAZARD -
CRITICALITY 2
DURATION 10-25 Minutes
FREQUENCY At start of mission

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Verify train make-up against train list	Train list and car numbers		Determines if cars are in proper order for set outs and if they are blocked. Notes car numbers at points where train will be cut for set outs.	If cars are not blocked, call yard master. If extra cars are in train but not on list notifies yard master.	Yard phone	Confirm that list and train agree. Yard master confirms receipt of message.	
2	Notes location of hazardous materials	Train list, car numbers and waybills. Knowledge of ICC and company rules regarding shipping of hazardous materials.		Determines if materials are being handled according to ICC and company rules.	If violation exists, yard master is called.	Yard phone or radio	Confirmation of receipt of message	
3	Note location of "high-wides"	Train list and visual observation						
4	Inspect lights and signals	Visual observations		Knowledge of proper signals and lights	If incorrect or defective report to yard master	Yard phone or radio	Confirmation of receipt of message	

TASK NO. B-3 TASK TITLE Pre-trip inspection
SUB-TASK NO. B-3.1 SUB-TASK TITLE Walk around inspection

DIFFICULTY 2
HAZARD -
CRITICALITY 2
DURATION 10-25 Minutes
FREQUENCY At start of mission

(CONTINUED FROM PREVIOUS SHEET)

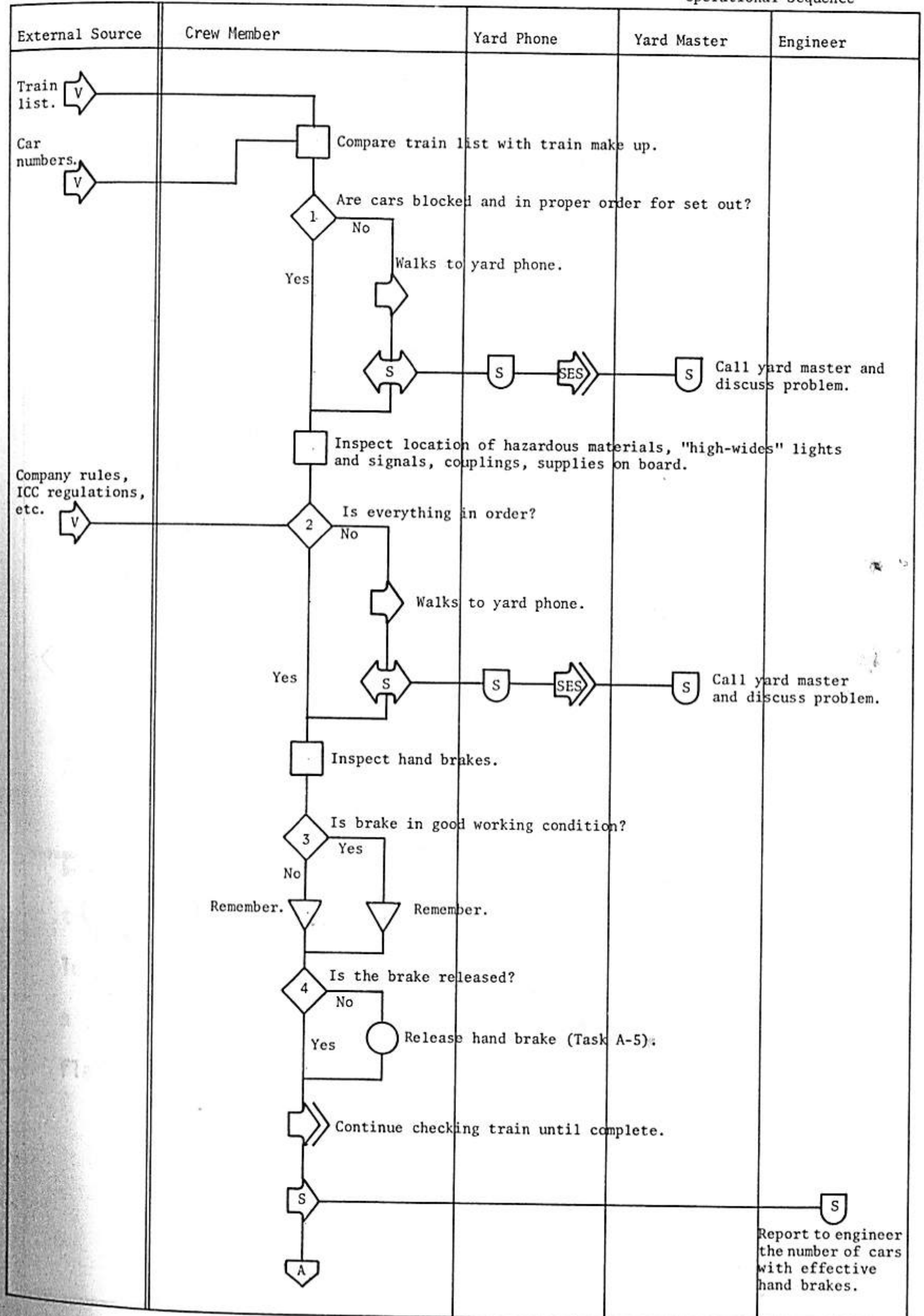
STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
5	Inspect coupling	Visual observation	Knuckles draw bars	Determination that couplings are in good condition	Walk around look at couplings. If defective report to yard master	Yard phone	Receipt of message confirmed	
6	Verify that hand brakes are released on all cars	Visual observation. Knowledge that all brakes must be released.	Chain. Piston.	Determination that brake is released and chain is not broken.	If brake is not released must release brake (see Task A-5). Report to the engineer the number of cars with effective air brakes.	Hand brake wheel Radio or direct verbal	Visual and tactual confirmation that brake is released. Verbal confirmation.	
7	Verify that sufficient supplies and tools are on board (locomotive and caboose)			Knowledge of what supplies and tools are required during the mission and the location where they are kept.	Visual observation. If insufficient, notify yard master.	Radio	Acknowledgement of message.	

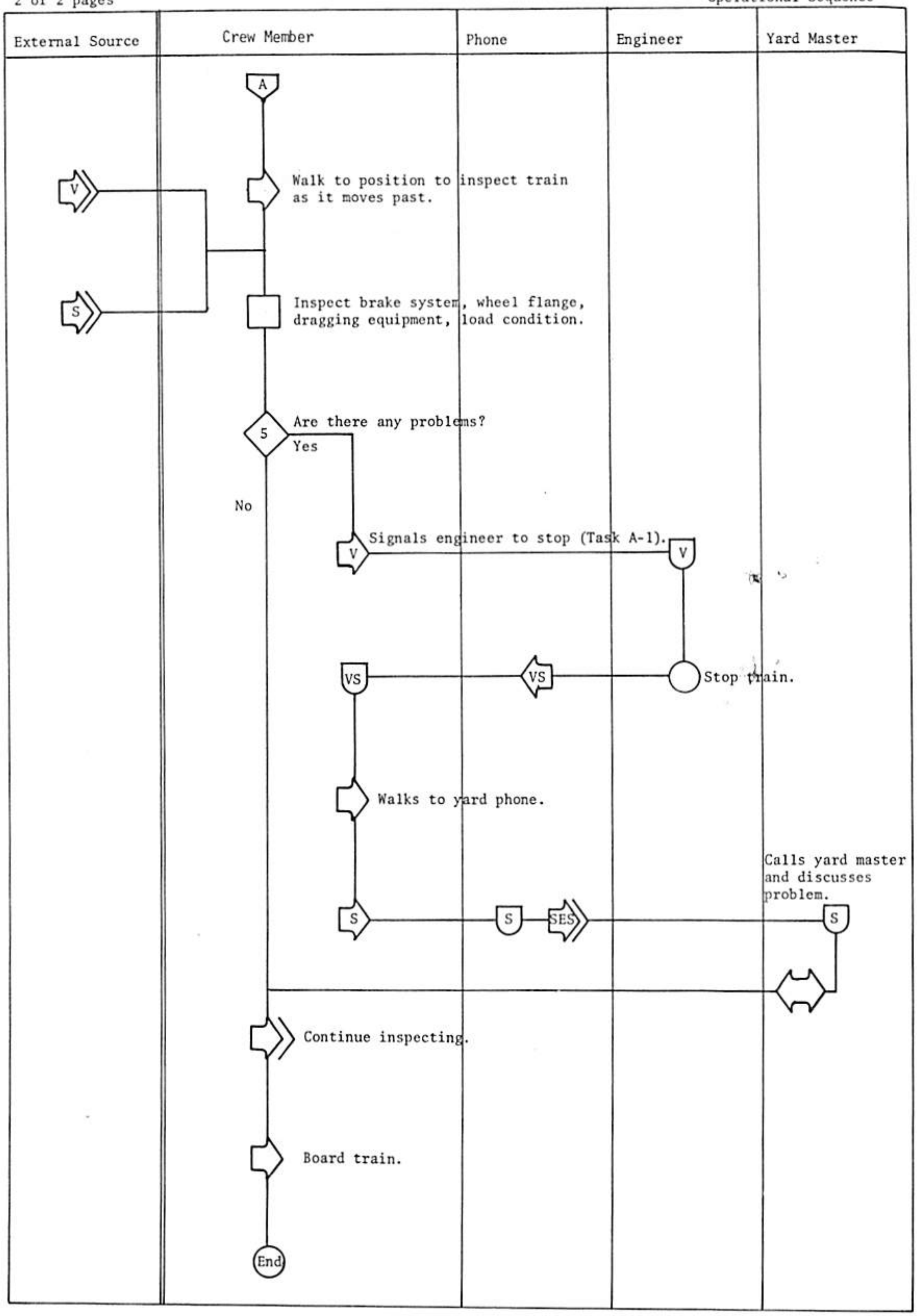
TASK NO. B-3 TASK TITLE Pre-Trip Inspection
SUB-TASK NO. B-3.2 SUB-TASK TITLE Roll Out Inspection

DIFFICULTY 2
HAZARD -
CRITICALITY 2-4
DURATION 5-30 Minutes
FREQUENCY At start of operation and wherever possible

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Inspect brake system	Knowledge of common defects Sound of shoe rubbing wheel, or wheel slipping.	Air lines, pistons, shoes, angle cocks, retainer valves.	Determine if brake system is functioning properly.	If defective, signal engineer to stop.	Hand, flag, or lantern	Observation that train stopped.	
2	Inspect wheel flange	Knowledge of what a wheel flange should look like.	Wheel flange	Determination of whether flange looks too sharp	Call yard master, signal engineer to stop	Yard phone Hand, flag, lantern	Confirmation Observation that train stopped.	
3	Inspect for any dragging equipment		Auditory sound of equipment hitting ground		Signal engineer to stop train, call yard master	Hand, flag lantern Yard phone	Observation that train stopped Confirmation	
4	Inspect for load conditions	Company rules and regulations Visual observation.		Are box car doors open, has a load on a flat car shifted?	Signal engineer to stop. Call yard master.	Hand, flag, lantern. Yard phone.	Observation that train stopped. Confirmation.	

Operational Sequence




External Source
Crew Member
Phone
Engineer
Yard Master
A
V
S
Walk to position to inspect train as it moves past.
Inspect brake system, wheel flange, dragging equipment, load condition.
5
Are there any problems?
Yes
No
Signals engineer to stop (Task A-1).
V
V
VS
VS
Stop train.
Walks to yard phone.
Calls yard master and discusses problem.
S
S
SES
S
Continue inspecting.
Board train.
End

B-3 PRE-TRIP INSPECTION

1. Are cars blocked and in proper order for set out?

This requires knowledge of the order in which set outs are made by destination. Matching car numbers with those on the train list verifies that cars are blocked and in proper order.

2. Is everything in order?

The crew member must know company and ICC regulations concerning shipment of hazardous materials and display of lights and signals. Knowledge of needed supplies and quantities must be memorized.

3. Is brake in good working condition?

See Task A-5, Decision 2.

4. Is the brake released?

See Task A-5, Decision 4.

5. Are there any problems?

The crew member is required to check for an unspecified number of possible problems as the train moves past.

Some conditions are cued auditorily, such as the noise made by slipping wheels due to locked brakes or dragging equipment on the track. Other potential problems require visual observation. A shifted load may require gross observation, while a worn wheel flange requires a difficult psycho-physical judgment concerning the thickness of the flange.

B-4 MOVE TO MAIN TRACK

After the train has passed the pre-trip inspection, the engineer directs the head brakeman to radio the yard master and request clearance to proceed to main track. As the train moves, the caboose (rear brakeman or conductor) radios the locomotive confirming its movement. The head brakeman may walk ahead of the train and align switches to "herd" the train onto the main track. Usually, this is done by yard crews.

As the train leaves the yard the head and rear brakemen pick up train orders from the order stand. This requires the crew member to lean out of the cab or caboose and, while the train is moving, grasp the message hanging from the stand. If the message is missed, the engineer is radioed to stop and the crew member walks back to pick up the message. The rear brakeman or conductor radios the engineer when the caboose leaves the yard. The conductor may be required to prepare a message ("soup ticket") to be dropped at the telegraph office. The message usually contains the train number, time of departure, number of cars and list of cars.

TASK NO. B-4 — TASK TITLE Move to Main Track
SUB-TASK NO. — SUB-TASK TITLE

DIFFICULTY	1,2 (Step 4)
HAZARD	F (Step 4)
CRITICALITY	2,5 (Step 3)
DURATION	5-10 Minutes
FREQUENCY	At start of operation

STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
1	Request clear-ance to proceed	Directive by engineer			Radio yard master and request clearance	Radio	Verbal confirmation of clearance to proceed	
2	Radio locomotive when caboose begins to move	Perception of movement in caboose			Radio locomotive	Radio	Verbal confirmation that message received	This must be done each time the train is started from a stop. Especially if cars have been added or dropped from train.
3	Align switches to herd the train on the main track	Knowledge of yard layout directives from engineer and yard master	Switch sig-nals and points	Knowledge of switch operations and desired alignments	(See Task A-2)			May be done by yard personnel
4	Pick up train orders from order stand	Location of order stand	Order board or signal light	Determine if orders are to be picked up, judge time of arrival to stand	Position self out-side on end of train, reach out, and catch string as train passes. If missed, radio engineer, stop, and back up.	Orders Radio	Tactual and visual con-firmation that orders were grasped Observation that train is stopping.	This is done at intermediate stations as well

TASK NO. B-4
SUB-TASK NO.

TASK TITLE Move to Main Track
SUB-TASK TITLE

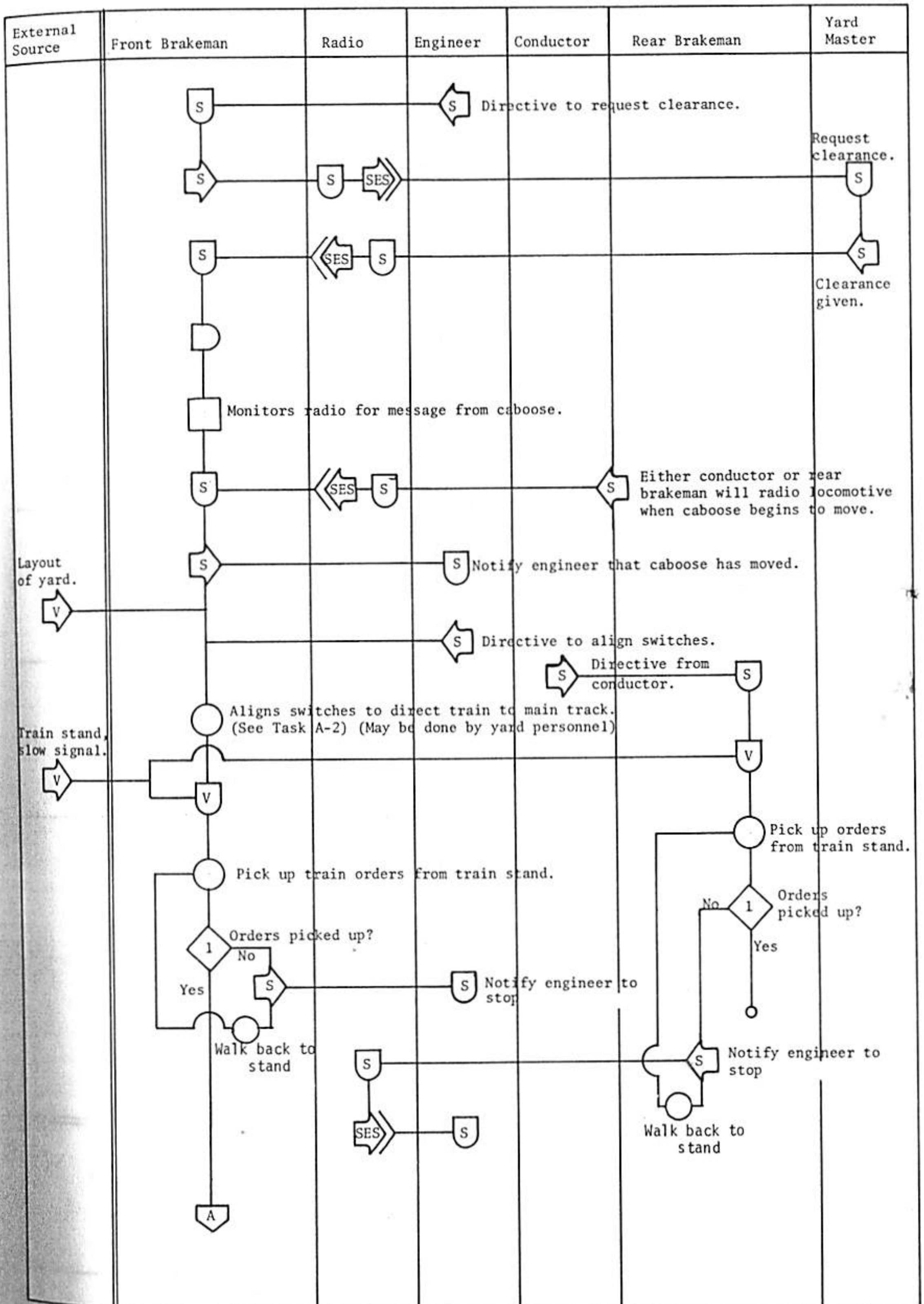
(CONTINUED FROM PREVIOUS SHEET)

DIFFICULTY
HAZARD
CRITICALITY
DURATION
FREQUENCY

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
5	Radio caboose when locomotive leaves yard.	Position of train			Radio caboose	Radio	Verbal confirmation that message received.	
6	Prepare message (soup ticket) for telegraph operator	Departure time train number, number of cars list of cars	Time piece Train list	Determination that caboose is at correct location	Message rolled up, a weight is secured to one end and it is thrown from the train	Paper and writing implement		

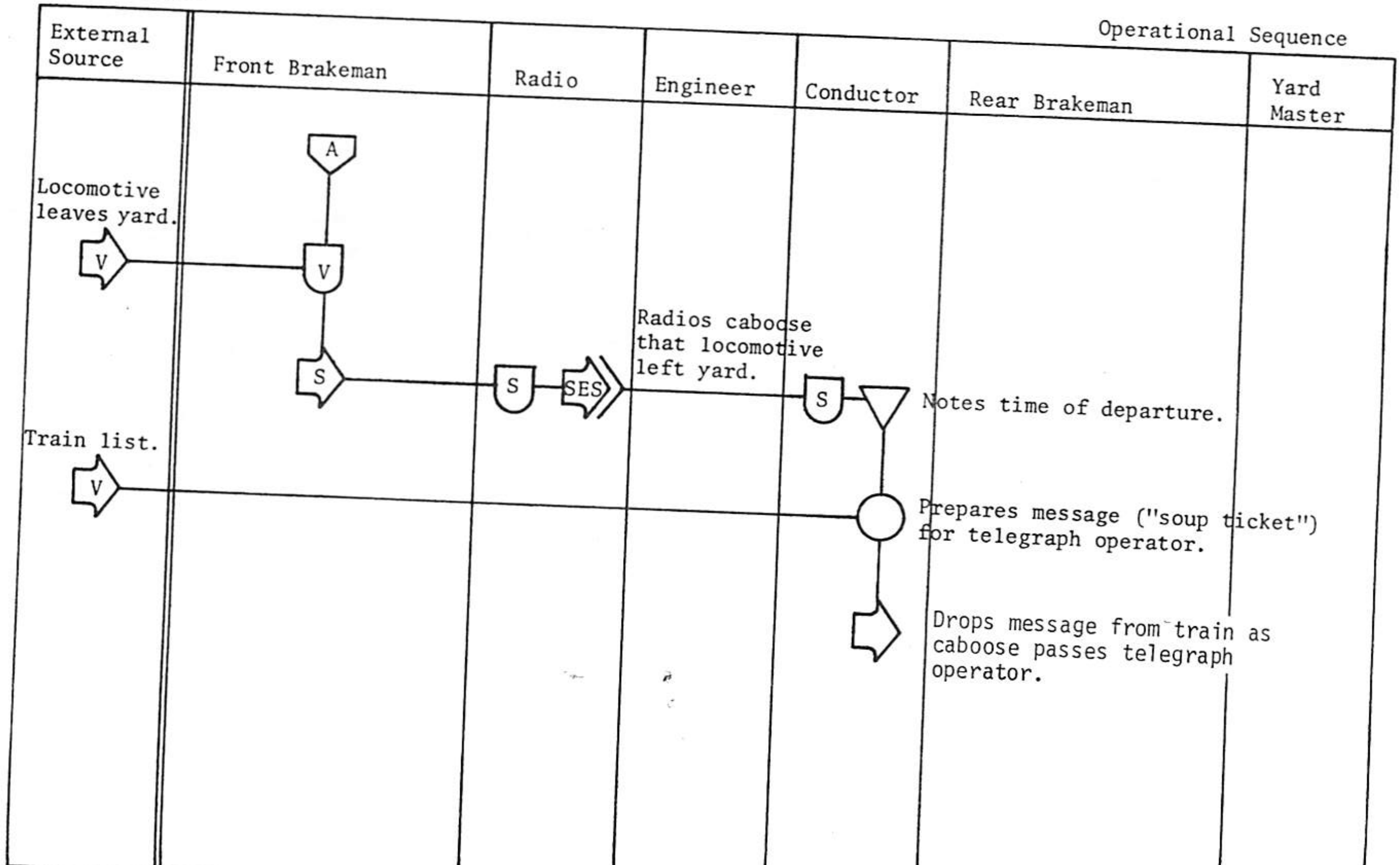
B-4 Move to Main Track
1 of 2 pages.

Operational Sequence



B-4 Move to Main Track

2 of 2 pages



B-4 MOVE TO MAIN TRACK

1. Orders picked up?

This is a simple go-no go decision. If the crew member missed the order string or if it were dropped, he has not picked up the orders.

B-5 DETERMINE LENGTH OF TRAIN

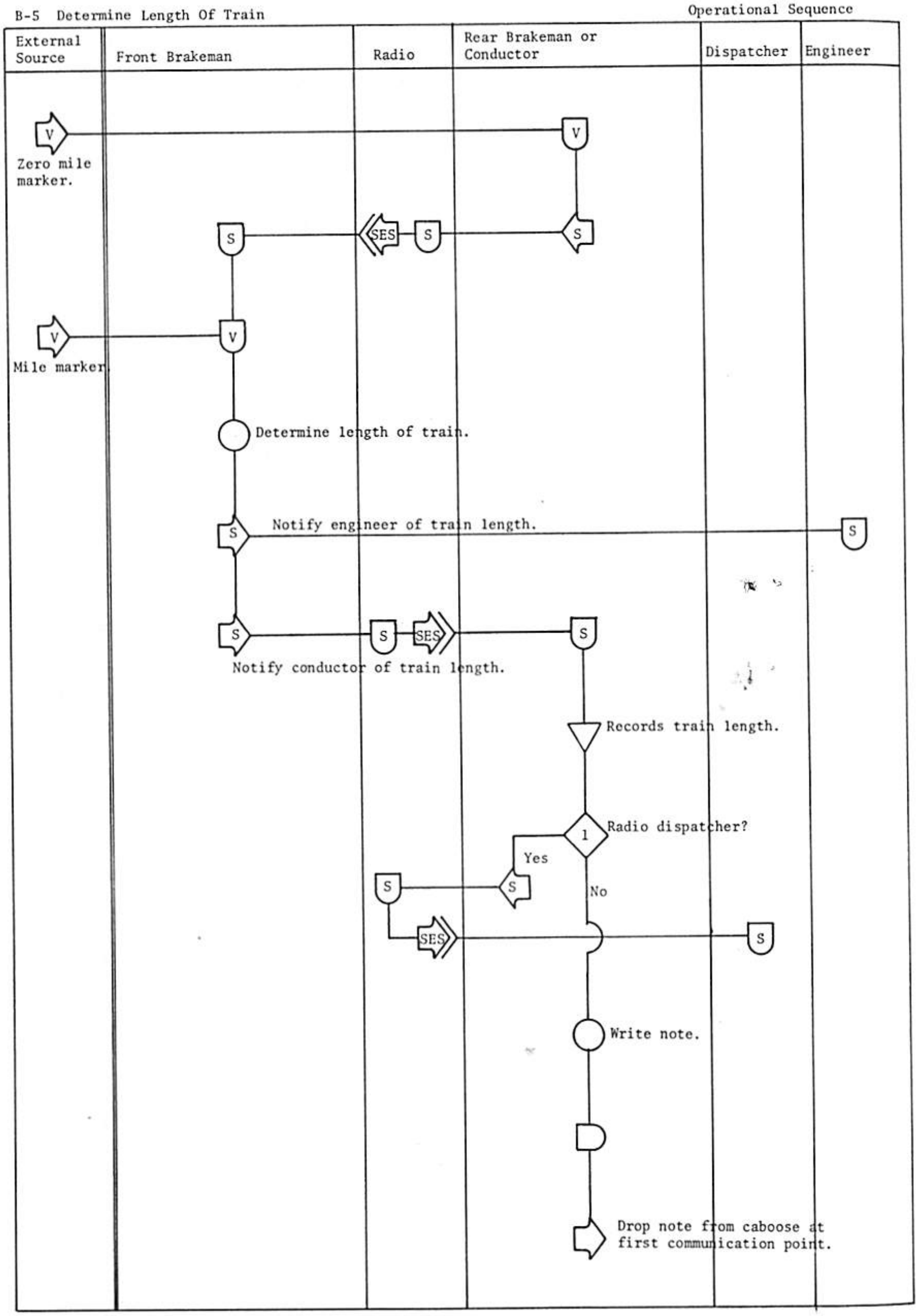
To determine the length of the train the rear brakeman or conductor radios the locomotive when the caboose passes a zero marker alongside the track (usually located at exit of the yard). The head brakeman notes the location of the caboose relative to distance markers located along track. This information is forwarded to the dispatcher via radio or message (soup ticket) drop.

TASK NO. B-5	TASK TITLE Determine Length of Train	DIFFICULTY	1
SUB-TASK NO.	SUB-TASK TITLE	HAZARD	-
		CRITICALITY	1
		DURATION	10 Seconds
		FREQUENCY	At start of the mission

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Radio locomotives when caboose passes zero marker.	Knowledge that length determination is to be made.	Zero marker		Radio locomotive	Radio	Head brakeman indicates length of train.	
2	Note location of locomotive when caboose radios position.	Meaning and use of distance markers. Message that locomotive is at zero marker.	Distance markers radio	Determine length of train by observing distance markers.	Radio caboose indicating the length of the train. Inform the engineer of length of train.	Radio Direct Verbal	Verbal confirmation Verbal confirmation	
3	Notify dispatcher	Length of train	Radio or message		Radio dispatcher or drop note at first communication point (See Task B, step 6)	Radio Paper & Pencil	Verbal confirmation	

B-5 Determine Length Of Train

Operational Sequence



B-5 DETERMINE LENGTH OF TRAIN

1. Radio dispatcher?

This is not a critical decision. The decision depends on the location of the train relative to the next message drop communication point, the work load of the conductor, and the apparent work load of the dispatcher (the latter judged by the volume of radio calls monitored).

C-1 REGISTER AT INTERMEDIATE STATIONS

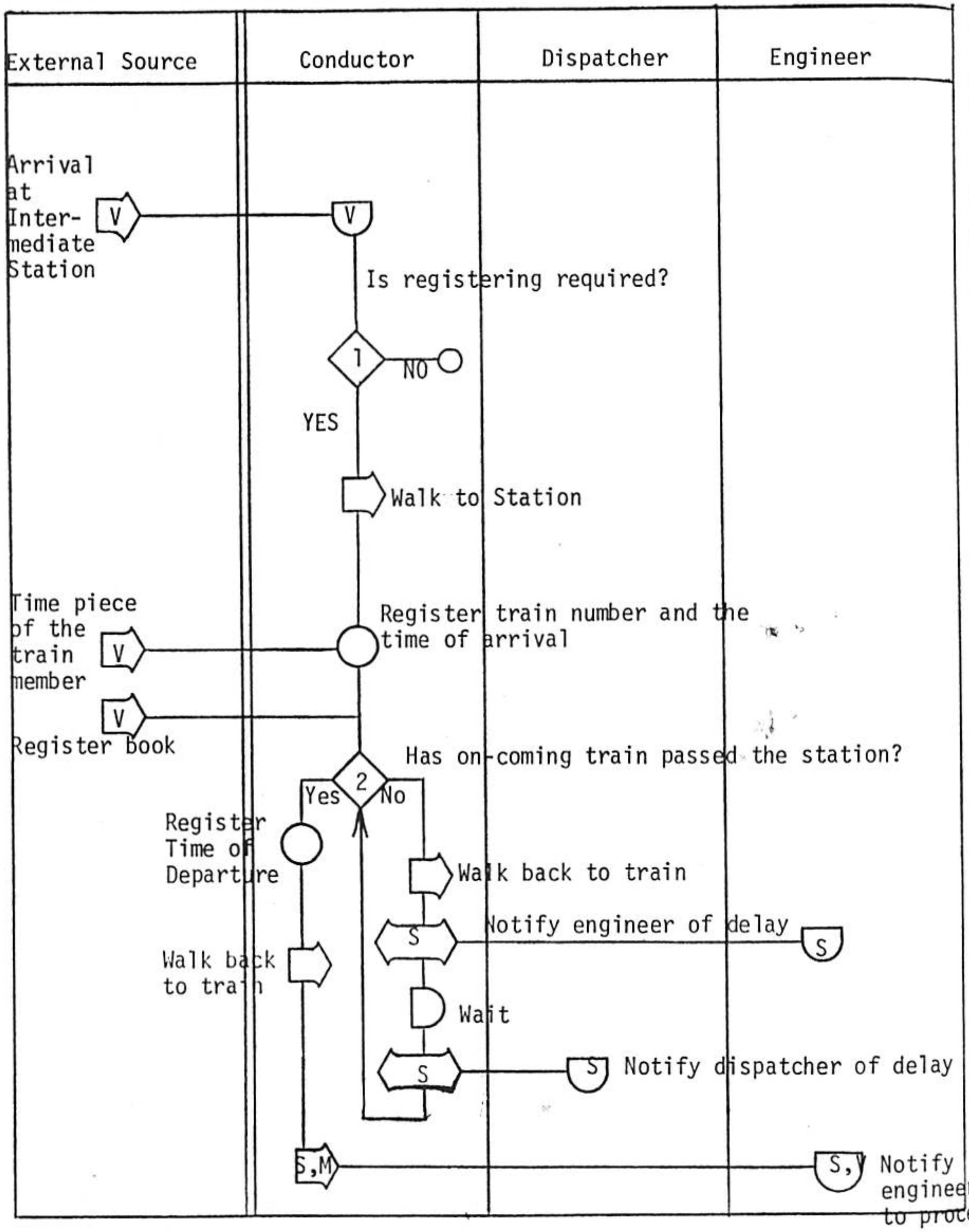
Company rules require trains to register at intermediate stations and to proceed only if oncoming trains have already passed by reading the register. The conductor can determine if the oncoming train has passed and that it is safe to proceed. If it is not safe to proceed, the conductor would notify the engineer and wait until the train does pass. All delays should be communicated to the dispatcher.

If the conductor misreads the register and instructs the engineer to proceed, the result could be a head-on collision.

TASK NO. C-1 | TASK TITLE Register at Intermediate Stations
SUB-TASK NO. | SUB-TASK TITLE

DIFFICULTY 1
HAZARD -
CRITICALITY 5
DURATION 2-10 Minutes*
FREQUENCY As Required
*Considerable delay possible waiting for train to pass.

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Register train at intermediate stations.	Knowledge of which stations require registering. Procedure followed in registering.	Time piece		Write train number time of arrival	Writing instrument	Visual confirmation that register is complete.	
2	Determine if it is safe to proceed.	Knowledge of safe conditions under which to proceed.	Register book	Confirming that oncoming trains have passed the station	Signal engineers to proceed and write time of departure in register.	Direct verbal hand, lantern, radio, writing instrument	Visual that train begins to move.	If it is not safe to proceed, the train would wait. The dispatcher would be called if delay was excessive.



External Source
Conductor
Dispatcher
Engineer
Arrival at Inter-mediate Station
V
V
Is registering required?
1
NO
YES
Walk to Station
Time piece of the train member
V
Register train number and the time of arrival
V
Register book
Has on-coming train passed the station?
2
Yes
No
Register Time of Departure
Walk back to train
S
Notify engineer of delay
S
Walk back to train
Wait
S
S
Notify dispatcher of delay
S,M
S,V
Notify engineer to proce

C-1 REGISTER AT INTERMEDIATE STATIONS

1. Is registering required?

Company policy dictates when registering is required. The conductor must know the policy and determine if it applies in the situation at hand. If the conductor should forget, the other crew member would remind him that registering is required.

2. Have oncoming trains passed the station?

The conductor reads the register to determine what trains have passed and when. He must know which trains must have passed before proceeding. This information might be contained in the time table or in a special train order.

C-2 INSPECT TRAINS ON THE ROAD

C-2.1 Inspect Own Train

This is done at every opportunity by the brakemen and conductor. As the train rounds a curve the train is visible from the ends. The most common problems include sparks or smoke from the wheels, unusual tilt of a car, or dragging equipment. If anything unusual is seen, the engineer is notified and the train may be stopped to allow closer investigation. If the problem demands quick action, the emergency brake will be activated.

TASK NO. C-2
SUB-TASK NO. C-2.1

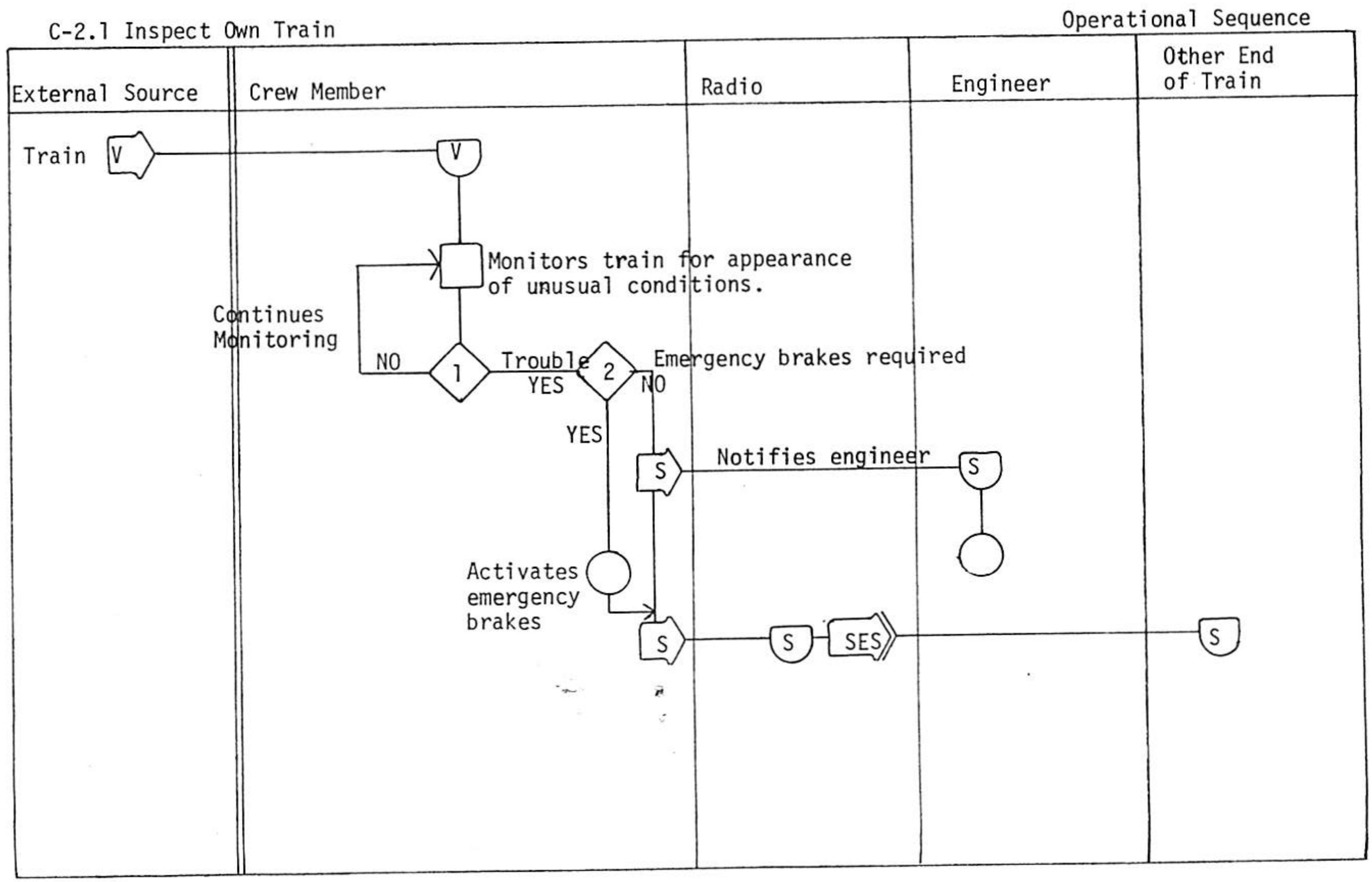
TASK TITLE Inspect Trains on the Road
SUB-TASK TITLE Inspect Own Train

DIFFICULTY	3
HAZARD	G
CRITICALITY	3-4
DURATION	Continuous
FREQUENCY	Whenever Possible

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Inspect own train on curve	Knowledge of common problems and their visual cues. Sparks or smoke from wheels, dust blowing from one wheel, unusual tilt of a car, dragging equipment, shifted load, etc.		Was there anything unusual seen? Is emergency braking required?	Notify engineer Activate the emergency brake	Direct verbal Emergency brake	Engineer acknowledges receipt of message Sound of escaping air, train slowing	

C-2 Inspect Trains on the Road

C-2.1 Inspect Own Train



C-2 INSPECT TRAINS ON THE ROAD

C-2.1 Inspect Own Train

1. Trouble?

The crew member must simultaneously check for several potential problems during the short interval in which the train is visible. The primary malfunctions inspected for are hot journal which is detectable by flames and smoke emitted from a wheel of a car and derailed cars. Other malfunctions include a shifted load, unusual tilt of a box car, an unsecured load, sparks from the wheel, dust being blown from a wheel, the sound of dragging equipment or an out-of-round wheel, sticking brakes or sliding wheels.

2. Emergency brakes required?

This is a split-second decision. The crew member must decide whether the hazard is grave enough to demand emergency braking and whether the train can be stopped by the engineer in sufficient time without emergency brakes. Such things as a misaligned switch or track obstruction would usually require emergency braking.

C-2 INSPECT TRAINS ON THE ROAD

C-2.2 Inspect Passing Trains

When passing a train, the crew member should inspect it for possible problems such as smoke or sparks from a wheel. If anything unusual is seen, the passing train is signalled (by hand or lantern) or radioed. A signal is given if nothing unusual was observed. The passing train also signals the status of the crew member's train. If the passing train notes any problems, they are relayed to the engineer or if necessary the emergency brake is activated.

TASK NO. C-2
SUB-TASK NO. C-2.2

TASK TITLE Inspect Trains on the Road
SUB-TASK TITLE Inspect Passing Trains

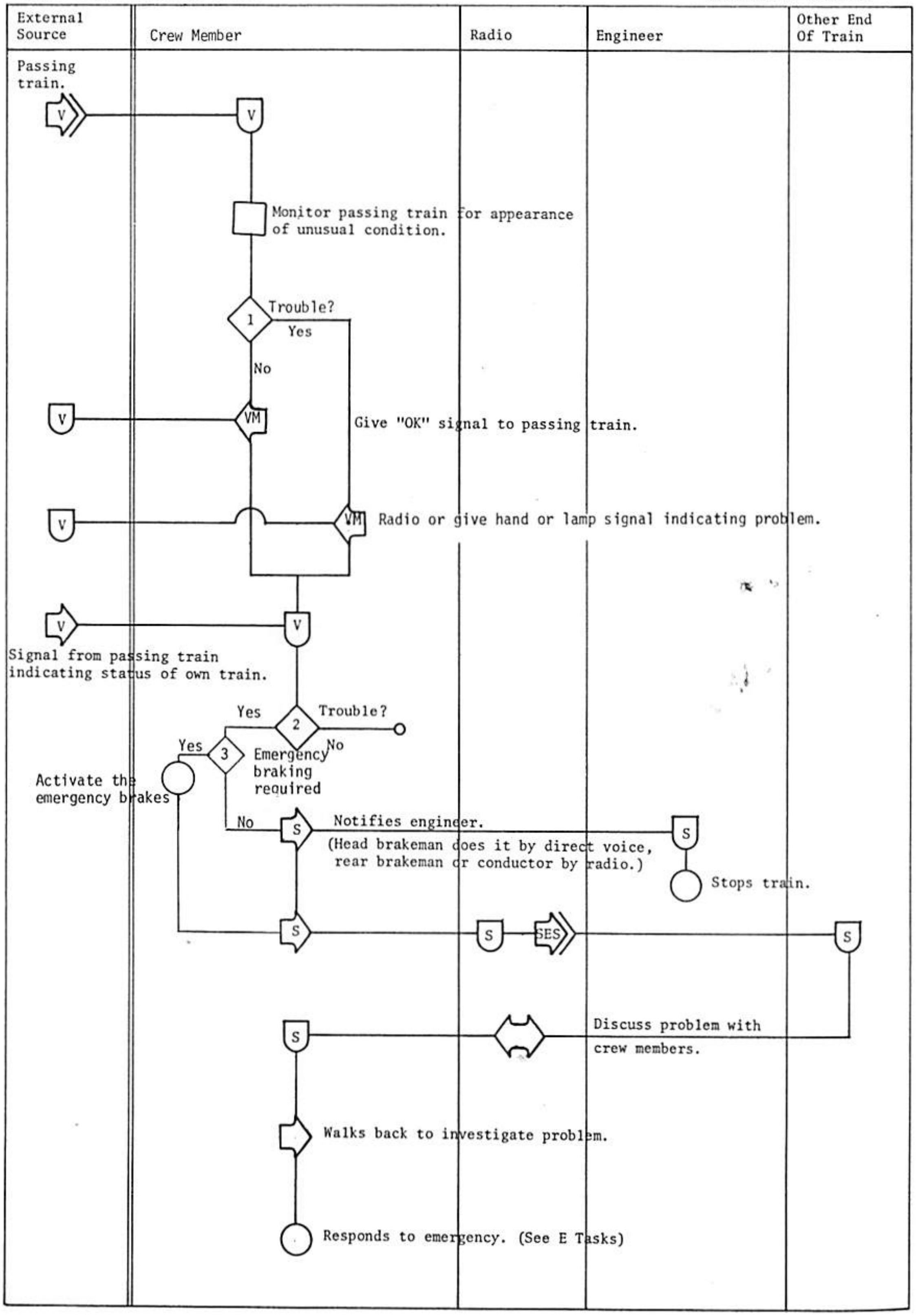
DIFFICULTY	3
HAZARD	-
CRITICALITY	2-4
DURATION	Continuous
FREQUENCY	Whenever possible

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Inspect Passing Trains	Same as C-2.1		Was there anything unusual seen?	Signal or radio passing train indicating status of their train	Lantern, hand, radio	Acknowledgement by passing train that message was received.	
		Signal from passing train concerning crew member's train	Flag, hand, or lantern	What is meaning of signal? Does it require emergency braking?	Notify engineer. Pull emergency brake.	Radio Emergency brake	Acknowledge message Escape of air, slowing of train	

C-2 Inspect Trains On The Road

C-2.2 Inspect Passing Trains

Operational Sequence



C-2 INSPECT TRAINS ON THE ROAD

C-2.2 Inspect Passing Trains

1. Trouble?

   See Task C-2.1, Decision 1

2. Trouble?

   This requires the crew member to know the meaning of standard signals.

3. Emergency brakes required?

   See Task C.2.1., Decision 2

C-3 REPORT TRACK AND SIGNAL CONDITIONS

This is done continuously by all crew members. The engineer is notified of all block signals, train and siding signs, slow orders, and other information displays concerning the train's operation. Track conditions such as switch alignments, obstructions, soft spots in the track bed, and trespassers are reported to the engineer. If the situation demands quick action, the crew member should pull the emergency brake.

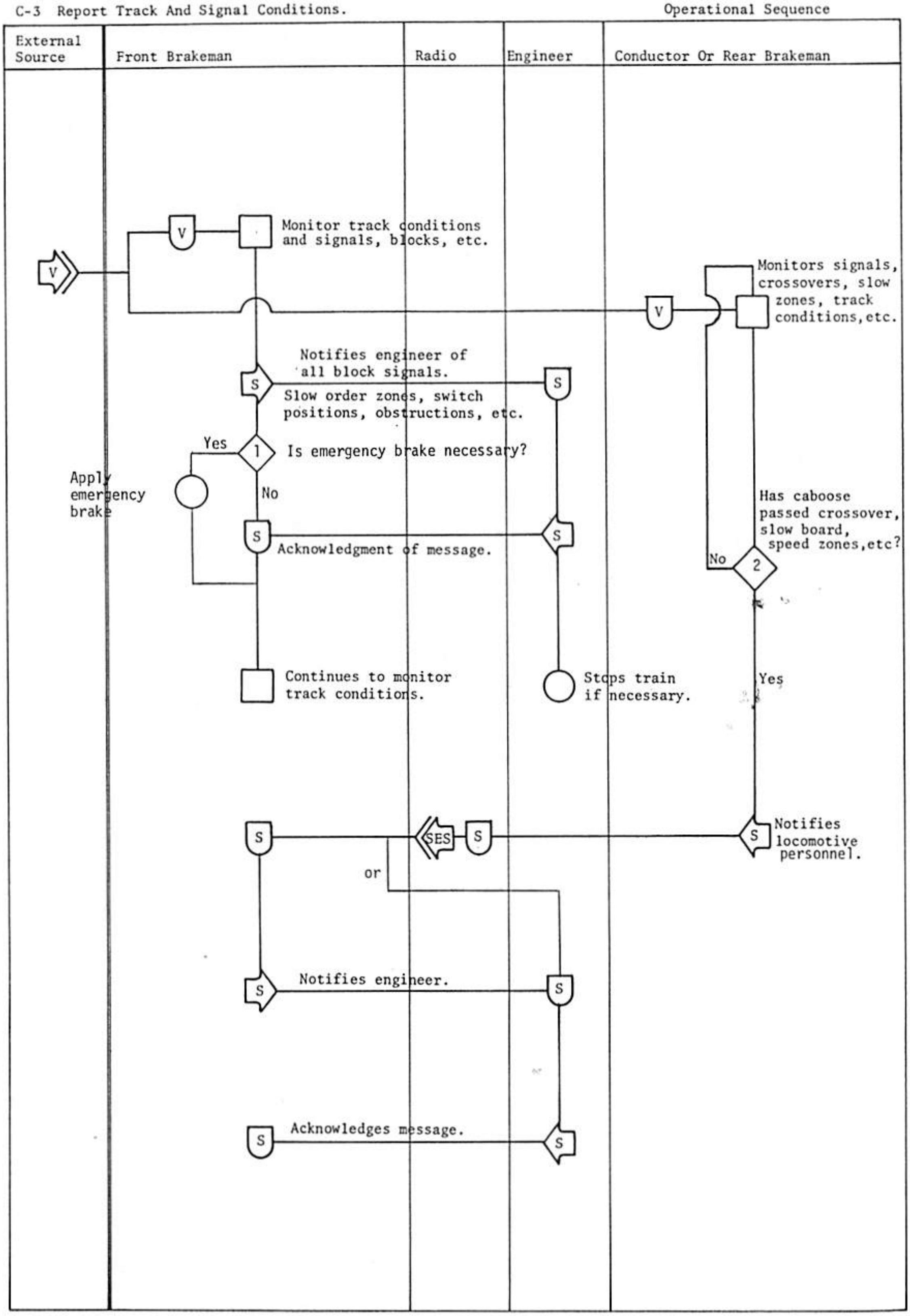
The rear brakeman or conductor radios the engineer when the caboose passes the end of a slow board, a crossover, or other area where the train had to be slowed.

TASK NO. C-3
SUB-TASK NO.

TASK TITLE Report Track and Signal Conditions
SUB-TASK TITLE

DIFFICULTY 2
HAZARD -
CRITICALITY 3-4-5
DURATION Continuous
FREQUENCY Continuous

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Monitor track and signal conditions	Switch alignment, obstructions, soft spots in the track bed, trespassers, slow orders, etc.	Signals, blocks	Knowledge of the meaning of various signals, location of slow orders, knowledge of subtle cues indicating unsafe conditions (e.g., light colored dirt on road bed may indicate a soft spot requiring a reduction in speed)	Call out the conditions to engineer Activate emergency brakes	Direct Verbal Emergency brake	Engineer repeats message. Sound of air escaping.	
2	Radio locomotive when caboose passes slow board, cross over, etc.		Signals, blocks		Radio engineer	Radio	Acknowledgement of message	


External Source
Front Brakeman
Radio
Engineer
Conductor Or Rear Brakeman
V
Monitor track conditions and signals, blocks, etc.
Monitors signals, crossovers, slow zones, track conditions, etc.
Notifies engineer of all block signals.
Slow order zones, switch positions, obstructions, etc.
Yes
Is emergency brake necessary?
Apply emergency brake
No
Acknowledgment of message.
Has caboose passed crossover, slow board, speed zones, etc?
Continues to monitor track conditions.
Stops train if necessary.
Yes
SES
Notifies locomotive personnel.
or
Notifies engineer.
Acknowledges message.

C-3 REPORT TRACK AND SIGNAL CONDITIONS

1. Is emergency brake necessary?

See Task 2.1, Decision 2

2. Has caboose passed cross-over, slow board, etc.?

The crew member must remember train orders and know the location of the train and where the orders apply. The wording of orders assumes familiarity with the territory and occasionally includes colloquial references to locations along the route.

C-4 PROTECT TRAIN AT RED BLOCK OR OTHER EMERGENCY

If the train stops for a red block or other emergency (e.g., obstruction, hot box, derailment) it is the brakeman's responsibility to protect the train from oncoming trains (from the front and rear). If the brakemen are notified in advance of a stop, they will ignite and throw fusees (slow burning flares) as the train comes to a stop according to company rules.

After the train stops, the brakemen dismount and walk down the track from the train a distance which they feel is sufficient to stop an oncoming train. The conductor notifies the dispatcher of the delay. He also fills out the delay sheet indicating time of stop and duration.

If the dispatcher authorizes the train to move through the red block, the engineer directs the front brakeman to walk ahead of the train and inspect for unsafe conditions. The brakeman must maintain a distance sufficient to allow the train to stop if he signals the engineer.

TASK NO. C-4
SUB-TASK NO.

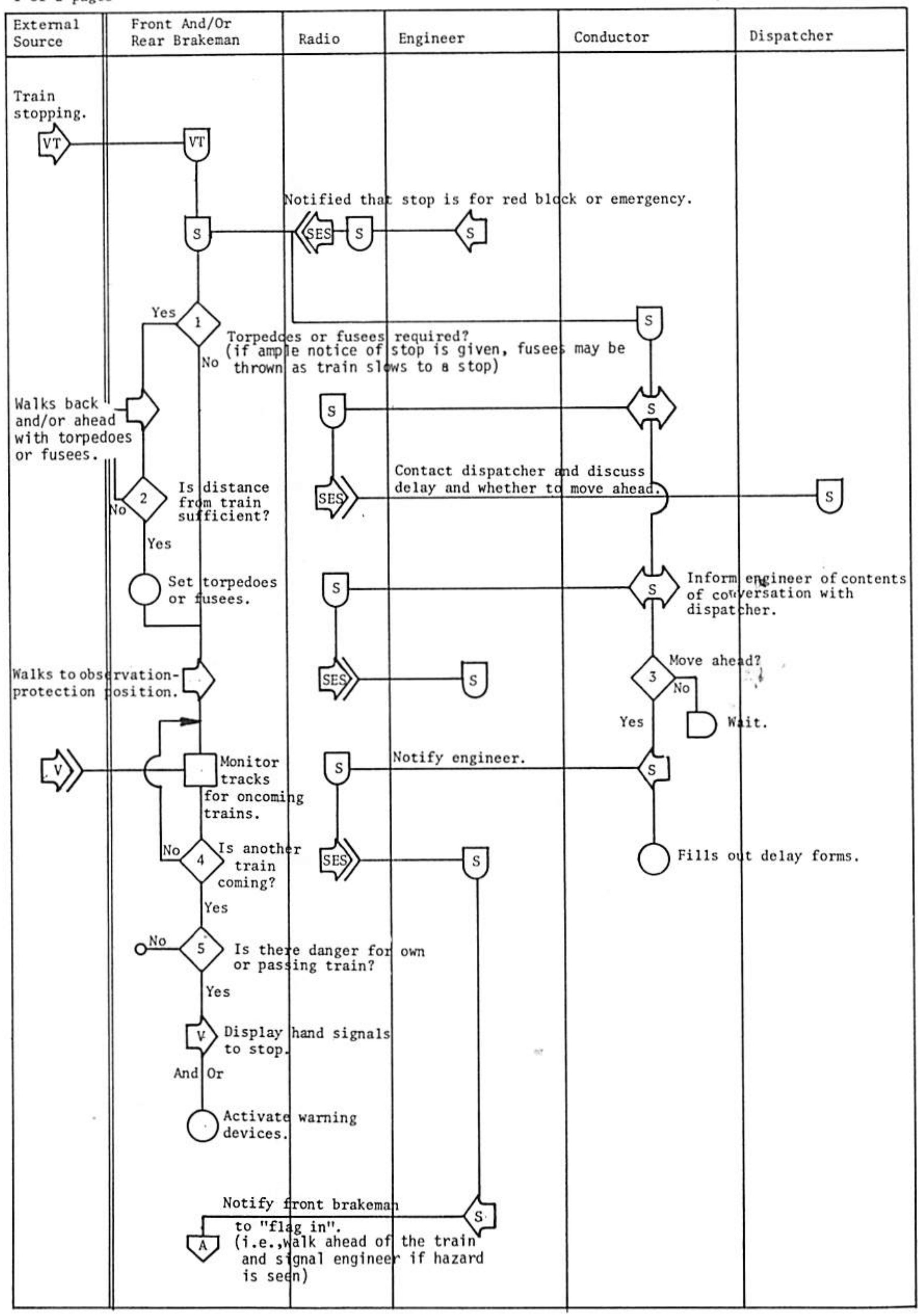
TASK TITLE Protect train at red block or other emergency
SUB-TASK TITLE

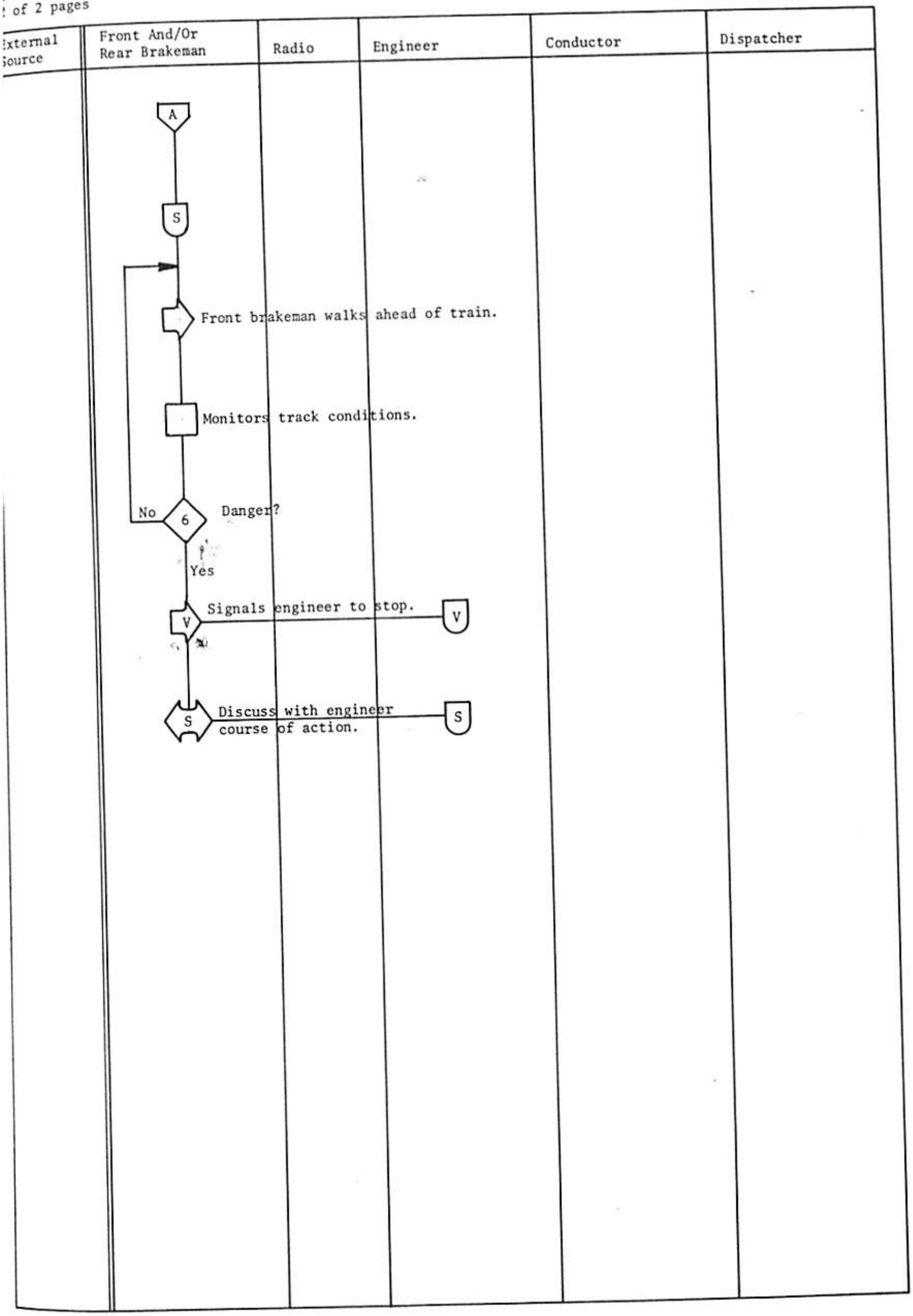
DIFFICULTY 1
HAZARD -
CRITICALITY 5
DURATION Indeterminant
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Protects ends of train	Knowledge that protection is needed. Geography and track layout directive from locomotive that stop is for red block or emergency	Red block Radio	Determination of distance from train necessary to stop an oncoming train. Determine if fuses or torpedoes are required.	Set fuses or torpedoes. Visual observation.	Fusees Torpedoes		Fusees may be thrown as train is slowing to stop if ample notice is given.
2	Contact dispatcher	Time delayed at red block			Radio operator or dispatcher	Radio	Verbal confirmation that message is received. Dispatcher may allow train to run the red block.	
3	Inspect track ahead of train while moving through red block.	Directive from engineer	Direct verbal Radio	Determination that conditions are safe for train to proceed	Walks ahead of the train and signals if unsafe conditions are found.	Lantern Radio		
4	Fill out delay sheet	Time of delay		Knowledge of procedure for filling out form	Fill in required information	Writing implement and form	Visual observation that form is complete	

C-4 Protect Train At Red Block Or Other Emergency

Operational Sequence




External Source
Front And/Or Rear Brakeman
Radio
Engineer
Conductor
Dispatcher
A
S
Front brakeman walks ahead of train.
Monitors track conditions.
No
6
Danger?
Yes
V
Signals engineer to stop.
V
S
Discuss with engineer course of action.
S

C-4 PROTECT TRAIN AT RED BLOCK OR OTHER EMERGENCY

◇1. Torpedoes or fusees required?

The brakeman must consider the visibility of the train as seen from an oncoming train, the track layout, and company rules or policy.

◇2. Is distance from train sufficient?

This is a judgmental decision. The criterion is stated in vague terms such as "a distance which allows an oncoming train to come to a safe stop without collision". The brakeman does not have the required information to make such a determination. He does not know, for example, the speed or weight of the oncoming train.

◇3. Move ahead?

This decision is made in conjunction with the dispatcher and should be cleared with the dispatcher before action is taken. In most situations, it is the dispatcher who makes the decision.

◇4. Is another train coming?

Usually auditory cues are the first indication that a train is approaching. The headlight may also be visible.

◇5. Is there danger for own or passing train?

This is a decision only if there is dual track, in which case an approaching train on the other track might pass without danger. On a single track, any approaching train is a danger.

◇6. Danger?

The brakeman is looking for such things as track obstructions, broken rails, switches (misaligned or tampered with) other trains or runaway cars.

C-5 SET OUT OR PICK UP CARS

C-5.1 Reomve Set Derails

If derails are present on a siding and a set out or pick up must be made, the derails must be removed first. After the operation, they are replaced. The crew member, typically the brakeman, unlocks the derails and removes them from the track. If the derails have been tampered with the dispatcher is notified. When the derails are replaced, they must be locked.

TASK NO. C-5
SUB-TASK NO. C-5.1

TASK TITLE Set out or pick up cars
SUB-TASK TITLE Remove set derails

DIFFICULTY 1
HAZARD F
CRITICALITY 5
DURATION 1 Minute
FREQUENCY As Required

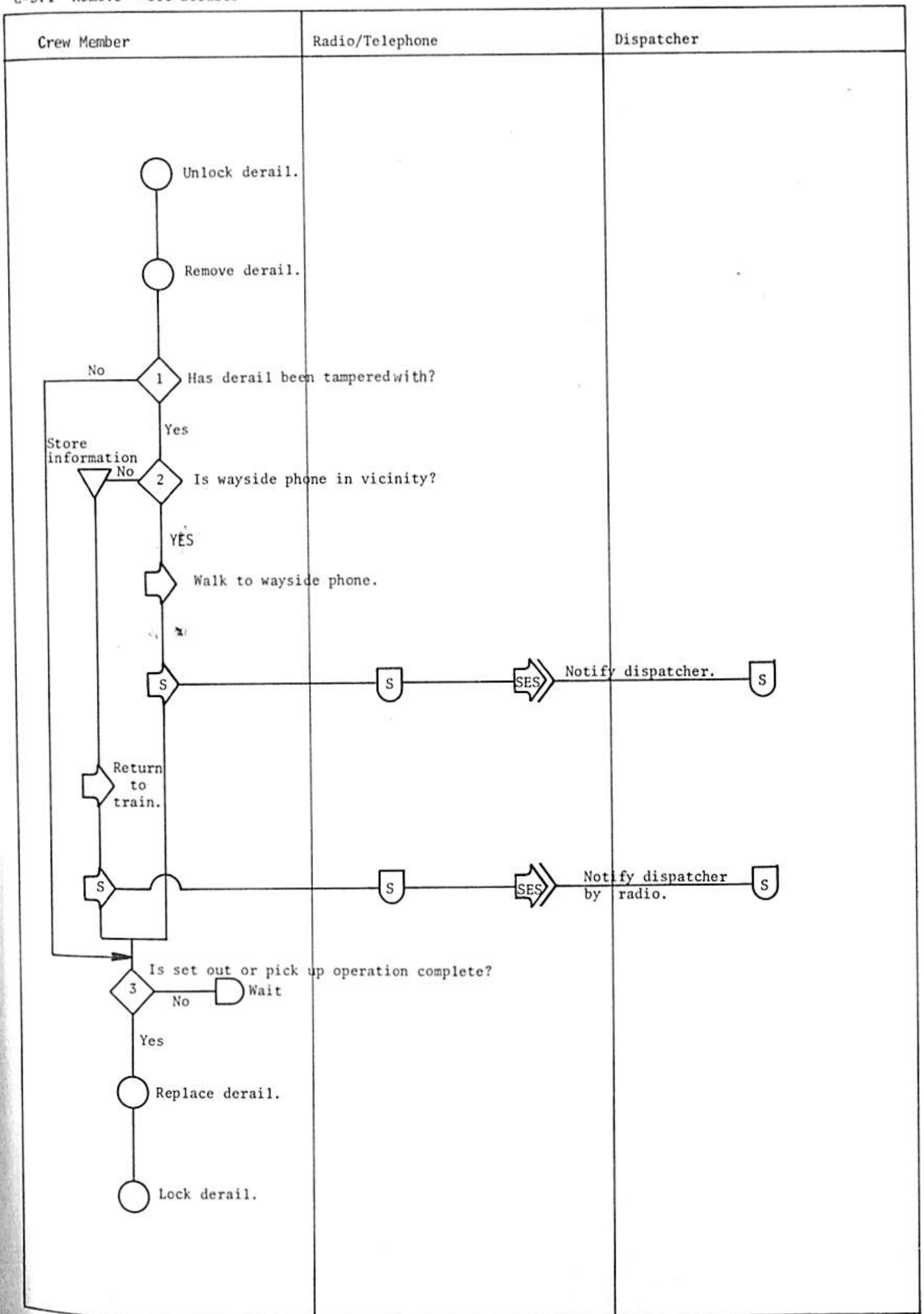
The sequence in which the subtasks are performed varies depending on the number and complexity of the set out or pick up operation.

STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
1	Unlock lock on derails	Knowledge of required procedure for using derails			Insert key in lock	Key	Visual observation	
2	Set or remove derail	Knowledge of required operation			Lift off or place on track or turn handle (depending on type of derail)	Handle	Visual observation that derail is set or removed.	
3	Lock the lock on the derail	Knowledge that derail must be locked			Attach lock and pull to be sure it is locked		Visual and tactual confirmation	
4	Notify dispatcher if derail has been tampered with or is defective.	Visual observation		Determine if derail is operative	Phone or radio	Wayside phone Radio	Verbal confirmation that message was received.	

C-5 Set Out Or Pick Up Cars

C-5.1 Remove - Set Derails

Operational Sequence



C-5 SET OUT OR PICK UP CARS

C-5.1 Remove Set Derails

1. Has derail been tampered with?

This can be determined by cursory observation. Usually tampering consists of removing the derail or fouling the lock so it cannot be opened.

2. Is wayside phone in vicinity?

Visual observations will usually confirm the existence of a wayside phone. The crew member's knowledge of the set out location can save search time.

3. Is set out or pick up operation complete?

Knowledge of the particular set out or pick up scenario is required in order to determine if additional operations are required.

TASK NO. C-5 TASK TITLE Set out or pickup cars
SUB-TASK NO. C-5.2 SUB-TASK TITLE Align switch

DIFFICULTY 1
HAZARD -
CRITICALITY 5
DURATION 2 Minutes
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Align switches		(S E E T A S K A-2)					

TASK NO. C-5	TASK TITLE Set out or pick up cars	DIFFICULTY	1-2
SUB-TASK NO. C-5.3	SUB-TASK TITLE Uncouple-couple cars	HAZARD	BF
		CRITICALITY	2
		DURATION	1-2 Minutes
		FREQUENCY	As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Uncouple or couple cars		(SEE TASKS A-3 AND A-4)					

C-5 SET OUT OR PICK UP CARS

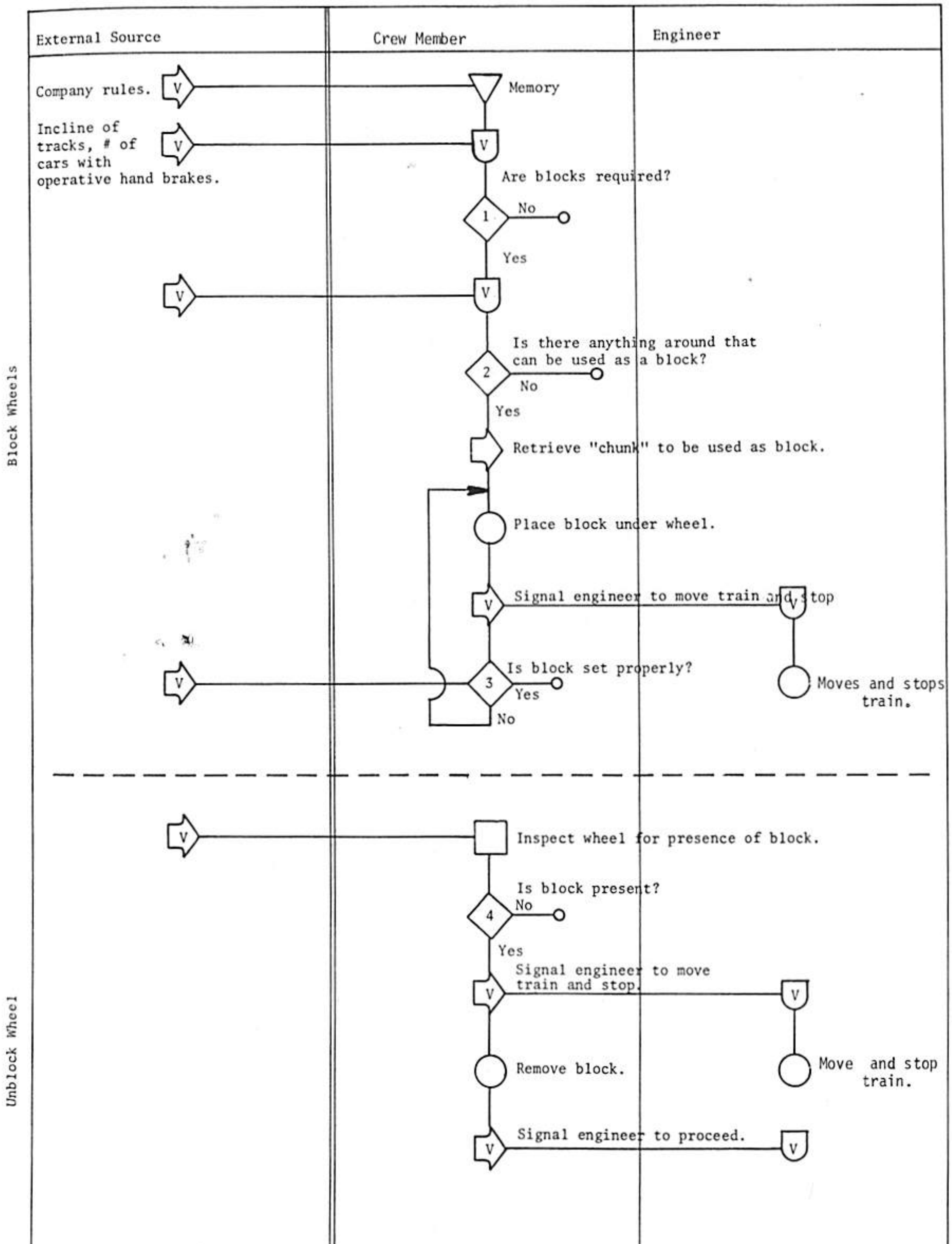
C-5.4 Block-Unblock Wheels

Depending on the grade, number of cars on the siding with operative hand brakes, the crew member may decide that blocking is required. Company rules often dictate conditions which require blocking. The crew member must find a suitable block, such as a piece of wood. The block is placed under the wheel. The engineer is signalled to move and stop. If the wheel rolls entirely over the block, it is reset and the engineer is again signalled to move and stop. To unblock a wheel, the engineer is signalled to move the train and the block is removed.

TASK NO. C-5   TASK TITLE Set out or pick up cars
SUB-TASK NO. C-5.4   SUB-TASK TITLE Block-unblock wheels

DIFFICULTY 1
HAZARD EB
CRITICALITY 3
DURATION 1-2 Minutes
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
1	Determine if blocks are required.	Grade, number of operative hand brakes, company regulations		Should blocks be used				
2	Find "chunk" to use as block	Visual surveillance of area for something to use as a block		Knowledge of what will make a good block	Retrieve object			
3	Place block under wheels	Knowledge of correct position of block			Place block under wheels		Visual confirmation that block is properly set	
4	Signal engineer to move and stop	Knowledge of the use and meaning of signals		Train must move just enough to squeeze block with wheel, if the wheels roll over block it must be reset	Signal (See Task A-1)	Hand, lantern radio	Visual observation of train's movement	
5	Unblock wheels	Visual observation that block is set			Signal to move train and remove block	Hand, lantern, radio	Visual confirmation that blocks removed.	


External Source
Crew Member
Engineer
Block Wheels
Company rules.
V
Memory
Incline of tracks, # of cars with operative hand brakes.
Are blocks required?
1
No
Yes
Is there anything around that can be used as a block?
2
Retrieve "chunk" to be used as block.
Place block under wheel.
Signal engineer to move train and stop
Is block set properly?
3
Moves and stops train.
Unblock Wheel
Inspect wheel for presence of block.
Is block present?
4
Signal engineer to move train and stop.
Remove block.
Move and stop train.
Signal engineer to proceed.

C-5.4 Block-Unblock Wheels

1. Are blocks required?

Company rules, regulations and policies specify situations where blocks are required. The crew member must consider the incline of the track and the number of cars with operative hand brakes engaged.

2. Is there anything around that can be used as a block?

This requires a little creativity in selecting a suitable object as a block. Objects not expressly made to be used as a block must be considered. Experience is the main guide in evaluating whether an object is suitable for use as a block.

3. Is block set properly?

Visual observation of block wedged between the wheel and rail indicates proper set. If the wheel has rolled over the block it must be reset.

4. Is block present?

This decision is a simple go-no go decision based on visual observation of the wheels of the car.

TASK NO. C-5
SUB-TASK NO. C-5.5

TASK TITLE Set out or pick up cars
SUB-TASK TITLE Set-release hand brakes

DIFFICULTY 1
HAZARD F
CRITICALITY 4-5
DURATION 2 Minutes
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
1	Set-release hand brakes	(S E E T A	S K A-5)					

C-5 SET OUT OR PICK UP CARS

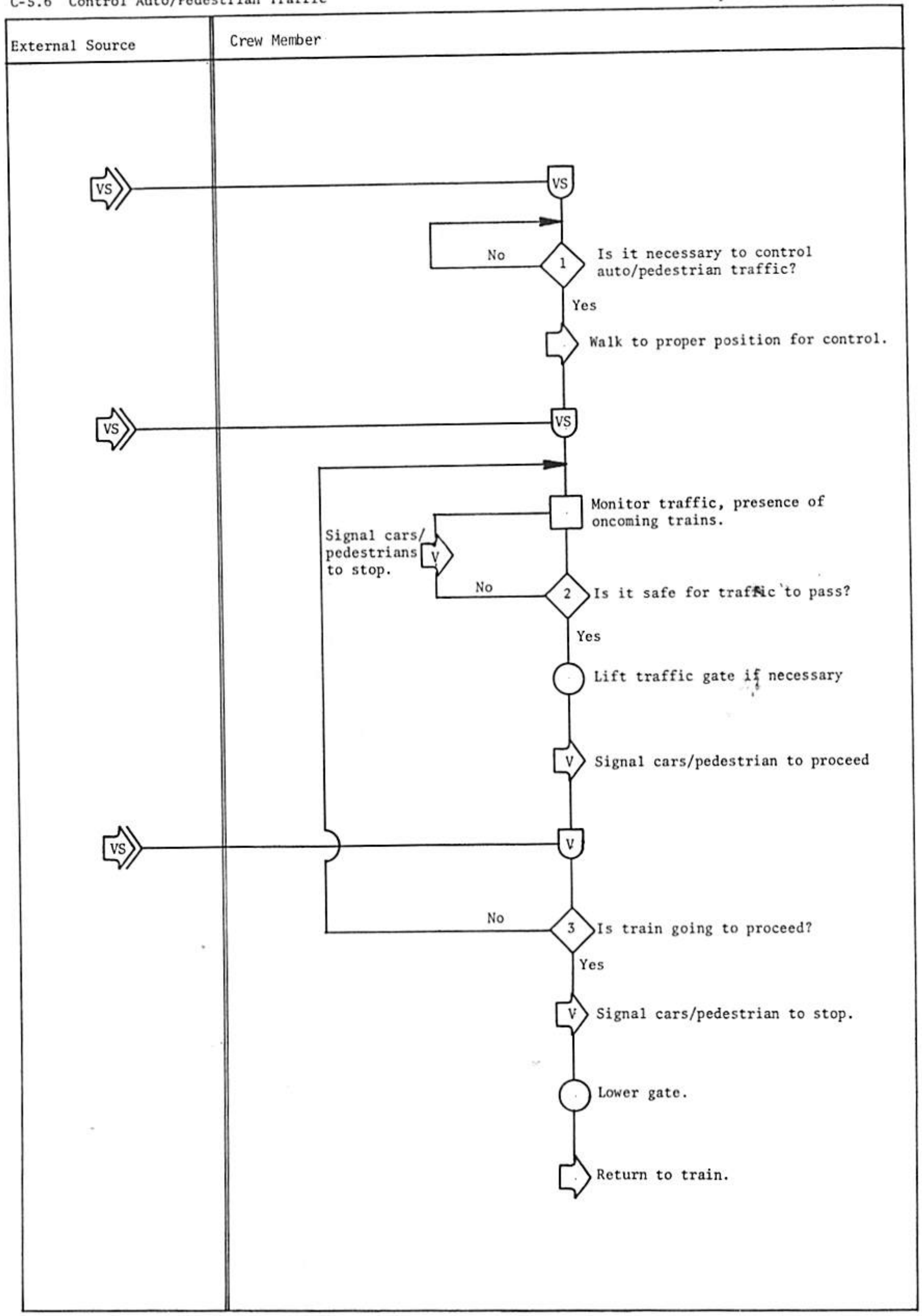
C-5.6 Control Auto/Pedestrian Traffic

Occasionally, a set out or pick up is made across a pedestrian or grade crossing. If the train is not blocking the crossing, a crew member, out of courtesy, will lift the gate (if necessary) and signal the traffic to cross the track if he determines it is safe to do so.

TASK NO. C-5 TASK TITLE Set out or pick up cars
SUB-TASK NO. C-5.6 SUB-TASK TITLE Control auto and pedestrian traffic

DIFFICULTY 1
HAZARD B
CRITICALITY 5
DURATION 1-10 Minutes
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Signal traffic	Geography of the immediate area and layout of the tracks.	Oncoming trains	Knowledge that it is safe for the traffic to cross the tracks.	Wave arm	Lantern	Visual observation that traffic is beginning to move	
2	Lift crossing gate if necessary	(SAME AS STEP 1)			Physically lift and hold gate	Gate		


External Source
Crew Member
VS
VS
No
1
Is it necessary to control auto/pedestrian traffic?
Yes
Walk to proper position for control.
VS
VS
Monitor traffic, presence of oncoming trains.
Signal cars/ pedestrians to stop.
V
No
2
Is it safe for traffic to pass?
Yes
Lift traffic gate if necessary
V
Signal cars/pedestrian to proceed
VS
V
No
3
Is train going to proceed?
Yes
V
Signal cars/pedestrian to stop.
Lower gate.
Return to train.

C-5.6 Control Auto/Pedestrian Traffic

1. Is it necessary to control A/P traffic?

The crew member must consider the expected length of time the train will remain in position and if cars and/or pedestrians wish to cross tracks. Often this is done as a courtesy.

2. Is it safe for traffic to pass?

The crew member must determine if the engineer will move the train and if any other train is approaching on another track. Visual and auditory cues are used to detect approaching trains. Knowledge of schedules is used to predict an oncoming train.

3. Is train going to proceed?

The primary cue used to determine if the train is about to move is the sound of the brakes being released. The engineer will usually signal with a standard signal on the horn.

C-5 SET OUT OR PICK UP CARS

C-5.7 Conduct Air Brake Test

When cars are picked up or set out, a brake test is performed. The angle cocks on all cars must be open. The engineer is then directed by the conductor to pump air into the brake lines. The conductor verifies that the pressure is sufficient in the caboose by looking at the pressure on the pressure gauge. If the pressure is not sufficient, the brakemen walk the train to discover the problem and repair it. Usually it will be a closed angle cock or a broken air hose. If the pressure is sufficient, the brakemen walk the train and inspect the pistons of each car to determine if the piston is out sufficiently. If not, the problem is corrected or noted if not correctable. The conductor then directs the engineer to reduce pressure by 20 lbs. This is verified by the conductor by looking at his gauge. The conductor then determines if the pressure drops more than 5 lbs/minute by watching the gauge for one minute. If the leak rate exceeds 5 lbs/min, the brakemen trouble shoot and repair the problem. The brakemen then inspect the pistons on all cars to be sure they are pushed in (released) properly. If not, the car will be cut out (that is, the air will be made to bypass the car), and its tanks bled to release the brake. The conductor will be notified and the proper repair forms will be filled out on the car. If the pistons are all properly released, the test is successfully ended.

TASK NO. C-5 TASK TITLE Set out or pick up cars
SUB-TASK NO. C-5.7 SUB-TASK TITLE Conduct air brake test

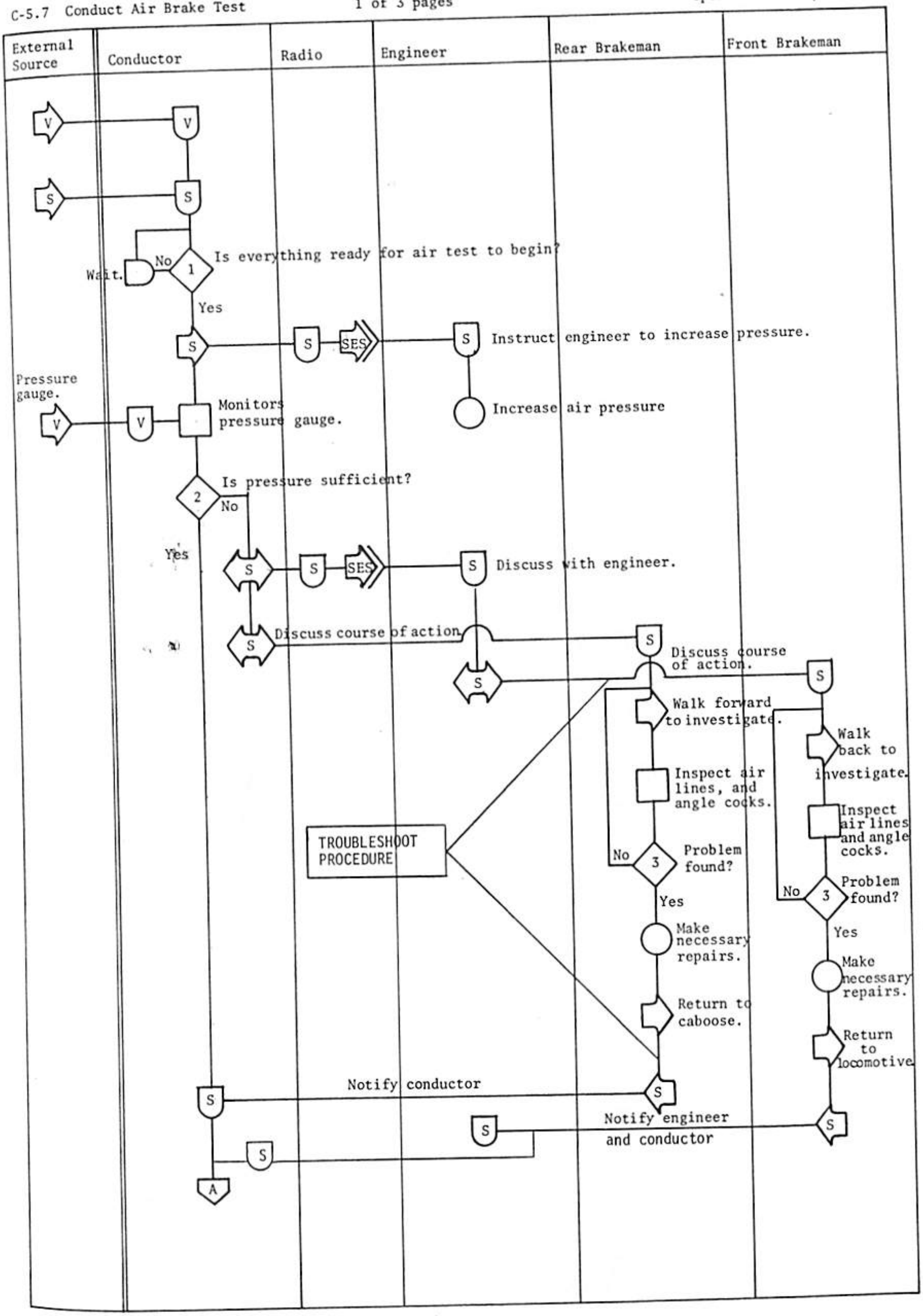
DIFFICULTY 3
HAZARD -
CRITICALITY 3
DURATION 10-60 minutes
FREQUENCY Each time cars are set out or picked up

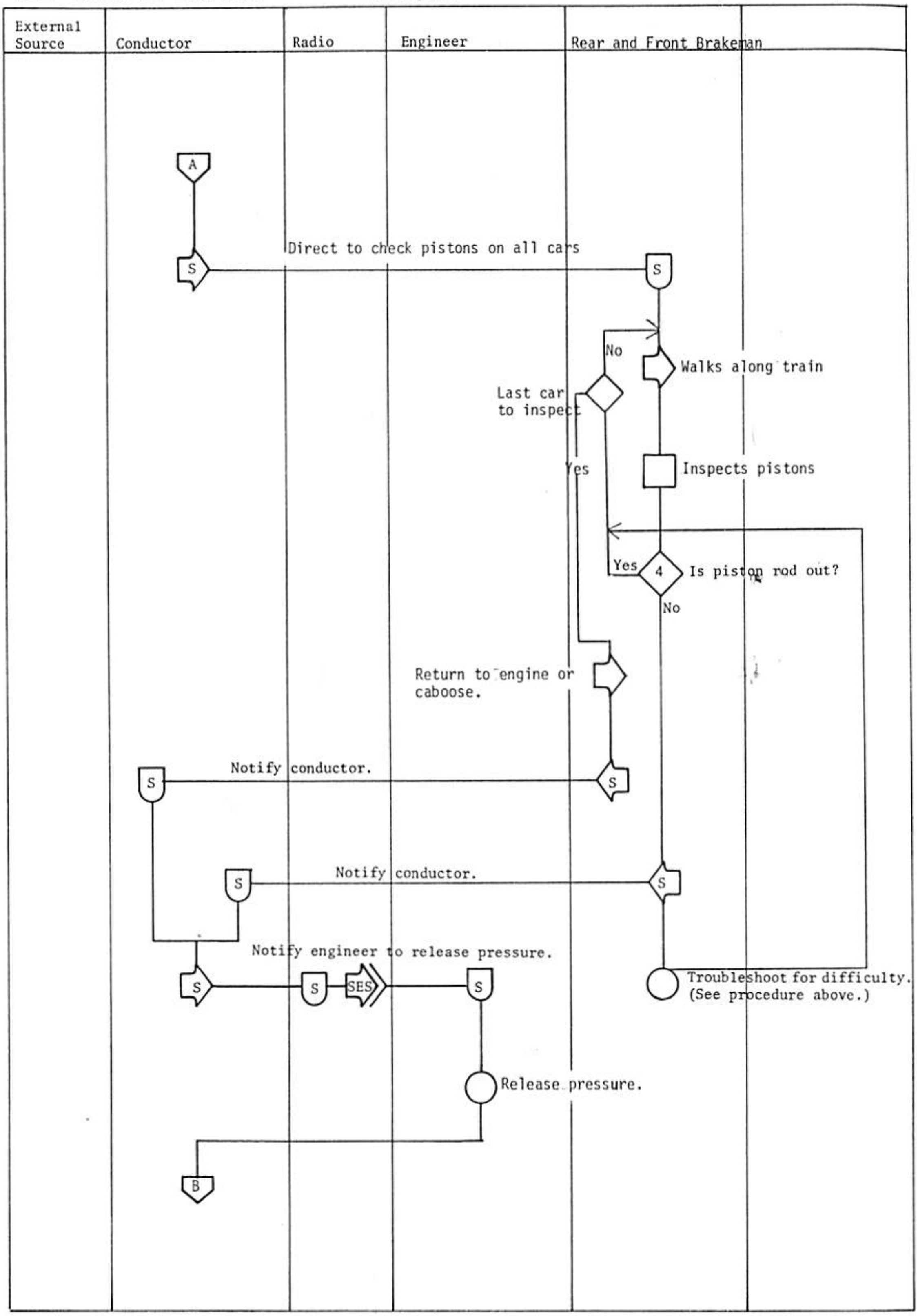
STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Verify that all angle cocks are open		Angle cock	Is angle cock open?	Open cock	Angle cock	Visual	
2	Notify engineer that all is ready for the test to begin.	Conductor's directive	Direct verbal		Radio Engineer	Radio	Verbal confirmation	
3	Verify that pressure comes up to proper pressure	Knowledge of proper pressure	Pressure gauge	Is the pressure sufficient?	Radio engineer. If insufficient pressure then troubleshoot for difficulty	Radio	Verbal	
4	Verify that pistons on cars are out	Knowledge of how far piston should be out	Piston	Is the piston in the proper position?	Leave caboose and walk the train to inspect pistons. If inoperative, troubleshoot and notify conductor		Acknowledgement of message	
5	Notify engineer to release pressure	Steps 2 and 3 check out			Radio engineer	Radio	Verbal confirmation	

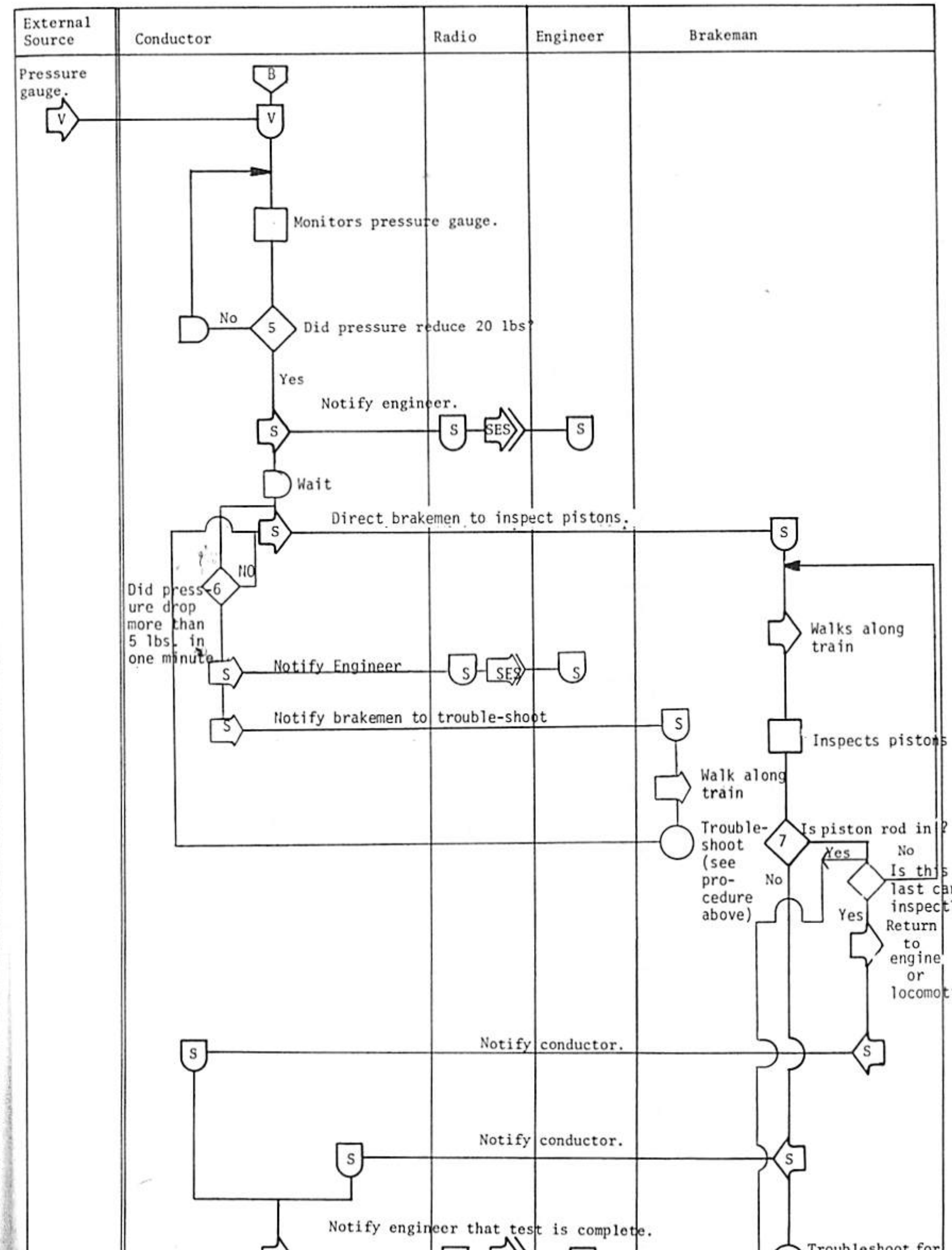
TASK NO. C-5 TASK TITLE Set out or pick up cars
SUB-TASK NO. C-5.7 SUB-TASK TITLE Conduct air brake test

DIFFICULTY 3
HAZARD -
CRITICALITY 3
DURATION 10-60 Minutes
FREQUENCY Each time cars are set out or picked up

STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
6	Verify that pressure reduced 20 lbs.		Pressure gauge	Did pressure drop?	Radio engineer	Radio	Verbal confirmation	
7	Check for leakage	Pressure gauge drops more than 5 lbs. in one minute	Pressure gauge		Radio engineer If too much leakage--trouble-shoot difficulty and repair	Radio Air hose angle cock of cars	Verbal confirmation Leakage stops	
8	Verify that pistons on all cars are in	Knowledge of proper piston position	Piston	Is the piston in the proper position?	Leave caboose & inspect piston. Notify engineer.	Radio	Verbal confirmation	


External Source
Conductor
Radio
Engineer
Rear Brakeman
Front Brakeman
V
S
Wait.
No
1
Is everything ready for air test to begin?
Yes
SES
Instruct engineer to increase pressure.
Pressure gauge.
Monitors pressure gauge.
Increase air pressure
2
Is pressure sufficient?
No
Yes
Discuss with engineer.
Discuss course of action
Discuss course of action.
Walk forward to investigate.
Walk back to investigate.
Inspect air lines, and angle cocks.
Inspect air lines and angle cocks.
TROUBLESHOOT PROCEDURE
3
Problem found?
Make necessary repairs.
Return to caboose.
Return to locomotive
Notify conductor
Notify engineer and conductor
A


External Source
Conductor
Radio
Engineer
Rear and Front Brakeman
A
Direct to check pistons on all cars
S
S
No
Walks along train
Last car to inspect
Yes
Inspects pistons
Yes
4
Is piston rod out?
No
Return to engine or caboose.
Notify conductor.
S
S
Notify conductor.
S
S
Notify engineer to release pressure.
S
S
SES
S
Troubleshoot for difficulty. (See procedure above.)
Release pressure.
B


External Source
Conductor
Radio
Engineer
Brakeman
Pressure gauge.
V
B
V
Monitors pressure gauge.
No
5
Did pressure reduce 20 lbs?
Yes
Notify engineer.
S
S
SES
S
Wait
Direct brakemen to inspect pistons.
S
S
NO
6
Did pressure drop more than 5 lbs. in one minute
S
Notify Engineer
S
SES
S
S
Notify brakemen to trouble-shoot
S
Walks along train
Inspects pistons
Walk along train
Trouble-shoot (see procedure above)
7
Is piston rod in ?
Yes
No
No
Is this the last car to inspect?
Yes
Return to engine or locomotive
S
Notify conductor.
S
S
Notify conductor.
S
Notify engineer that test is complete.
S
S
SES
S
Troubleshoot for difficulty. (See procedure above.)

C-5.7 Conduct Air Brake Test

1. Is everything ready for air test to begin?

The conductor must be sure that all functions of set out or pick up have been complete and that the angle cocks on all the cars are open.

2. Is pressure sufficient?

This requires simple check reading of the pressure gauge. Minimum and maximum allowable pressures must be known.

3. Problem found?

The major cause of failure is a broken air line or a closed angle cock. A broken air hose can be detected by the sound of escaping air. Angle cocks must be checked visually.

4. Is piston rod out?

The operator must have knowledge of acceptable piston length. This is a double check against the pressure gauge.

5. Did pressure reduce 20 lbs?

The operator must remember the initial setting with the pressure up and determine if the pressure dropped sufficiently.

6. Did pressure drop more than 5 lbs. in one minute?

This is determined by observing the gauge and timing one minute on a watch. This is the brake pipe leak test.

7. Is piston rod in?

See Decision 4.

C-6 MAINTAIN RECORD OF ALL CARS SET OUT OR PICKED UP

There are four main types of forms that are filled out by the conductor when cars are picked up or set out: wheel report and switch list, bad order form, defective car report, and blind siding report. Appendix B contains examples of each of these forms. The information required is contained on the waybills for the cars or is obtained by direct observation of the cars.

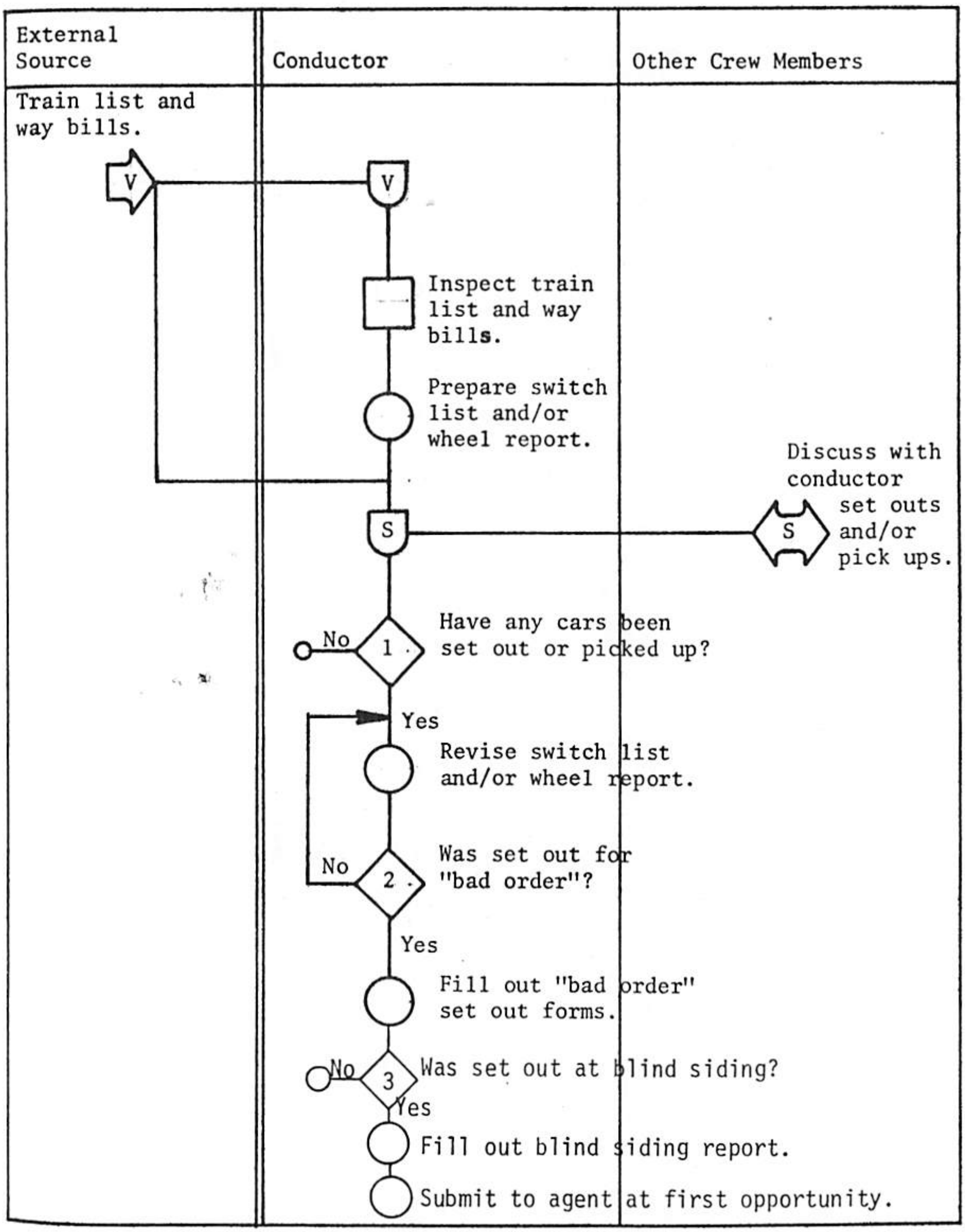
TASK NO. C-6 | TASK TITLE Maintain record of all cars set out or picked up
SUB-TASK NO. | SUB-TASK TITLE

DIFFICULTY 2
HAZARD -
CRITICALITY 1
DURATION 1-5 Minutes
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Prepare switch list and wheel report	List of cars picked up	Train list Waybills	Knowledge of what has to be listed and/or deleted	Record necessary information on forms	Writing implements and forms	Visual observation that forms are complete.	
2	Prepare "bad order" set out form and/or defective car report	Car(s) is being set out as bad order. Reason, car number, where billed to, from, etc.	Radio Direct Verbal	Knowledge of what information is required to fill out forms.	Fill out necessary forms.	Writing implement and forms.	Visual observation that form is complete.	
3	Prepare "blind siding" report			Knowledge that form is required.	Fill out necessary information	Writing implement & form	Visual confirmation	

C-6 Maintain Record of all Cars
Set Out or Picked Up

Operational Sequence



C-6 MAINTAIN RECORD OF ALL CARS SET OUT OR PICKED UP

1. Have any cars been set out or picked up?

The conductor will be aware of any set outs or pick ups because of the activities required. He must verify what car numbers were set out and picked up. This is often not checked first hand but rather is obtained from the train list.

2. Was set out for "bad order"?

The conductor must make the decision to set out a car as a bad order (i.e., hot journal, broken knuckles, etc.). Therefore, this information is self-generated.

3. Was set out at a blind siding?

A blind siding is a siding at which there is no agent (i.e., an unattended siding). If there is no agent present, a blind siding report must be filled out and submitted to an agent at the first opportunity.

C-7 CHECK SPEED OF TRAIN

If a crew member judges that the train's speed may be excess for the circumstance, he determines the speed by timing the interval between mile posts and converting that time to miles per hour using a conversion table usually found in the time table.

The judgment of excessive speed is based on visual, auditory, and motion cues. The computed speed is communicated to the engineer.

TASK NO. C-7
SUB-TASK NO.

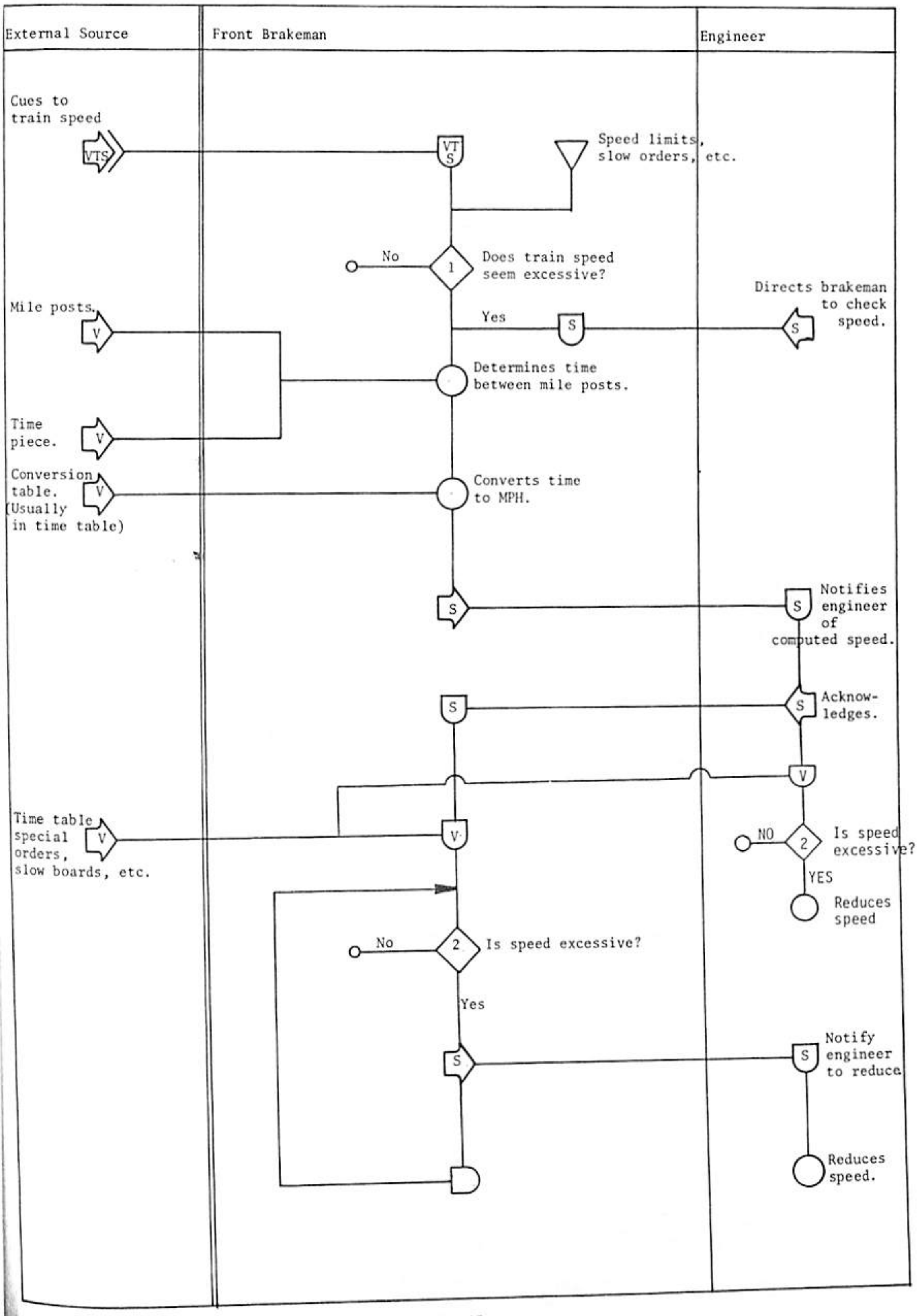
TASK TITLE Check Speed of Train
SUB-TASK TITLE

DIFFICULTY 1
HAZARD -
CRITICALITY 2
DURATION 1 Minute
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Determine time taken to pass mile posts	Judgment that speed may be in excess based on slow signals, orders special instructions, rules, time table	Mile posts Time piece		Observe time piece as locomotive passes mile posts. Subtract values to determine time from one mile post to the next.			
2	Determine speed of train		Table contained in time table		Notify the engineer of speed and instruct to show if necessary		Acknowledgement of message by engineer	

C-7 Check Speed of Train

Operational Sequence



C-7 CHECK SPEED OF TRAIN

1. Does train speed seem excessive?

Brakeman continuously receives vestibular, visual, and auditory cues related to the speed of the train. From experience he learns to estimate speed. In memory he must store speed limits, special orders, etc., and recall them at the appropriate time. A judgment is made comparing the desired speed with the estimated speed.

2. Is speed excessive?

This merely requires a comparison of the calculated speed with the maximum allowable speed at that location. Maximum allowable speed can be found in the time tables, special orders, rule books, etc.

C-8 RUN TRAIN WITH BACK-UP HOSE

Back-up hoses are not used very often in freight, but are more common in passenger service. The emergency brake lever in the caboose can be used like a back-up hose if the caboose is the end car while backing up. If a long line of cars is being backed up, a back-up hose may be connected to the last car's air hose. Connecting a back-up hose to the air hose is identical to connecting the air hoses of two cars together. By operating the level of the back-up hose the crew member can apply or release the brakes to slow or stop the train.

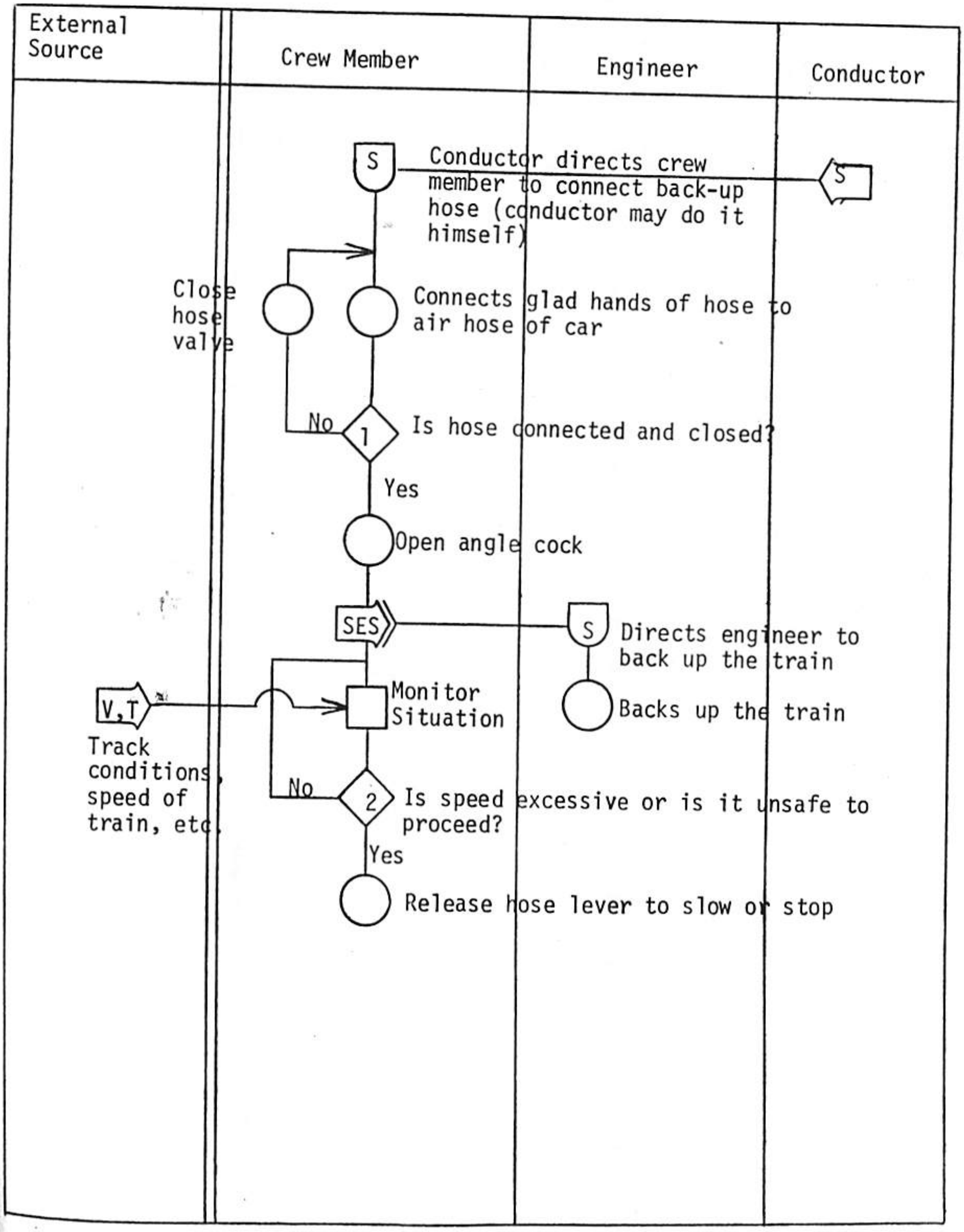
TASK NO. C-8
SUB-TASK NO.

TASK TITLE Run Train with Back-Up Hose
SUB-TASK TITLE

DIFFICULTY 3
HAZARD BC
CRITICALITY 4-5
DURATION Less than 5 minutes
FREQUENCY Infrequent

STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
1	Connect back-up hose	Directive from conductor	Verbal		Engage gladhands of back-up hose with air hose	Back-up hose, air hose	If connection is successful, the ends will stay together	This operation is the same as Task A-3.2
2	Open angle cock or car	Back-up hose successfully connected & back-up valve closed	Back-up hose		Turn angle cock	Angle cock	Sound of air bleeding into back-up hose	
3	Signal engineer to back up train	Ready to begin back-up	Visual	All is ready to begin operation	Radio or hand-lantern signal	Radio Lantern	Train begins to move	
4	Controls movement of train with back-up hose	Environmental conditions, track conditions, switch positions, etc.		Is it safe to proceed? Is speed excessive?	Operation of lever on back-up hose Applies brake to slow or stop the train	Back-up hose lever	Sound of escaping air, motion of train.	

C-8 RUN TRAIN WITH BACK-UP HOSE



C-8 RUN TRAIN WITH BACK-UP HOSE

◇1. Is hose connected and closed?

This is a go-no go decision. If the hose is not connected, the glad-hands will fall apart. Visual inspection of the back-up hose leve will indicate if it is open or closed.

◇2. Is speed excessive or is it unsafe to proceed?

This is a complex decision and depends on number aspects of the situation. Such things as the track conditions, switch alignments, obstructions, intended objective of mission, distance to intended destination, etc. Experience is a prime determinant of performance.

D-1 HERD TRAIN INTO YARD

After the train is given clearance to enter the yard and has been assigned a track number, the front brakeman may be required to walk ahead of the train and align switches to direct the train to the proper location in the yard. This may be by the yard crew, however.

The head brakeman dismounts from the train, runs ahead, and determines if he has enough time to throw the switch before the train arrives. If he does, the switch is thrown and he mounts the train as it passes. If he does not have enough time, he signals the engineer to stop.

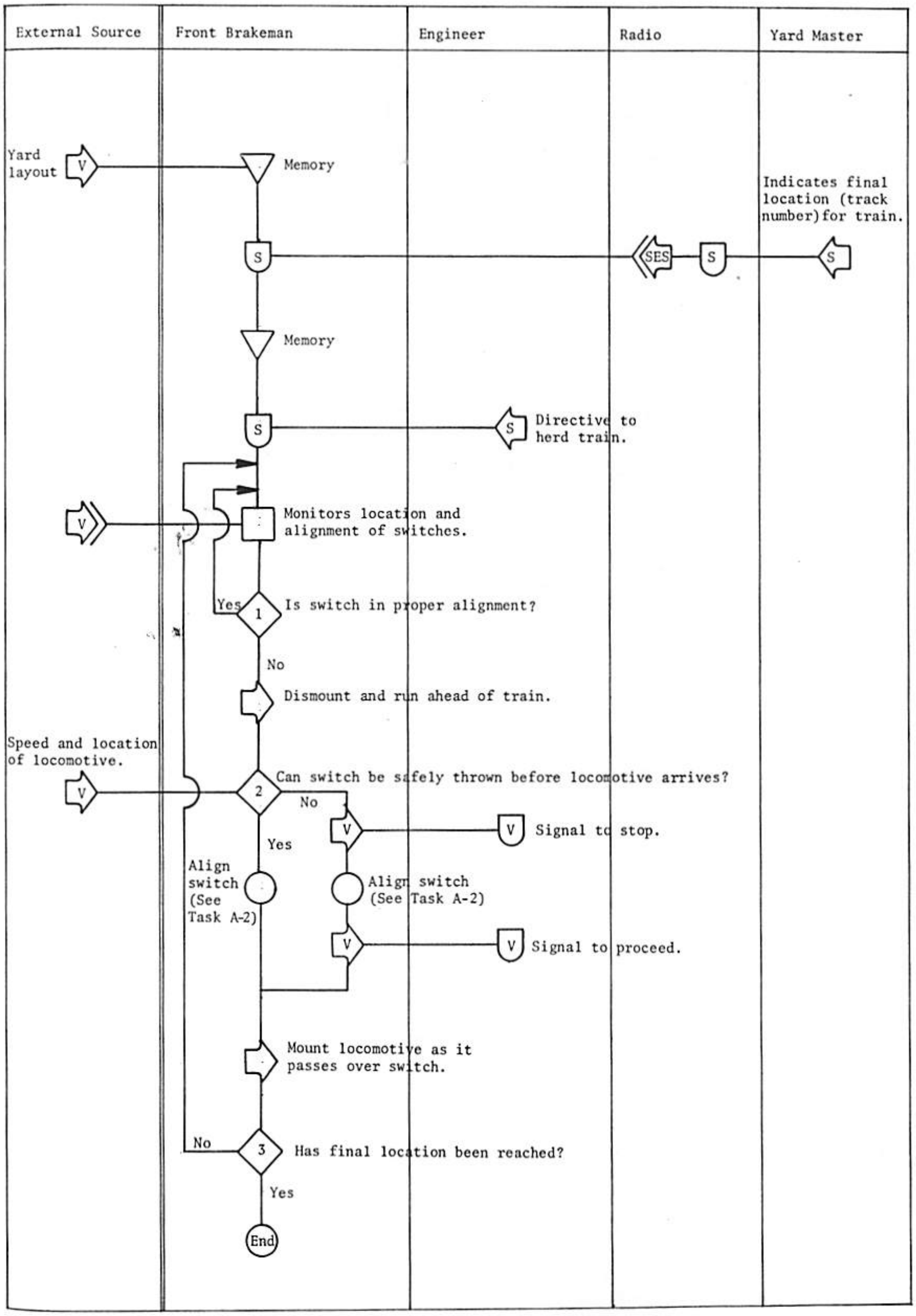
The brakeman must know the layout and track numbers of the yard. This is learned through experience. The task of herding can be hazardous. When mounting or dismounting a moving train, there is always a danger of falling, twisting an ankle, or straining the back. Also there is frequently danger from both stationary and moving cars on adjacent tracks.

TASK NO. D-1
SUB-TASK NO.

TASK TITLE Herd train into yard
SUB-TASK TITLE

DIFFICULTY 2
HAZARD FB
CRITICALITY 4
DURATION 5-15 Minutes
FREQUENCY End of mission

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Align switches to direct train to proper location in yard	Directive from engineer Track number where train is to be left	Direct verbal Radio from yard master	Knowledge of track numbers and layouts in the yard. When to dismount train to throw switch.	Jump off train, run ahead, throw switch (see Task A-2) and mount train as it passes	Switch handles		May be done by yard personnel


External Source
Front Brakeman
Engineer
Radio
Yard Master
Yard layout
V
Memory
Indicates final location (track number) for train.
S
SES
S
S
Memory
S
S
Directive to herd train.
V
Monitors location and alignment of switches.
Yes
1
Is switch in proper alignment?
No
Dismount and run ahead of train.
Speed and location of locomotive.
V
2
Can switch be safely thrown before locomotive arrives?
No
V
V
Signal to stop.
Yes
Align switch (See Task A-2)
Align switch (See Task A-2)
V
V
Signal to proceed.
Mount locomotive as it passes over switch.
No
3
Has final location been reached?
Yes
End

D-1 HERD TRAIN INTO YARD

1. Is switch in proper alignment?

This requires knowledge of switches and their alignment. Brakeman must compare the desired alignment, based on intended direction of train, with the actual alignment. The intended direction requires knowledge of the yard layout and final destination for the train.

2. Can switch be safely thrown before locomotive arrives?

This requires the brakeman to estimate the time of the arrival of the train and the time required to throw the switch. A miscalculation might result in the train entering the wrong track or being derailed.

3. Has final location been reached?

The brakeman must remember the track number designated by the yard master. This is matched against his cognitive map of the yard. Many yards do not number the tracks or supply maps. The cognitive map is acquired through experience.

D-2 SUBMIT TRAIN DOCUMENTS

At the termination of an operation, the conductor submits all train documents and forms filled out during the trip. Appendix B illustrates the most common forms filled out by the conductor and submitted during or at the termination of the trip. Different documents go to different yard personnel. The specific person receiving the various forms varies from company to company.

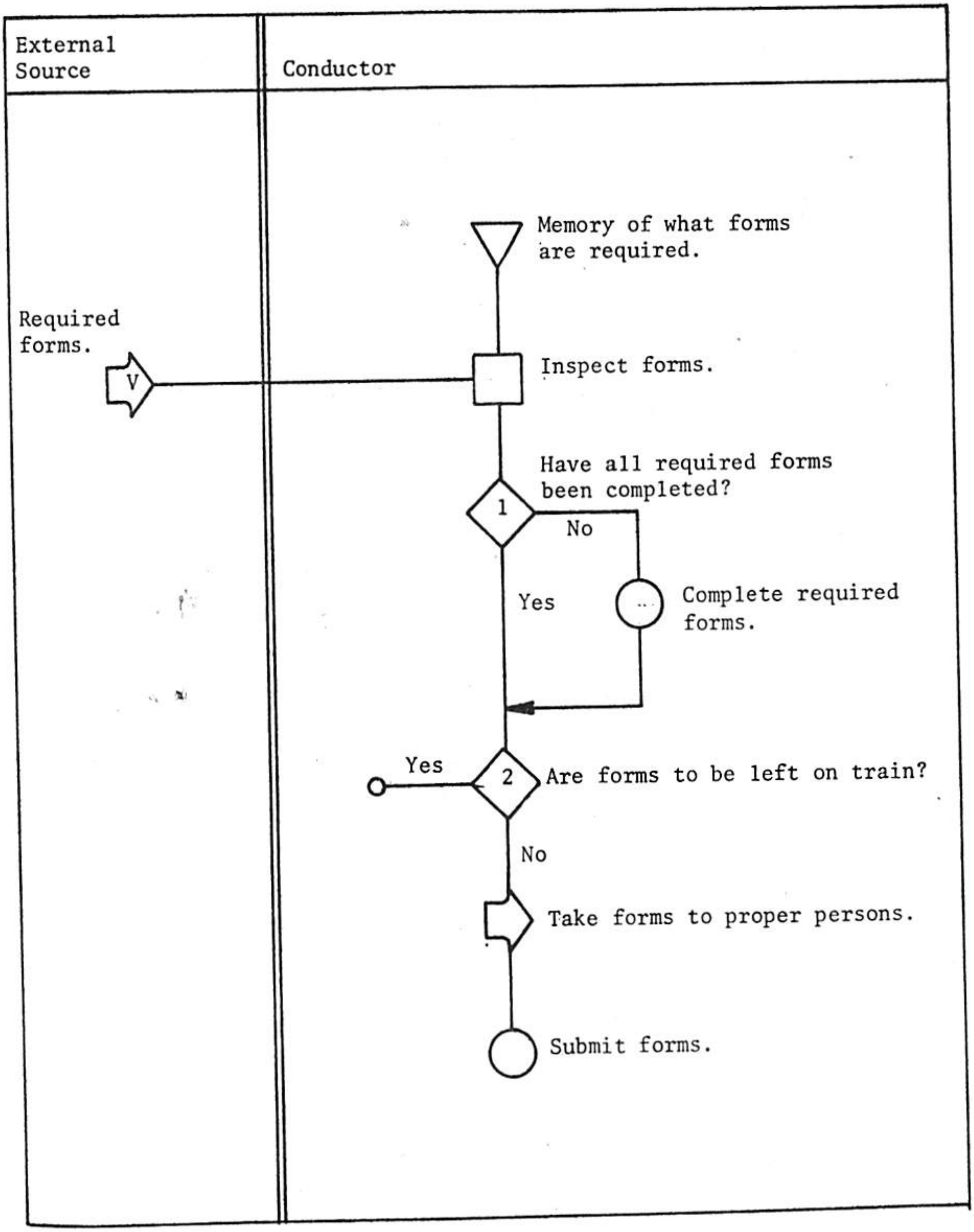
If the train is a through freight, the documents are left on board for the next crew.

TASK NO. D-2
SUB-TASK NO.

TASK TITLE Submit train documents
SUB-TASK TITLE

DIFFICULTY 1
HAZARD -
CRITICALITY 1
DURATION 2-10 Minutes
FREQUENCY At end of mission

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Verify that all forms have been correctly filled out.	Knowledge of required forms and information needed.	Forms	Are the forms completely and correctly filled out?	Fill out the required information		Visual observation	
2	Submit train documents to proper persons	Knowledge of where forms are to be submitted			Submit forms to proper authorities		Acknowledgement of receipt of forms	For through freight, documents are left on board


External Source
Conductor
Memory of what forms are required.
Required forms.
V
Inspect forms.
Have all required forms been completed?
1
No
Yes
Complete required forms.
Yes
2
Are forms to be left on train?
No
Take forms to proper persons.
Submit forms.

D-2 SUBMIT TRAIN DOCUMENTS

◇1. Have all required forms been completed?

This requires the conductor to know from memory what forms were required to be filled out based on the events of the mission. Company rules and regulations are the primary source of information.

◇2. Are forms to be left on train?

If the train is to continue with a new crew, the documents are left on board. Whether the train will continue is indicated in the time table, but is also known from experience.

E-1 COPE WITH DERAILMENTS

In the event of a derailment the engineer is signalled to stop the train. The conductor notifies the dispatcher of the situation. The brakemen provide protection for the train. Fusees and/or torpedoes may be dropped at various distances from the train. The extent of damage is surveyed. If possible and safe, the crew will attempt to rerail the train using a rerailing device. The rerailer is attached to the track and spiked to the tie. The engineer is signalled to move the train. If the rerail was successful, it is removed from the track. If the rerail was unsuccessful, the process can be repeated. It is possible that in attempting to rerail a car, the car wheel will wedge between the rerailer and rail causing the rerailer to break loose and shoot out from the rail, creating a safety hazard.

If it is decided that rerailing would be impractical or unsafe, the crew would wait for assistance to arrive. The brakeman would protect the train and adjacent track and the conductor would contact the dispatcher.

TASK NO. E-1	TASK TITLE Cope with Derailment	DIFFICULTY	1
SUB-TASK NO.	SUB-TASK TITLE	HAZARD	BE
		CRITICALITY	3,5 (Step 1)
		DURATION	Indeterminant
		FREQUENCY	Infrequently

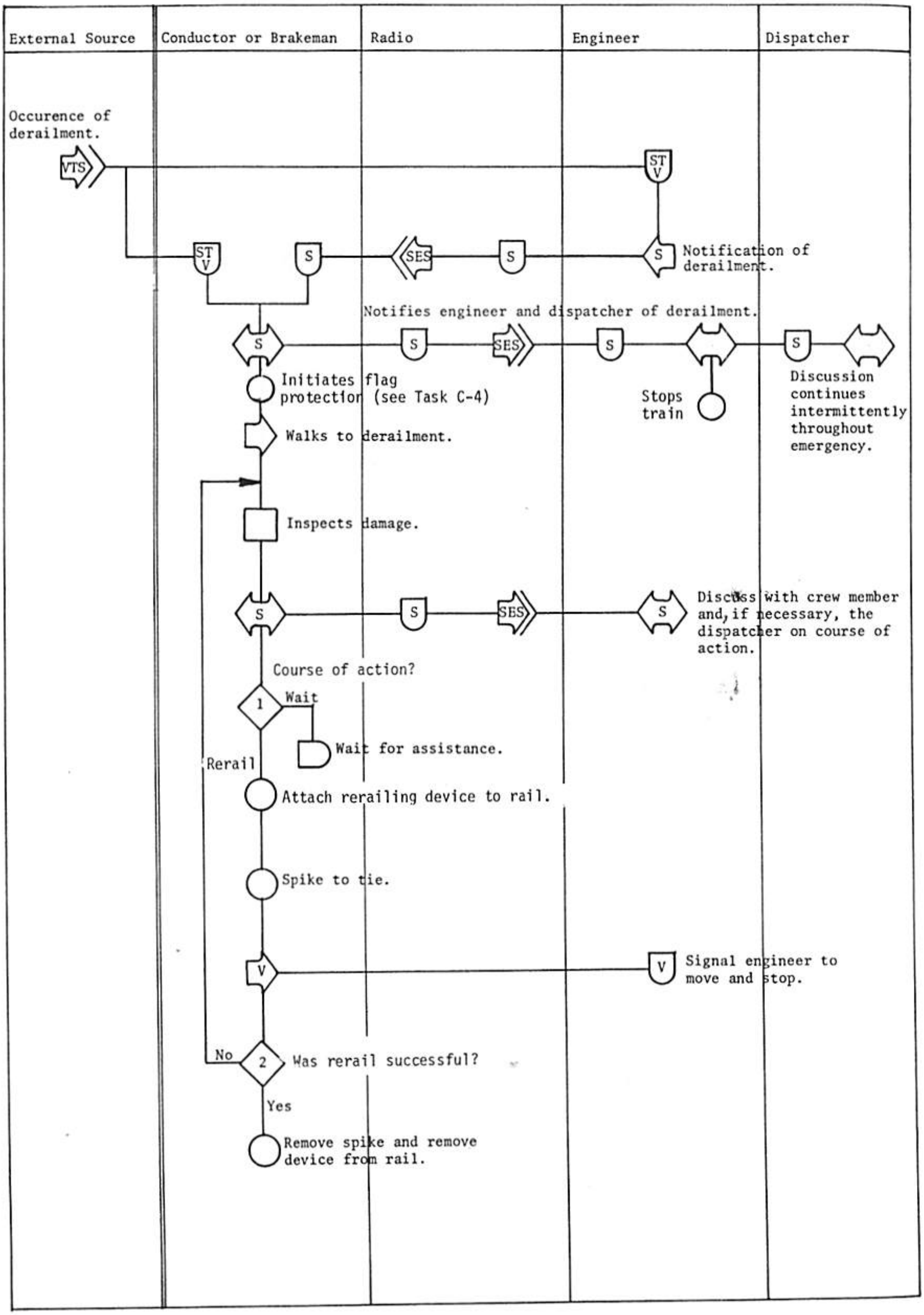
STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Protect train and adjacent track	Knowledge that derailment has occurred		(S E E T A S K C-4)				
2	Notify dispatcher of derailment	Knowledge that derailment has occurred, visual tactile, and auditory cues. Communication from other end of train.	Radio	Determination of location of the train.	Radio dispatcher	Radio	Acknowledgement of the message	
3	Determine course of action	Extent of derailment directives from dispatcher. Discussion from crew members. Available equipment.	Radio	Determine course of action to be taken	Radio for assistance or attempt to derail	Radio	Acknowledgement of the message	Extensive interaction among all crew members
4	Attach rerailing device to rail	Knowledge of correct use of rerailing device. Position of derailed car.			Attach rerailing device and spike to tie	Hammer	Visual observation	

TASK NO. E-1
SUB-TASK NO.

TASK TITLE Cope with Derailment
SUB-TASK TITLE

DIFFICULTY 1
HAZARD BE
CRITICALITY 3,5 (Step 1)
DURATION Indeterminant
FREQUENCY Infrequently

STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
5	Signal engineer to move and stop the train	Knowledge of signal meanings. Rerail device in proper position		If rerail is un-successful steps 2, 3, and 4 are repeated	Signal engineer	Radio Lantern	Visual observation that train is moving	
6	Remove re-railing device	All cars are on track			Remove rerailing device, pull spikes		Visual observation that rerailer is removed	


External Source
Conductor or Brakeman
Radio
Engineer
Dispatcher
Occurence of derailment.
VTS
ST V
ST V
S
SES
S
S
Notification of derailment.
Notifies engineer and dispatcher of derailment.
S
S
SES
S
S
Initiates flag protection (see Task C-4)
Stops train
Discussion continues intermittently throughout emergency.
Walks to derailment.
Inspects damage.
S
S
SES
S
Discuss with crew member and, if necessary, the dispatcher on course of action.
Course of action?
1
Wait
Wait for assistance.
Rerail
Attach rerailing device to rail.
Spike to tie.
V
V
Signal engineer to move and stop.
No
2
Was rerail successful?
Yes
Remove spike and remove device from rail.

E-1 COPE WITH DERAILMENTS

1. Course of action?

This is a joint decision made by the crew based on the extent of damage and severity of derailment. The number of cars derailed and the distance the wheels have traveled from the rail must be considered. The available tools and outside assistance are critical. The experiences the crew has had in similar situations is a major determinant of the decision choice.

2. Was rerail successful?

This requires a go-no go decision regarding whether the wheel has returned to the track.

E-2 COPE WITH RUNAWAYS

Coping with runaway cars requires split second action. Upon realizing that a runaway car exists, his first responsibility is to alert other personnel in the area. This is done by yelling. Depending on the situation, the crew member may attempt to derail the car by throwing an obstruction onto the track, align a switch to divert the car, open the angle cock as the car rolls by causing the brakes to engage or run for safety. Conceivably the crew member could mount the car and apply the emergency brake but many companies forbid such action. The dispatcher or yard master is notified of the situation. Flag protection is provided by the crew member.

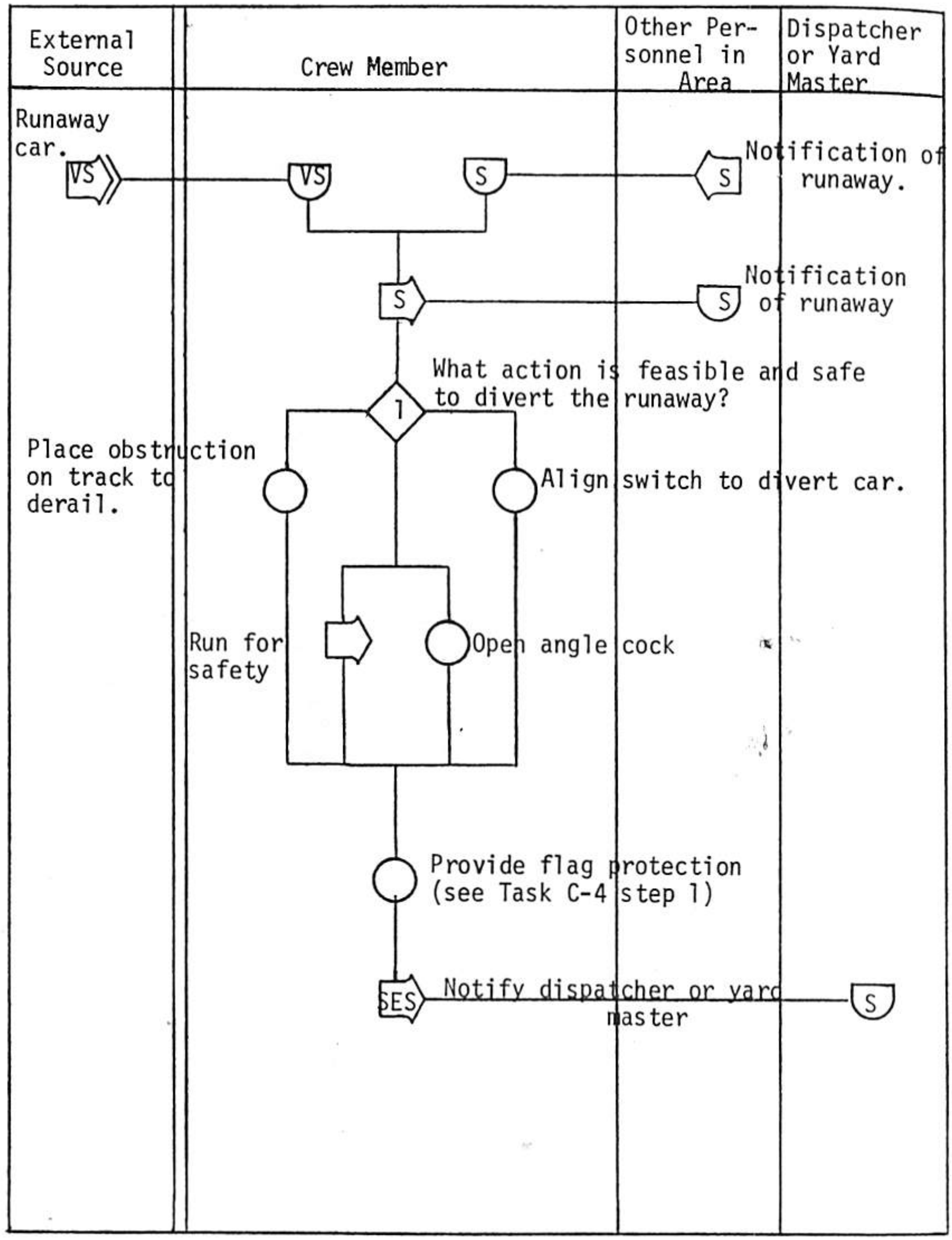
TASK NO. E-2
SUB-TASK NO.

TASK TITLE Cope with Runaways
SUB-TASK TITLE

DIFFICULTY	3
HAZARD	BF
CRITICALITY	5
DURATION	Indeterminant
FREQUENCY	Infrequent

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Cope with runaway cars	Direct voice car speed and location		Determination of what action is feasible and safe	Alert personnel in the area of condition. Divert runaway by aligning switches. Open angle cock.	Direct voice radio Switch Angle cock		
					Derail runaway by placing an obstruction in its path			
2	Provide flag protection	Stopped runaway		SEE TASK C-4 STEP 1				
3	Notify dispatcher or yard master	Runaway			Radio or phone dispatcher	Radio or phone	Verbal confirmation	

E-2 Cope with Runaways



E-2 COPE WITH RUNAWAYS

1. What action is feasible and safe to divert the runaway?

This often requires split second decision making. Consideration must be given to what courses of action are available and the probable consequences of each. Personality variables, such as risk taking, impulsivity, tolerance for stress and self-image probably play a significant role in determining the course of action taken.

E-3 COPE WITH HOT JOURNAL CONDITION

The crew member becomes aware of a hot journal condition, either by direct observation of smoke and fire from a wheel or being notified by a passing train or the dispatcher who observed a "hot box" on his hot box indicator (a device mounted near the track which senses heat and radios an alert to the dispatcher). In all cases, the engineer is notified to stop. The brakeman provides protection for the train and the dispatcher is notified by the conductor. The hot journal box is coated by inspecting each box for charring, fire, heat, or smoke. The fire is extinguished with a fire extinguisher or by throwing dirt in the box. The packing is removed and the car is set out as a bad order.

Sometimes the fire is believed to be out when the car is set out but a hot ember can ignite the entire car and the fire will burn unattended. It is important that the crew member puts out the fire and cools any embers that may exist.

TASK NO. E-3
SUB-TASK NO.

TASK TITLE Cope with Hot Journal Condition
SUB-TASK TITLE

DIFFICULTY 1
HAZARD H
CRITICALITY 4,5 (Step 1)
DURATION 20+ Minutes
FREQUENCY Infrequent as required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Protect train	Stopped train		SEE TASK C-4				
2	Locate hot journal	Fire, smoke, heat, evidence of charring, Blown seat on roller bearing signal from passing train or ground personnel.	Hot box journal	Note car number and location	Signal on radio location	Radio Lantern	Acknowledgement of the message	
3	Extinguish fire	Fire, smoke		Determination that fire exists	Operate fire extinguisher (See Task F-3) or throw dirt into box	Fire extinguisher	Visual observation that fire is out.	
4	Remove packing	Knowledge that packing must be removed.			Pull packing out of journal box		Visual observation that all packing has been removed.	
5	Set out car as bad order	Directive from conductor		SEE TASK C-5				

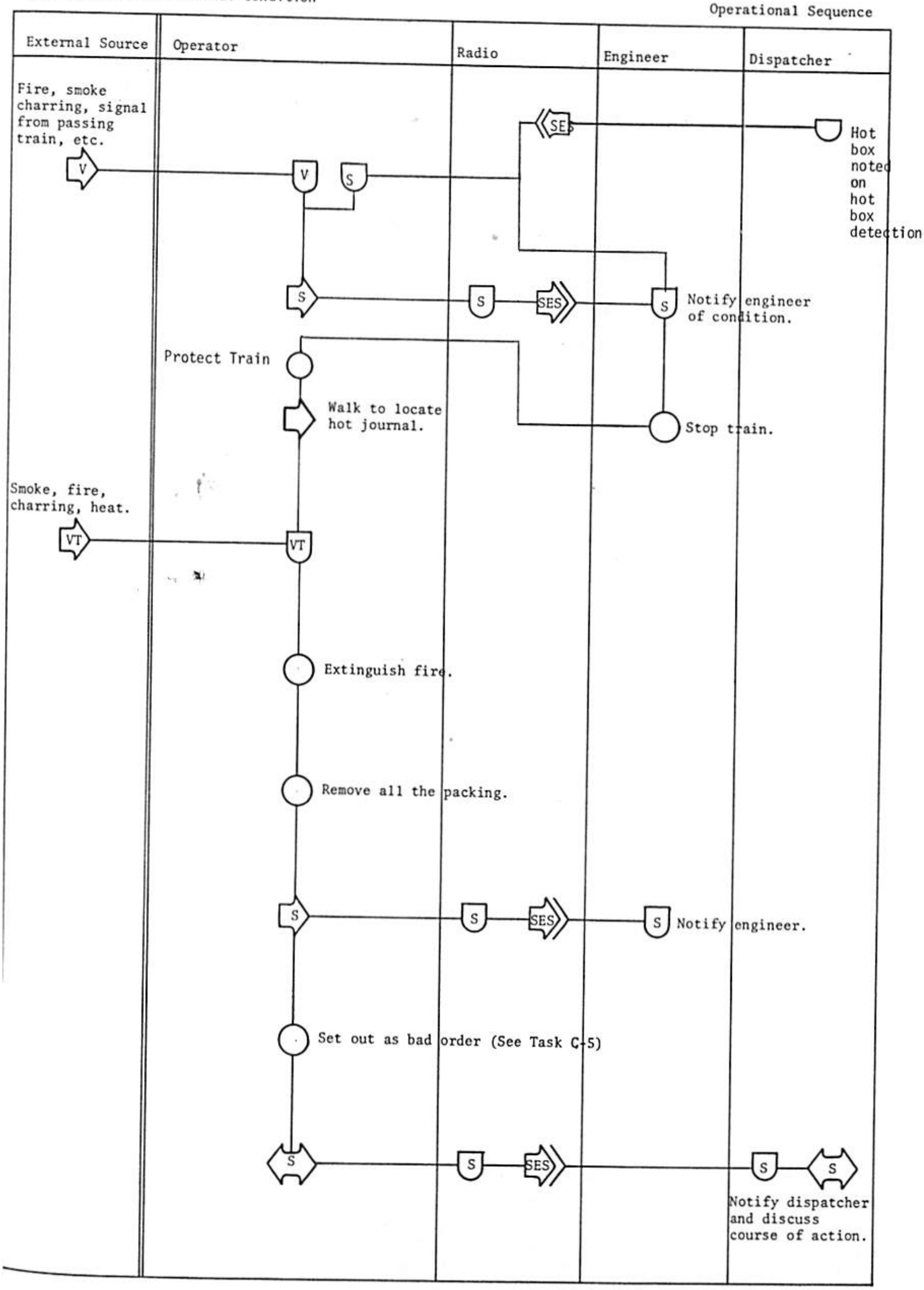
TASK NO. E-3 TASK TITLE Cope with Hot Journal Condition
SUB-TASK NO. SUB-TASK TITLE

DIFFICULTY 1
HAZARD H
CRITICALITY 4,5 (Step 1)
DURATION 20+ Minutes
FREQUENCY Infrequent as required

STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
6	Notify dispatcher			Should the fire department be summoned?	Radio or phone dispatcher	Radio wayside phone	Acknowledgement of the message	

E-3 Cope with Hot Journal Condition

Operational Sequence



E-4 RESPOND TO LOCOMOTIVE ALARM BELL

Although trouble shooting and repairing the locomotive is the assigned responsibility of the engineer, the engineer often directs the head brakeman to trouble shoot the difficulty. Warning bells are installed on locomotives which activate if certain malfunctions occur. The brakeman will confer with the engineer throughout the trouble-shooting and repair. If the problem cannot be corrected, the conductor is notified and the consequences of the malfunction are discussed. The dispatcher will be contacted if any change in the operation plan has to be made.

TASK NO. E-4
SUB-TASK NO.

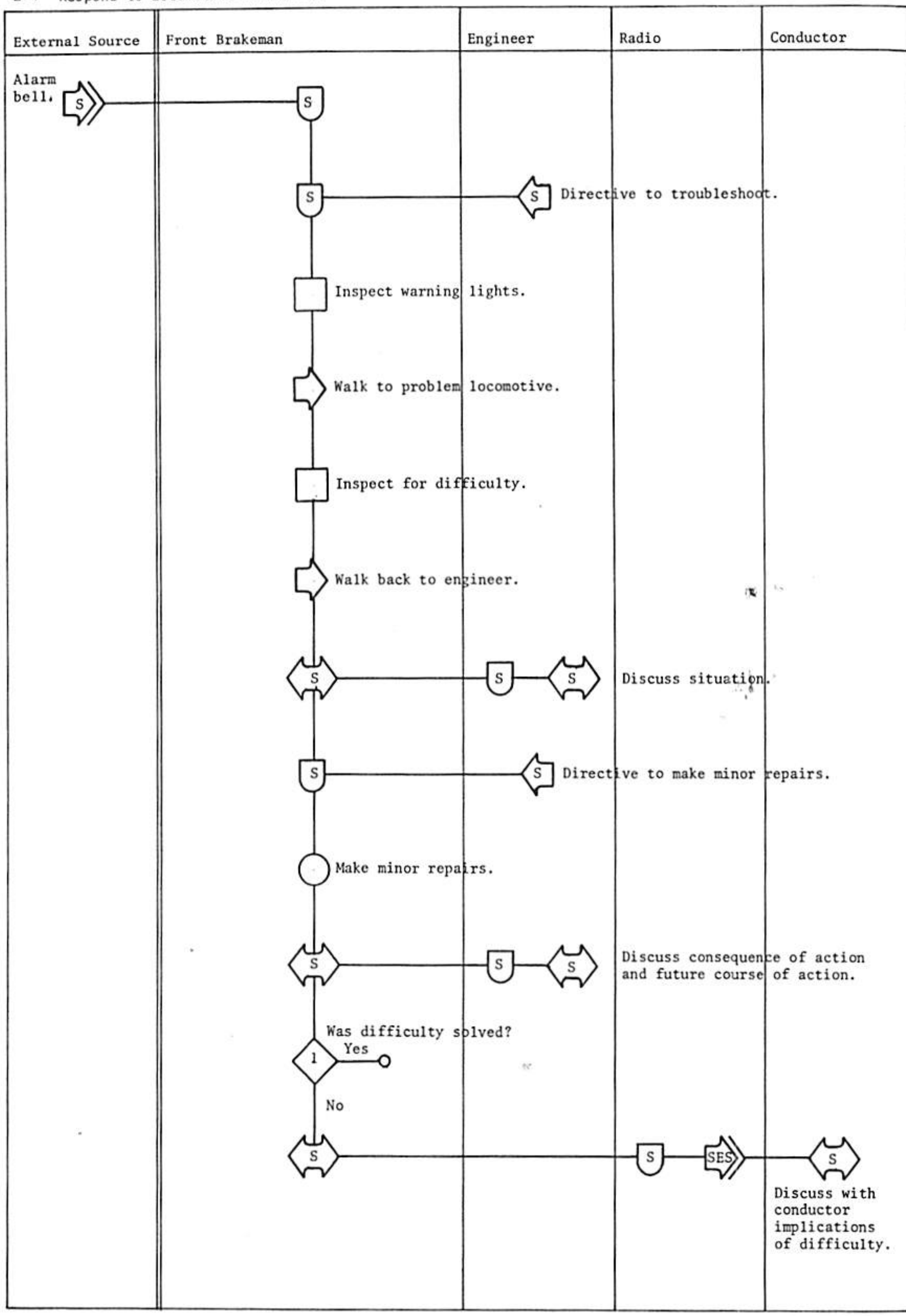
TASK TITLE Respond to Locomotive Alarm Bell
SUB-TASK TITLE

DIFFICULTY 3
HAZARD AFH
CRITICALITY 3
DURATION Indeterminant
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Troubleshoot difficulty	Directive from engineer to determine problem	Alarm bell warning lights	Knowledge of common locomotive problems and procedures for troubleshooting	Troubleshoot and notify the engineer of the problem	Direct Voice	Acknowledge message	This is the primary responsibility of the engineer but it is sometimes delegated.
2	Make minor repairs	Directive from engineer		Knowledge of procedure for making minor repairs	Perform repairs	Tools	Confirmation that problem has been corrected	
3	Discuss with conductor the implications	Problem not solved			Radio Conductor	Radio	Discussion	

E-4 Respond to Locomotive Alarm Bell

Operational Sequence



E-4 RESPOND TO LOCOMOTIVE ALARM BELL

1. Was difficulty solved?

The engineer will usually make this decision if it involves the operating characteristics of the train (e.g., loss of power in one locomotive). The brakeman can often get visual or auditory cues indicating whether the malfunction has been corrected.

E-5 SECURE LOOSE CARGO

Upon realization that a loose cargo situation exists, the engineer is directed to stop the train, and the conductor is notified of the situation. The conductor directs the rear brakeman to provide protection for the train. The conductor notifies dispatcher of delay.

A crew member walks back to the loose cargo and determines if it is possible to secure it. If so, it is secured. If it cannot be secured, the dispatcher is notified and the car is set out as a bad order.

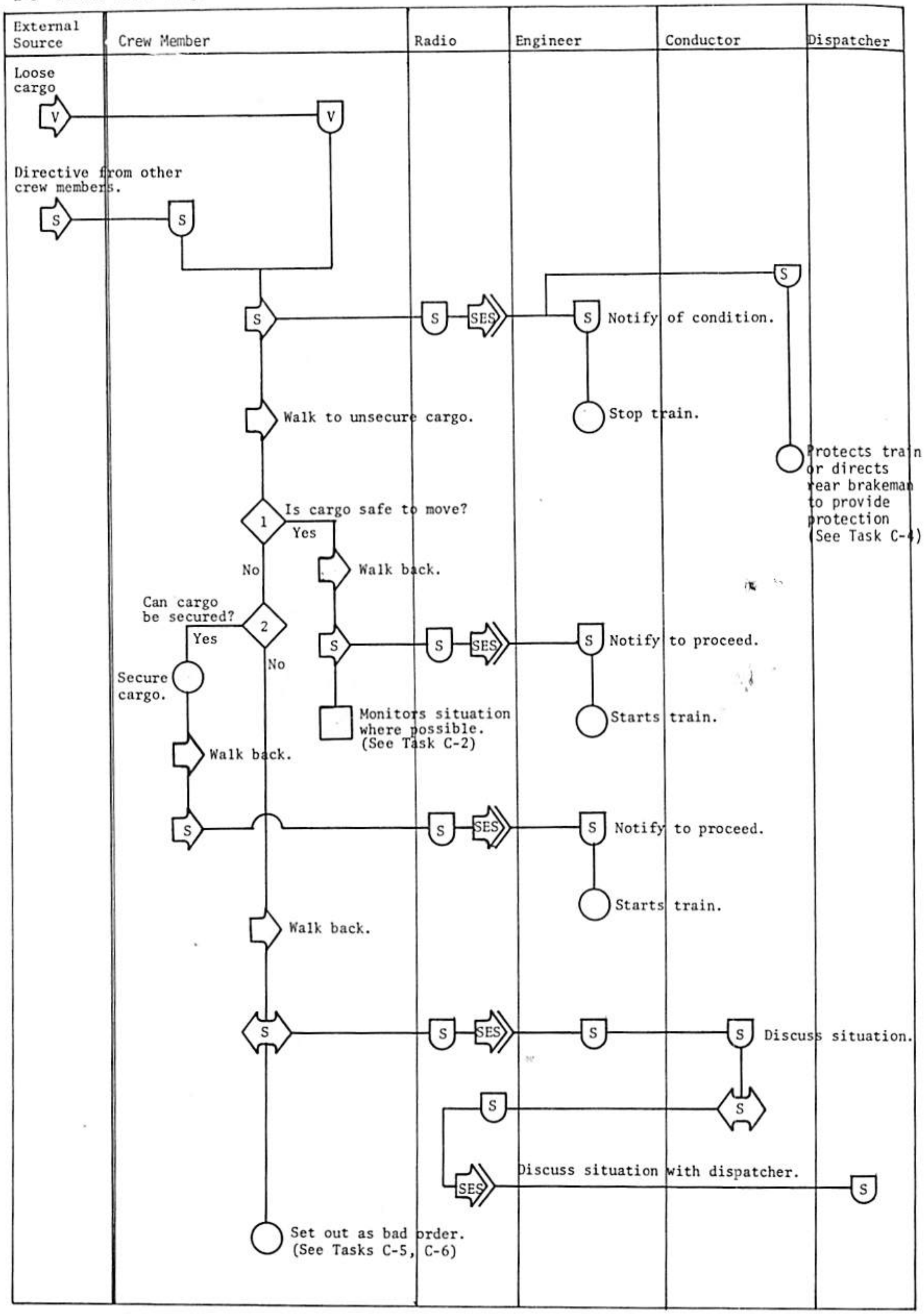
TASK NO. E-5 TASK TITLE Secure Loose Cargo
SUB-TASK NO. SUB-TASK TITLE

DIFFICULTY 1
HAZARD BF
CRITICALITY 3
DURATION Indeterminant
FREQUENCY As Required (Infrequently)

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Realization that loose cargo situation exists	Visual observation directive from crew members	Radio	Determination that cargo is not secured and is hazardous	Notify conductor of situation. Engineer may be notified to stop the train	Radio direct voice. Radio direct voice	Acknowledgement of message.	
2	Inspect cargo	Visual Observation		Decide if cargo is safe to move and/or that it can be secured.	Secure cargo if possible. Set out as bad order car if unsafe to move (see task C-5)	Wire, rope, etc.	Visual observation	Conductor has the prime responsibility for determining cause of action based on his judgment and information and opinion of the crew.
3	Secure cargo	Necessary supplies are available to do the job.		Determination of the best method, given the situation, of securing the cargo	Secure cargo	Wire, rope etc.	Visual observation	

E-5 Secure Loose Cargo

Operational Sequence



E-5 SECURE LOOSE CARGO

1. Is cargo safe to move?

This is a subjective decision. Consideration must be given to the distance to the destination and the type of trip anticipated (i.e., bumpiness, grade, number, and severity of curves). The crew member may climb aboard the car to check the load or just visually inspect it from the ground. Knowledge gained from experience and mechanical aptitude may play a part in the decision process.

2. Can cargo be secured?

Consideration must be given to the tools and securing materials available. Experience and mechanical aptitude play a part in delineating and evaluating possible securing procedures.

E-6 COPE WITH PERSONNEL INJURIES

First aid is administered to the victim if it is judged necessary and safe to do so. The conductor fills out an accident report and notifies the dispatcher of the injury. If additional medical care is required, assistance will be requested through the dispatcher or the victim will be transported on the train.

TASK NO. E-6
SUB-TASK NO.

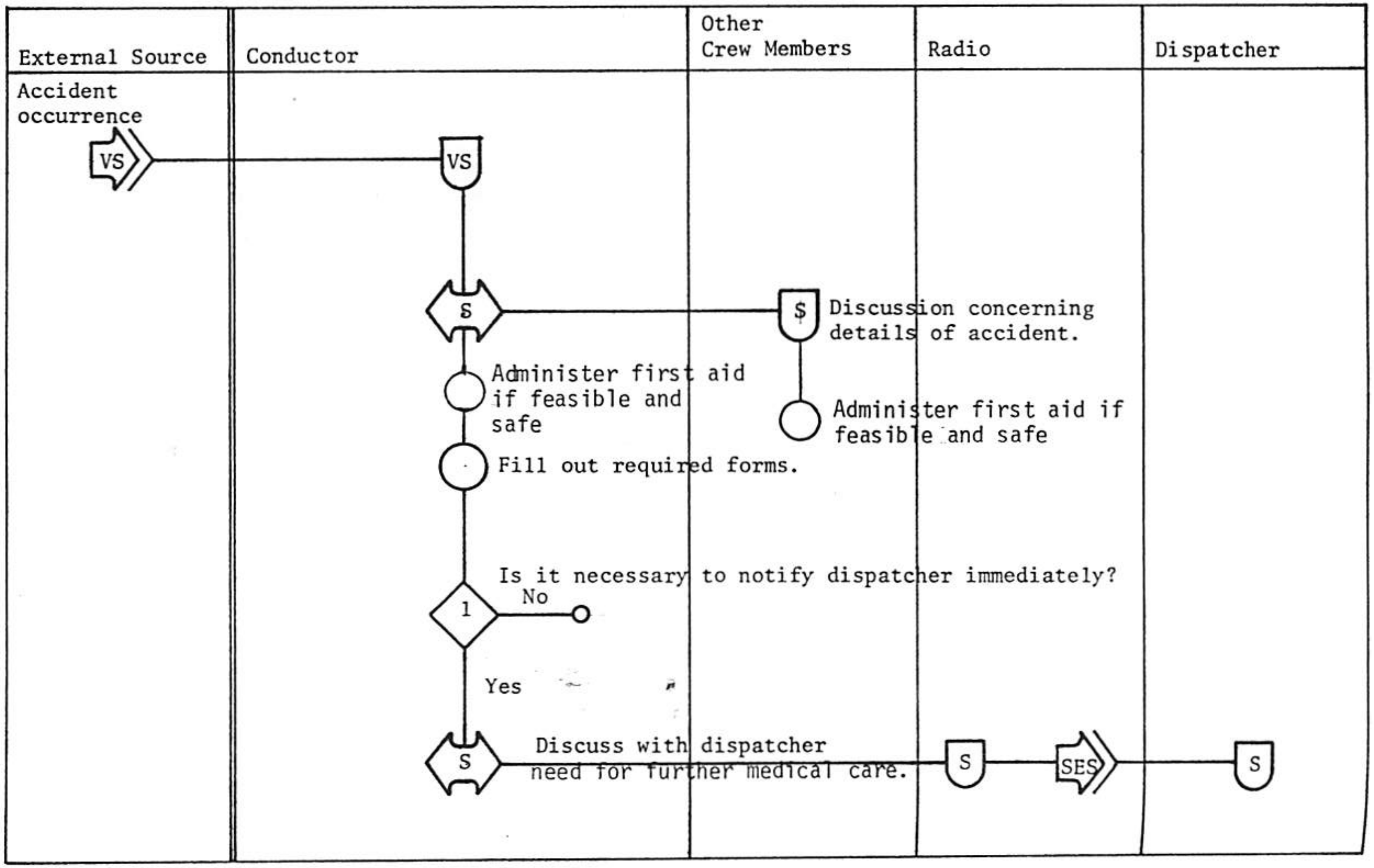
TASK TITLE Cope with Personnel Injuries
SUB-TASK TITLE

DIFFICULTY	1
HAZARD	-
CRITICALITY	1-4
DURATION	5-10 Minutes
FREQUENCY	In case of accident or injury

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Administer first aid	Injured victim		Is it safe and feasible to administer first aid?	Depends on extent and type of injury. Typically bandaging a wound or moving victim to safe place	First aid kit		
2	Fill out accident injury forms	Information required to fill out forms			Fill in required forms	Writing implement and forms	Visual observation	
3	Notify dispatcher of accident			Is it necessary to notify dispatcher?	Notify dispatcher	Radio	Acknowledgement of message	

E-6 Write Accident/Injury Reports.

Operational Sequence



E-6 WRITE ACCIDENT/INJURY REPORT

The conductor must know relevant company rules and regulations. A major factor involved in the decision is the extent of the injury or severity of the accident.

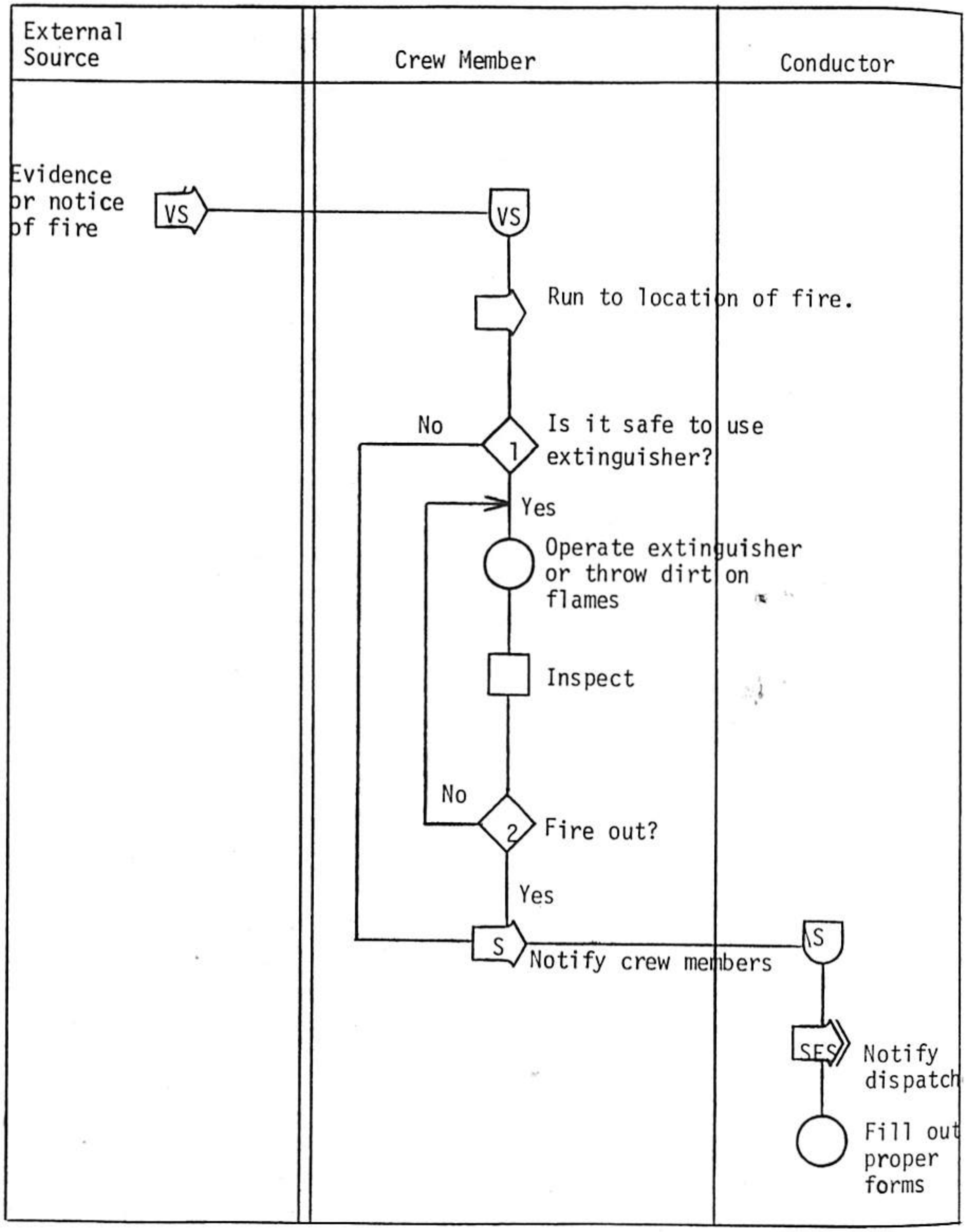
E-7 COPE WITH FIRE EMERGENCY

Fire emergencies are relatively rare. The most common are hot boxes and engine fires. The only real firefighting equipment on board is extinguishers in both the engine and caboose. When the fire is controll or burns out, the dispatcher is notified. An accident form is filled out. If the car is set out, a bad order and defective car report are required. Examples of these forms are contained in Appendix B.

TASK NO. E-7 | TASK TITLE Cope with Fire Emergency
SUB-TASK NO. | SUB-TASK TITLE

DIFFICULTY 1
HAZARD G
CRITICALITY 4
DURATION 1-20 Minutes
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Determine type and extent of emergency	Directive from crew member, smoke and/or fire odor		Evaluative extent of fire and assess availability of firefighting equipment				
2	Extinguish fire			Knowledge of how to operate fire extinguisher	Activate extinguisher and direct on flames Throw dirt on flames	Extinguisher Dirt	Fire goes out	
3	Notify dis-patcher				Radio dispatcher	Radio	Verbal confirmation of message	
4	Fill out proper forms	Details of situations		Knowledge of what forms to use and information required	Fill out forms	Writing implement & form	Visual confirmation	


External Source
Crew Member
Conductor
Evidence or notice of fire
VS
VS
Run to location of fire.
No
Is it safe to use extinguisher?
1
Yes
Operate extinguisher or throw dirt on flames
Inspect
No
2
Fire out?
Yes
S
Notify crew members
S
SES
Notify dispatch
Fill out proper forms

E-7 COPE WITH FIRE EMERGENCY

◇1. Is it safe to use extinguisher?

The crew member must consider the extent and type of fire and how close he must come to the fire to be effective. The type of fire is ascertained by visual observation or from previous experience with fires of the sort encountered. Knowledge of the type of fires for which the extinguisher is designed is required also.

◇2. Fire out?

The principal cues used to detect the presence of fire are visual observations of flames and/or burning embers. Often it is difficult to detect embers with the presence of smoke. It is critical that the fire is entirely extinguished or it may ignite after personnel have left the scene and burn unchecked.

F-1 OPERATE RADIO/TELEPHONE

The crew member perceives a need to use the radio/telephone, he picks up the receiver, selects the proper channel and volume level, and initiates conversation. He must observe FCC, state and company communication rules. When the conversation is complete, the receiver is hung on its cradle.

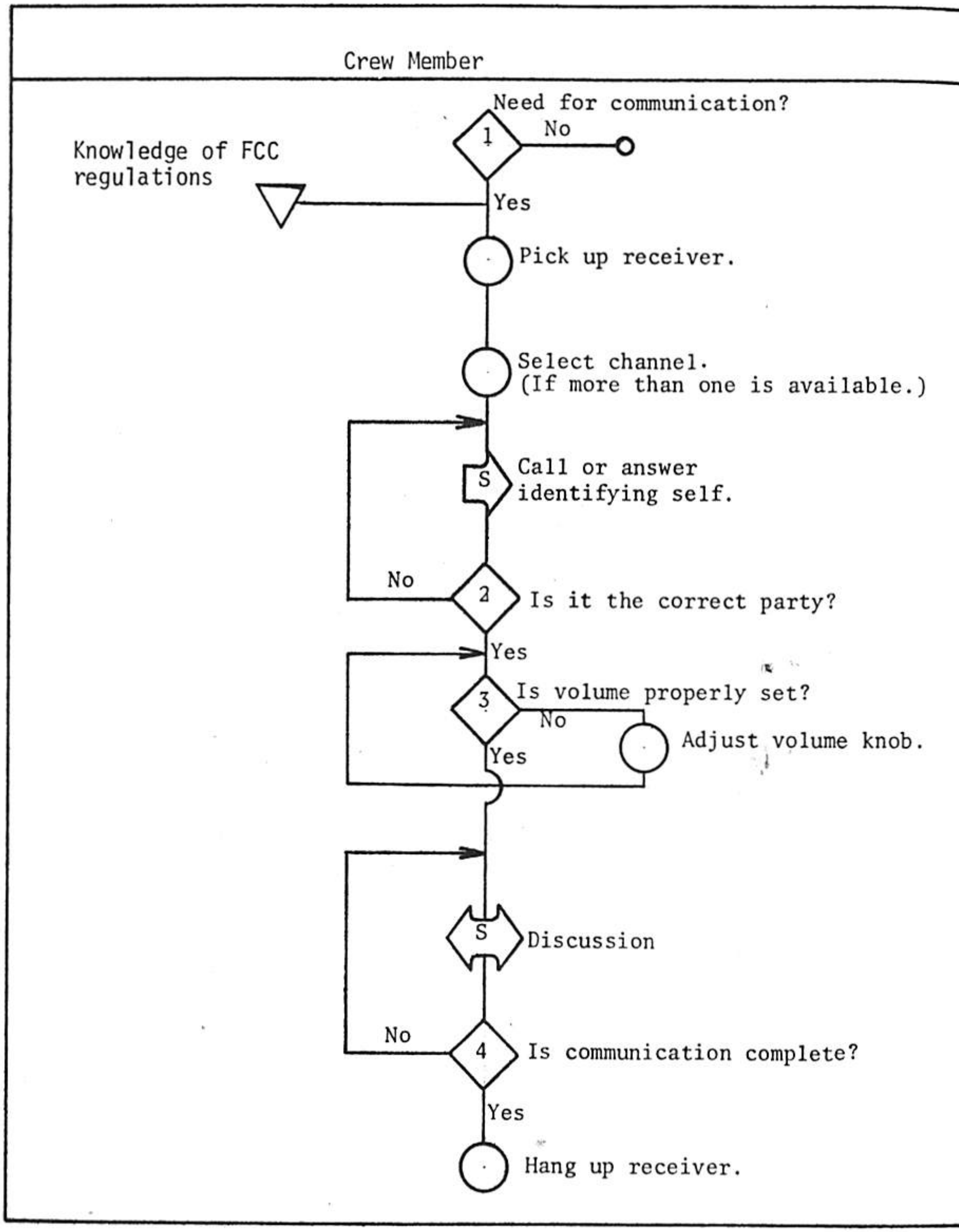
TASK NO. F-1
SUB-TASK NO.

TASK TITLE Operate radio/telephone
SUB-TASK TITLE

DIFFICULTY 1
HAZARD -
CRITICALITY 1-5
DURATION Varies
FREQUENCY As required

STEP NO.	DESCRIPTION	INPUT (STIMULUS)		INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE)		FEEDBACK (RESULTS)	COMMENTS
		INFORMATION	DISPLAY COMM EQUIP		ACTION	CONTROL COMM EQUIP		
1	Operation of radio/telephone as a communication device	Needs to communicate with personnel	Radio/ telephone	Knowledge of communication rules; FCC, state and company. Proper identification of communication parties is important	Pickup head set and speak. Volume control and channel selection may also be available.	Headset Volume control	Person in office addressed answers	

F-1 Operate Radio/Telephone



F-1 OPERATE RADIO/TELEPHONE

1. Need for communication?

Either the crew member will initiate the communication or respond to a call. The latter situation is an extension of Task A-8. In the former case, the particular situation would demand the use of radio/telephone, or another crew member would direct him to use the radio/telephone. There is rarely any ambiguity involved in this situation.

2. Is it the correct party?

The operator matches the information received concerning the party reached with the stored information of the party desired.

3. Is volume properly set?

This is a matter of personal preference.

4. Is communication complete?

This will depend on the content of the conversation and intent of the parties. It is a non-critical decision because communication can be re-established if prematurely ended.

F-2 OPERATE WAYSIDE TELEPHONE

The operation of the wayside telephone is essentially the same as the operation of the radio/telephone (Task F-1) except there are no channel or volume controls.

TASK NO. F-2
SUB-TASK NO.

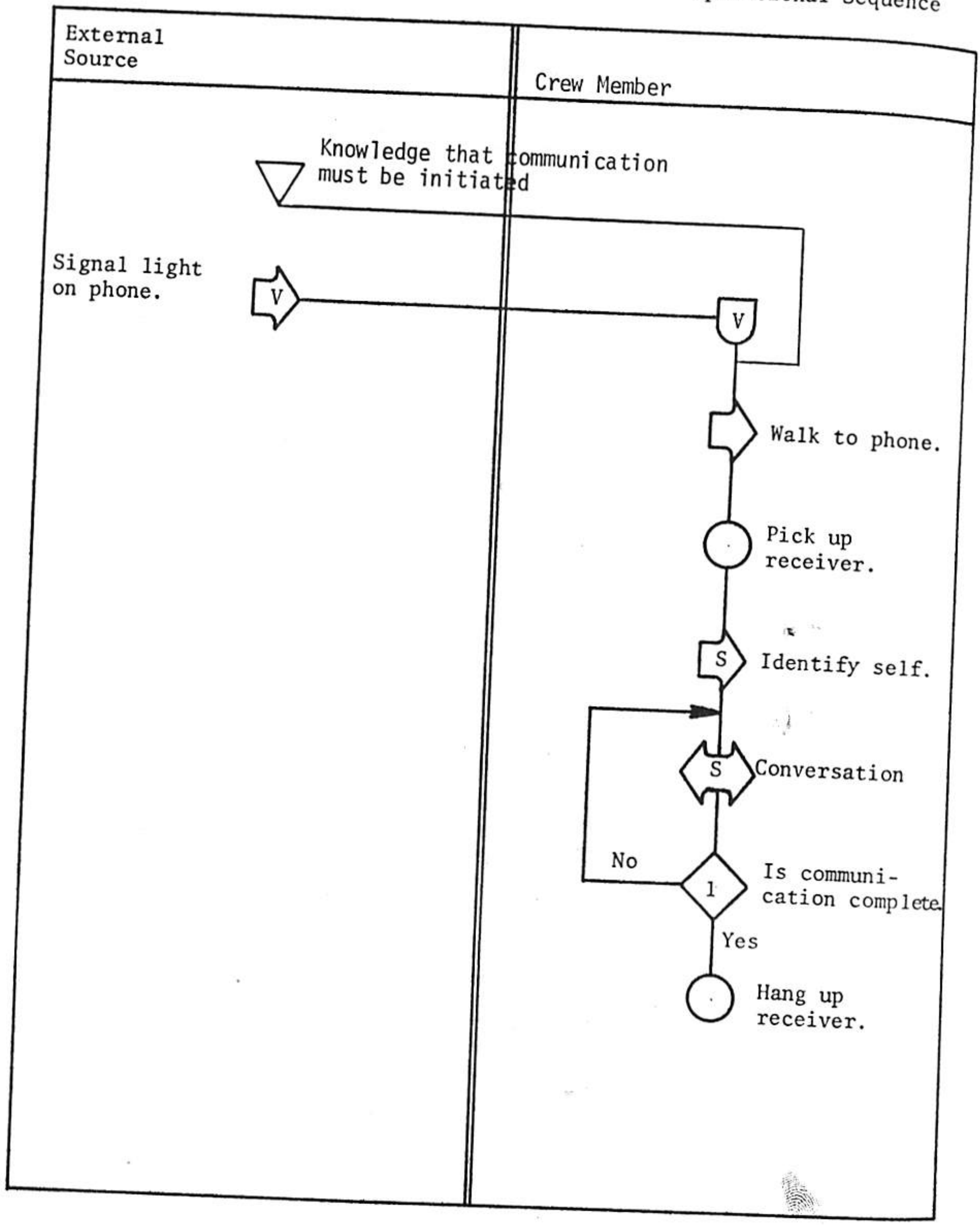
TASK TITLE Operate Wayside Telephone
SUB-TASK TITLE

DIFFICULTY 1
HAZARD -
CRITICALITY 1
DURATION Varies
FREQUENCY As Required

STEP NO.	DESCRIPTION	INPUT (STIMULUS) INFORMATION	INPUT (STIMULUS) DISPLAY COMM EQUIP	INFO PROCESSING DECISION MAKING	OUTPUT (RESPONSE) ACTION	OUTPUT (RESPONSE) CONTROL COMM EQUIP	FEEDBACK (RESULTS)	COMMENTS
1	Operation of wayside telephone	Directive from crew member	Signal light on phone	Knowledge of communication rules. Proper identification of communicating parties.	Pick up receiver	Telephone	Person in office addressed answers	

F-2 Operate Wayside Telephone

Operational Sequence



F-2 OPERATE WAYSIDE TELEPHONE

◇1. Is communication complete?

See Task F-1, decision 4.

2. SUMMARY AND RECOMMENDATIONS

From observing the operation of a train crew, it is obvious that each man can and does assist in the operation of all tasks. Brakemen fill in for conductors and vice-versa to expedite the safe movement of the train. Although the difficulty level of each task is not high, the total difficulty of the job is greater than the average difficulty of the individual tasks. Operations to set out or pick up cars represent the more difficult and involved tasks required. When not engaged in this activity, the crewman's primary task is monitoring the radio, track conditions, conditions of passing trains and conditions of the crew members' train.

The jobs require a moderate degree of mental ability, spatial relations ability, physical agility and endurance.

The following recommendations include some not related to the primary purpose of the study, but which were inspired as a result of the observations and interviews conducted during this project. The order is not meant to imply priority. Assigning priorities to the list would require information beyond the scope of this project. Each recommendation is listed and discussed briefly.

1. <u>Develop more reliable radio equipment</u>.

It is not unusual for the train radio to fail intermittently. Deprived of the primary source of communication, it is difficult to coordinate actions at the front and rear of the train or between the train and dispatcher. Possibly vibration proofing could improve performance.

2. <u>Supply hand-held walkie-talkie radios</u>

This would improve the efficiency of the operation and would eliminate the need to relay signals around bends during switching operations. It is recommended that the radios be equipped with a signal which tells the receiver that his radio is in contact with the sender even if the sender is not speaking. In this way, if during a coupling operation, for example, the engineer loses contact with the crew member he would stop the train.

3. <u>Investigate better crew scheduling procedures</u>

Crews are called on an "as needed" basis. What frequently occurs is that crew members work with little sleep. For example, a crew member gets home at 4PM thinking that he will not be called out again until the following day. He spends the remainder of the day with his family and perhaps goes to bed at 11PM. He may be called at 1AM to go out with only two hours sleep! This type of situation is not uncommon and was witnessed several times during the trips taken for this project. No doubt, working in a physically demanding task such as required of brakemen and conductors with little sleep is an invitation to an accident.

Study should be conducted to develop and determine the feasibility of using computers to assign crews to trains so that a crew member can know his schedule several days in advance.

4. Human Factors: The Placement, Coding, and Operation of the Various Angle Cocks Located on Cars

Presently, brake line angle cocks, piston bleeding valves, etc., are placed without much consideration for the crew member who must inspect and operate them. Efforts have been made to relocate hand brake wheels so that the crew member can operate the brake from the ground. Similar efforts directed toward placement of other controls on freight cars should be initiated.

5. Connect Air Hoses to the Car with a Chain or Similar Restraint

When cars are coupled, the air hoses whip around and can strike a crew member if he is standing too close. It is recommended that the air hoses be chained to the car to prevent them from whipping around. A length of chain or similar restraint could be employed to allow proper slack yet prevent an air hose from flying around or hitting the ground should it disconnect while the train is operating. Some cars already employ such a system. Its use should be extended to all air hose connections.

6. Use Shatterproof Glass on Locomotive and Caboose

During the train trips we made, crews frequently mentioned the hazard presented by juveniles throwing rocks at passing trains. Several of the crew members we talked to had, themselves, been struck by flying glass. There exist several "vandal proof" glass substitutes. It is recommended that their use be mandated if necessary.

7. <u>Develop Orientation Training Package for New Railroad Employees</u>

Presently, new employee training is on-the-job and somewhat haphazard. Depending on specific circumstances a new employee may not be told, warned, etc., about aspects of his job. A systematic training program, maybe lasting a week or so, conducted by competent trainers could be developed. Films, demonstrations, mock-ups, etc., could be employed to instruct employees on safety procedures, nomenclature, rules, etc.

8. <u>Train On-The-Job Trainers</u>

A new brakeman, working his way up through the seniority system, will still require on-the-job training from the conductor in charge of his train. Unfortunately, conductors are not taught how to instruct a new worker. This can be dangerous, inefficient, and lead to frustration and dissatisfaction in the new worker. A training package, perhaps one day in length, could be developed to instruct conductors in the art of on-the-job training. Such things as how to present instructions to the new worker, how to sequence work tasks, how to feed back information to the new employee, how to recognize and correct learning difficulties, etc.

9. Develop Job Aids for the New Brakeman or Conductor

Many systems do not have pocket maps of their track and yards to help orient a new employee. After orientation, such aids might also improve the efficiency of the worker. Check lists might also be valuable so that required operations are not forgotten.

10. Develop Programmed Instruction Books Covering Rule Books

A job candidate must pass a rules knowledge test before becoming a conductor. Most candidates do not use efficient methods of study and hence waste valuable time trying to memorize the rule book. A professionally developed programmed text covering the rule book would reduce study time and result in better performance on the test with far less frustration to the worker.

11. Rewrite Standard Rule Books Including Operating Rules and Air Brake Rules

Although efforts have been made to simplify the rule books and eliminate obsolete rules, much still can be done. Especially acute is the need to improve sentence structure and word use. The reading ease could be improved drastically, legal phraseology could be eliminate and simple sentence structure could be instituted. One sentence of an air brake manual concerned with when a particular test should be applied contained 74 words and ran over six (6) lines of type.

12. Considerations Should Be Given for Establishing Minimum Cut-Offs for Promotion to Brakeman or Conductor

Such things as job knowledge tests, other than just the rules of the road, physical agility and stamina tests, etc., should be developed and validated as selection tools to be used in conjunction with the present seniority and bidding system.

APPENDIX A. SELECTED TRAIN DOCUMENTS

We would like to thank the Atchison, Topeka, and Santa Fe Railway Company for permitting the use of their forms in this report. Different companies may alter the information requested on a particular form, may require additional forms not presented here, and may require that the forms be delivered to different people. The purpose of this appendix is only to illustrate examples of the more commonly used forms filled out by the conductor relating to a particular operation. Some forms are required for all operations; others are used only if required.

Delay Report (Santa Fe Form 827 Standard)

Required for each trip. Conductor fills out a record of all delays, including red blocks, switch time, tie up time, etc. Copies are distributed to the time keeper at the terminal yard, telegraph operator, train master, and the conductor himself.

DELAY REPORT (FRONT)

TICKET NUMBER

SANTA FE — **TIME RETURN AND DELAY REPORT** — **TRAIN EMPLOYEES ROAD SERVICE**

Form 827 Standard
Regular Claim ☐
Special Claim ☐

TIME SLIP NO. ______ DATE ______ 19 ____ DIVISION ______

TRAIN NUMBER ______ ENGINES ______

( ) IF DBLHDR WRITE (1) IN BLANK IF LEAD CREW, AND, (2) IF 2ND CREW.

NAME AND SOCIAL SECURITY NUMBER	OCCU-PATION	CODE NO.	LENGTH OF TIME OFF DUTY PREVIOUS TO THIS TRIP	FIRST WENT ON DUTY			FINALLY WENT OFF DUTY			TOTAL TIME ON DUTY		ACTUAL MILES RUN	MISCELLANEOUS CLAIMS — WRITE THE CLAIM NUMBER(S) SELECTED BELOW AND MILES (IF ANY) CLAIMED								
				STATION NO.	DATE	TIME	STATION NO.	DATE	TIME	HRS.	MIN.		NO.	NO.	NO.	NO.	MILES	NO.	MILES	NO.	MILES
	Condr.	3																			
	Bkmn.	4																			
	Head Bkmn.	5																			

KIND OF SERVICE AND PAYMENT CLAIMED

PASS.	FREIGHT	LOCAL	ROAD SWITCHER
(1)	(2)	(3)	(4)
WORK	MIXED	SWITCH	D. H.
(5)	(6)	(7)	(8)

MAXIMUM NO. OF CARS

DETAILS OF SERVICE (INC. TERMINAL DELAYS)

DEPARTURE			ARRIVAL		
STATION	TIME WENT ON DUTY	TIME TRAIN DEPARTED	STATION	TIME TRAIN ARRIVED	TIME WENT OFF DUTY

REMARKS:

OTHER EMPLOYES

OCCUPATION	CODE NO.
BRAKEMAN BAGGAGEMAN	6
TRAIN BAGGAGEMAN	7
PORTER BRAKEMAN	8
HELPER CONDUCTOR	9
CHAIR CAR ATTENDANT	0

CLAIM FOR MEAL ALLOWANCE
Enter Details of PRIOR trip
WENT OFF DUTY
PLACE ______

DATE	TIME

MISCELLANEOUS CLAIMS

CLAIM	NO.	CLAIM	NO.
AIR PAY	13	CABOOSE LODGING	18
MEALS	25	PASS. COND. SLEEPING CAR SERVICE	15
LODGING	19	INIT. TERM. DELAY ★	17
MEALS + LODGING	20	FIN. TERM. DELAY ★	14
HOLIDAY	80	SWITCHING (TERM.) ★	10
OTHER ★	99	SWITCHING (ROAD) ★	26

★ REQUIRES MILES WITH THE CLAIM NO.

EXPLAIN "OTHER" MISC. CLAIMS UNDER "REMARKS"

(SEE "GENERAL INSTRUCTIONS" ON REVERSE SIDE)

I certify this Report to be correct:

Signature

Occupation

WITH ENGINEER

193

DELAY REPORT (BACK)

GENERAL INSTRUCTIONS

1. This report shall be rendered for all train employes in road service. It will be prepared and signed by the conductor, or in the absence of a conductor, by the ranking employe included on this report. Conductors, trainmen, porter brakemen and chair car attendant shall also use this form when reporting individually. Reports shall be numbered consecutively for each month beginning with No. 1.

Conductor will render this report in duplicate to cover his entire trip, whether interdivisional or otherwise, turning the original and duplicate in at their respective points for handling according to outstanding instructions. Conductors will not mail this report.

2. This report shall be dated as of the date on which the employe first goes on duty.
3. Enter the train number or symbol and engines. Leave "Ticket Number" blank. Individual "Other Employes" must show their occupation and code number in the appropriate blank column.
4. Where On and Off Duty Time is shown, military time shall be given (0001 thru 2400). Show station number on and off duty, total time on duty and actual miles run.
5. Under "Remarks" shall be shown any irregularities of the hours of duty. When a crew or employe is relieved before the completion of a trip, the name(s) of the employes being relieved will be shown. If the whole or part of service is deadheading, the place at which the deadheading began and ended and the train on which the employe deadheaded will be shown.
6. Miscellaneous Claims – The prenumbered claims may be claimed by entering the number(s) in appropriate column(s) opposite name of employe who is entitled to such claim(s). Employes making additional claims not prenumbered and shown in the "Miscellaneous Claims" chart must enter number "99" (Other) in the appropriate column opposite employes name and explain details under "Remarks" section.
7. Enter miles in the appropriate columns of "Kind of Service and Payment Claimed" for the entire trip.
8. Fill in "Details of Service" for each trip indicating the departure and arrival information.
9. Indicate the "Maximum No. of Cars" handled in your train during the trip.
10. In reporting delays the cause of each delay, the place at which it occurred, the time it began and the time ended shall be given. Delays due to different causes shall be shown separately.

Conductors on Interdivisional runs will furnish on this form, delay information for each division passed over, properly identifying same by filling in necessary headings, and file the delay report for each division at the final terminal of such division upon arrival thereat.

DELAY REPORT Train No.__________ Date ____________________ 19_____

All delays must be shown and divided between causes

PLACE (1)	DURATION OF DELAY: TIME BEGAN (2)	TIME ENDED (3)	FULL EXPLANATION OF CAUSE OF ALL DELAYS: AMOUNT (4)	CAUSE (USE SYMBOLS BELOW) (5)

Time of Delay must be assigned to or divided between the contributory causes, and designated in column 5 above. (See detailed instructions below).

IN DESIGNATING THE CAUSE USE THE FOLLOWING SYMBOLS:

D - Meeting or to be passed by Passenger trains.
Dc - Meeting or to be passed by Freight trains.
Ff - Loading and unloading passengers, baggage, mail and express.
Ks - Fuel and water and freight train employes' meals.
S - Switching station freight.
M - All other delays.

____
CONDUCTOR

SPECIFIC INSTRUCTIONS

(a) The total time of each delay should be accounted for.

In cases where delay time is exclusively assignable to a specific cause as represented by one of the symbols specified, such time should be assigned under the appropriate symbol. Where delay time is devoted concurrently to two or more symbolized causes, such time should be divided equally among the contributing causes. Where the delay is chargeable to two or more symbolized causes and one of them requires more time than the other or others, the excess delay time should be charged against the symbol which causes the additional delay as well as its proportion of the concurrent time.

(b) At all stops of passenger trains for meals, excess delay over the regular meal time, if any, is to be charged to the contributing causes as provided for under Rule (e).

(c) All time of freight trains used for meals should be assigned to symbol "Ks" (Fuel and water and freight train meals).

(d) When crew performs station switching service at train terminals under road pay time, the delay time should be assigned to "S".

(e) Delays assigned to symbol "M" must be separated between contributing causes and the amount of delay chargeable to each cause shown separately.

Wheel Report (Santa Fe Form 1318A Standard)

Used to report any cars picked up and kept or set out in route. The information required is contained on the waybills. If cars are initially on the train and are to be set out, they are listed on the computer output wheel list given the conductor at the initial terminal. The wheel report is given to the telegraph operator or car desk at the terminal point.

BEFORE WRITING
Place this symbol (←━ in square

Santa Fe

Form 1318-A Standard

PLACE SYMBOL) | PLACE SYMBOL ;

Addresses

Sheet No. ____________

		L TRAIN 1 2 3 4 5 6 7 8 9 10	R ENG. 4 3 2 1	L / T	D I R	R T E	R Mo. 2 1	R Day 2 1	Yr	R TIME 4 3 2 1

R — Means maintain straight perpendicular columns from right hand side.
L — Means maintain straight perpendicular columns from left hand side.
Numbers used with "R" and "L" indicate number of spaces in each column.
Maintain margins as indicated below and do not write across column lines.

Place in each line this symbol —

L LINE NO. 1 2 3	L INITIAL 1 2 3 4	R NUMBER 6 5 4 3 2 1	R Kind 2 1	L / E	L CONTENTS 1 2 3 4 5 6 7 8	L ON LINE DEST.—JCT. 1 2 3 4 5	L Rte. at Jct. Point 1 2 3 4	R Gross 3 2 1	R NET Rev. 3 2 1	NET Co. 2 1	–	R TAKEN FROM 5 4 3 2 1	R LEFT AT 5 4 3 2 1	L OFF LINE DESTINATION 1 2 3 4 5 6 7 8 9 10 11 12 13 14	L P.P.S.I. 1 2 3 4

Conductors Trip Record (Santa Fe Form 806 Standard)

This is part of the conductor's train book which he carries with him. It is for the conductor's own record and serves as a notebook for taking information which may later be transferred to a standard form. The trip record is kept by the conductor and is not turned in to the railroad.

CONDUCTOR'S TRIP RECORD

MEMORANDUM OF PASSES

KIND	NO.	ISSUED TO	FROM	TO

CASH FARES

FROM	TO	SLIP NO.	AM'T

COLLECTIONS

CASH FARES ... ______

SCRIP FARES .. ______

LOCAL TICKETS LIFTED...... ______

INTERLINE " " ______

TICKETS HONORED BUT NOT LIFTED.. ______

TOTAL .... ______

TRIP PASSES... ______

OTHER " .... ______

TOTAL .... ______

REPORTS SENT.. ______

REMITTA'S SENT ______

REMARKS: ______

IRREGULARITIES:

Use Other Blank Space, If Necessary.

Form 806 Standard **Santa Fe**

CONDUCTOR'S TRIP RECORD

Train No. Date 19

Left at M. 19

Arrived at M. 19

ENGINEMAN	ENG.	FROM	TO

Fireman	C.C.A.	T.B. Man.
"	"	"
"	"	"
"	"	"
Brakeman	"	"
"	"	"
"	"	"
"	"	Porter

Pullman Cond. Postal Clerk

CAR RECORD

INIT.	NUMBER	KIND	FROM	TO

Bad Order Form (Santa Fe Form 1571 Standard)

This report is filled out when any car is damaged. Even if the car has been repaired and is being moved to its intended destination a report must be filled out. Some of the information requested on the form is contained on the waybills. The form is given to the telegraph operator at the destination point.

Form 1571 Std.

SANTA FE

WIRE REPORT OF CARS SET OUT BAD ORDER
or Repaired Enroute

Leave duplicate copy of this report with waybill

Location Filed and Date ____________________

Trainmaster ____________________ } Address to Divn. Headquarters

Chief Dispatcher ____________________

Car Foreman ____________________ (At end of your run) Third copy

AGM Mechanical ____________________ (Topeka, Amarillo, L. A.)

Data Correction Topeka ____________________ (when car set out bad order)

Agent ____________________ (Where Waybill Left)

A. Train, Time, date, location set out ____________________

____

B. Car initial and number ____________________
(include vans and containers on flat car)

C. Origin & Consignor ____________________

D. Contents ____________________

E. Destination & Consignee ____________________

F. Nature of defect & repairs made ____________________

____

G. If hot box, north or south side ____________________

H. Box number ____________________

I. Packing date ____________________

J. Manufacturer of Lubricator ____________________

K. Size of Journal or Bearing ____________________

L. Make of Journal Stops ____________________

M. Manufacturer of Roller Bearing ____________________

N. Can wheel truck get to car to change wheels ____________________

O. Conductor or Agent ____________________

This report to be made out on all cars set out, or repaired enroute. When car set out bad order in yard, Agent will complete section A thru F. Make this form in triplicate. Original to communication office, attach copy to waybill and copy to Car Foreman.

Conductors will show all existing defects that may require attention, such as broken couplers or parts, brake beams, flat wheels, or defective air brake appliances, etc. All parts removed from cars between terminals must be taken to terminal station and turned over to Inspector. A & B ends of a car are determined by location of brake staff which is on B end. On cars equipped with two brake staffs, stencilling on car will govern. Boxes are numbered as follows: Beginning at B end of car, boxes on right side are numbered R1, R2, R3 and R4; on left side, L1, L2, L3 and L4. Thus boxes L1 and R1 would be on outside axle B end of car. All information called for must be shown.

Defective Car Report (Santa Fe Form 1523 Standard)

Must be filled out if a car needs or needed repair. Even if the car was repaired by the crew, the form must be filled out. The form is given to the car inspector and train master at the terminal point.

DEFECTIVE CAR REPORT

Form 1523 Standard

Santa Fe

CONDUCTOR'S REPORT OF DEFECTIVE CARS ON TRIP

Hall 100M 7 54

FROM ________________ TO ________________ TRAIN No. __________ ENGINE No. __________ DATE ______________ 19____

HOT BOXES AND BRASSES								WAS CAR EQUIPPED WITH PACKING RETAINER SPRINGS?
			BRASS APPLIED				BRASS REMOVED	
INITIAL	CAR No.	STATION	YES OR NO	BOX NUMBER	NEW OR S.H.	7" 8" 9" 10" 11" 12"	CAUSE OF REMOVAL	

AIR HOSE APPLIED					
INITIAL	CAR No.	STATION	END OF CAR	NEW OR S.H.	CAUSE OF REMOVAL

DO NOT USE THE LETTERS "ARA" OR "AAR" IN DESCRIBING COUPLERS OR KNUCKLES. SHOW SIMPLEX, SHARON, TYPE D OR E OR WHATEVER KIND OF COUPLER OR KNUCKLE IS REFERRED TO. TYPE D OR E COUPLERS AND KNUCKLES USUALLY HAVE THE LETTERS D OR E CAST ON THEM. HIGH TENSIL KNUCKLES HAVE HT STAMPED ON THEM, IF NOT STAMPED HT THEY ARE GRADE B.

INITIAL	CAR No.	STATION	KNUCKLE APPLIED				A OR B END OF CAR	TYPE OF COUPLER IN CAR	KNUCKLE REMOVED			
			TYPE D, E, ETC.	FACE 9" or 11"	GRADE B or H.T.	NEW OR SH			TYPE D, E, ETC.	GRADE B or H.T.	FACE 9" or 11"	CAUSE OF REMOVAL

OVER

Blind siding report (Santa Fe Form 63)

If a car is picked up or set out at a siding at which no agent is present (blind siding), this report must be filled out and delivered to the agency office having jurisdiction over the blind siding.

BLIND SIDING REPORT

CARS CHECKED — ***From Moving Train** / **Actual Inspection**

Conductor ______________________

Train No. ______________ ***East** / ***West** **Date** ____________ **19** ______

Siding ______________________ **Time** ______ **A. M.** ______ **P. M.**

Block Out Line Not Used.

I	J	K	L	M	N	O
Initial	Set Out No.	Picked Up No.	On Hand No.	Kind	Contents	Sym.

Agents receiving these reports from conductors will retain and file the Original and mail the Triplicate to Agent next beyond Siding for his guidance and file. Superintendent will advise what disposition to make of Duplicate.

DAILY NON-AGENCY REPORT 4BF

PCDB FORM 63

Accident Report Form (Santa Fe Form 810 Standard)

This report must be filled out for any kind of accident involving property, people or the train. The form is delivered at the first available point of communication.

Form 810 Standard

See other side for further information required, case of highway or street crossing accident.

Santa Fe

TELEGRAPHIC REPORT OF ACCIDENT

_______________ Station _______________ 19 ____

To ACCIDENT _______________ at _______________

1. Train ______ Direction ______ Conductor ______ Engineman ______
2. Place ______ Time ______ Date ______ Speed ______ Weather ______
3. No. of loads in train ______ No. Empties ______ No. Tons ______ Engine Units ______
4. Nature and cause of accident ______
5. Did accident occur starting, stopping or when running? ______
6. Is car defective? ______. If so, explain details ______
7. Is main track obstructed? ______ How long take to clear track? ______
8. What is position in train of damaged cars? ______
9. Equipment damaged and derailed:

INITIALS	NUMBER	CONTENTS	DESTINATION	TO WHAT EXTENT DAMAGED

10. Were there any persons injured or killed? If so, give their names, addresses and occupation, extent of injury and disposition. State whether employe, passenger or trespasser. Furnish name, title and location of investigating officers. State in whose care body left or location to which removed and by whom. ______
11. Name and position of crew members ______
12. How long delayed? ______ Further particulars and suggestions? ______

Signature ______

Conductors, Enginemen and/or Engine Foremen and others making reports of accidents by telegraph will use this form in every case.

Be careful to answer all questions noted above.

In transmitting report, operators will give NUMBERS and ANSWERS of questions ONLY.

When received on printer, report will be transferred to form 810 Special, page 1 and page 2.

Conductors will keep a supply of these blanks and a supply of same will also be kept at all telegraph stations.

Agents and operators must send this report promptly by telegraph, and the receiving operator must deliver without delay.

Form 810 Standard

13. Name and address of driver of vehicle?

Names and addresses of occupants?

14. License number, make and kind of vehicle?

15. Estimated speed of vehicle

16. Did vehicle approach from right or left side?

17. Extent of damage to vehicle?

18. Did train strike vehicle or vehicle strike train?

If the latter, state where struck

19. Was view obstructed for driver?

20. If obstructed, state how obstructed

21. Straight track or curve?

22. Was whistle sounded? Was engine bell ringing?

23. What effort made to stop when it was seen collision unavoidable?

24. How brakes applied?

25. Show highway crossing number where so identified, otherwise show mile post plus feet location

26. Kind of crossing protection, "Crossing sign" – "Flashing Light" – "Wig Wag" – etc.

27. If other than "Crossing sign", was it working?

28. Distance of train from crossing when vehicle or person first observed

29. In case of switching movement, was crossing protected?

State where each member of crew stationed at time of accident

30. For persons witnessing accident show information below:

NAME	OCCUPATION	POST-OFFICE ADDRESS

Signature

Work Train Report (Santa Fe Form 957 Standard)

This is used if the train was involved in track and right-of-way maintenance. For example, if the train handled ballast cars, wrecker equipment cars, rail cars, etc. It is important to distinguish run time, work time, meal time, and idle time.

Hall—7-72—75M

Form 957 Std.

WORK TRAIN REPORT

DIVISION ____________________

ENGINEER ____________________ CONDUCTOR ____________________

CALLED TIME ____________ M DATE ____________ 19____

TIED UP TIME ____________ M DATE ____________ 19____

ENGINE	Run or Work * R or W	Run or Work ** Miles	FROM	TIME DEPARTED	TO	TIME ARRIVED	DESCRIPTION OF WORK PERFORMED	Hrs.	Min.
				M		M			
				M		M			
				M		M			
				M		M			
				M		M			
				M		M			

*RUNNING TIME AND WORK TIME MUST BE SEPARATED, SHOW "R" or "W".
**FOR AUDITOR'S AND SUPERINTENDENT OF CAR SERVICE'S USE.

FOR AUDITOR'S USE

Area Code P.R.	Area Code Loc.	Function Code Acct.	Function Code Activ-ity	Cls	State	Authority Type	Authority No.	Authority Yr.	Special Data	Amount

MOVEMENT OF CARS GOING AND RETURNING

Report only one car on each line

	INITIAL	NUMBER	KIND	Ld. or MTY	FROM	TO	DATE	CONTENTS	Unloaded or Loaded At	TONS Gross	TONS NET Rev.	TONS NET Co.
1												
2												
3												
4												
5												
6												

Tie Up Sheet (Santa Fe Form 830 Standard)

This form is filled out at the terminal point crew dispatcher's office. It is not used in all parts of the system. Often the informat is collected from the conductor and the crew dispatcher fills out the form himself.

Hall—12-72—400M

Form 830 Standard

Santa Fe

TO________________

____
(Insert Name of Railway Company)

________________19____

TRAIN NO.________ DATE________19	TIME WENT ON DUTY	TIME AND DATE RELEASED PREVIOUS TRIP	NUMBER HOURS ON DUTY SINCE HAVING LEGAL REST
SYMBOLS NAMES	. (A)	(B)	(C)
(1)	M.	M.	
(2)	M.	M.	
(2)	M.	M.	
(3)	M.	M.	
(3)	M.	M.	
(4)	M.	M.	
(4)	M.	M.	
(5)	M.	M.	

(1) CONDUCTOR
(2) ENGINEMAN
(2) ENGINEMAN
(3) FIREMAN
(3) FIREMAN
(4) BRAKEMAN
(4) BRAKEMAN
(5) BRAKEMAN OR PORTER

SIGNED________________

NOTE.—"Time went on duty" must include time prior to departure by crews to get train and engine ready. Write names opposite figure indicating occupation, filling in information called for under symbols A, B and C. In case double header use the two spaces provided for that purpose. Operators will transmit information by symbols: 1-A, B, C, etc.

Blue Form (Santa Fe Form 1468 Standard)

This is a form put out by the dispatcher to the train crew notifyin them of any movement of cars of excessive width or height ("high-wides" that may affect their operation. This will include high-wides on their train and any train they may pass. In addition, the form is used to notify the train crew of any unusual conditions such as track repair, etc. The form is not passed on to anyone by the crew members. It is for their reference only.

Form 1468 Std. Hall—6-73—50M

Santa Fe

NOTICE OF THE MOVEMENT OF CARS OF EXCESS WIDTH OR HEIGHT

....19.......

TO C&E ....

AT ....

EXTRA ....LEAVING ....

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APPENDIX B. ANNOTATED BIBLIOGRAPHY

1. Applied Science Associates. Handbook for Development of Advanced Job Performance Aids (JPA) in Accordance with MIL-J-83302 (USAF). Valencia, Pa.: Applied Science Associates, January 1971.

This handbook provides guidance in the development of advanced Job Performance Aids (JPA) in accordance with MIL-J-83302(USAF). The handbook covers Task Analysis, Proceduralized Troubleshooting Aids, Development of Troubleshooting Decision Aids, Translation of JPA into Vietnamese, and Preparation of Practice Exercises.

2. Ardon, V. The elemental time monitor--A trial marriage between electronics and work measurement. Journal of Industrial Engineering, 1968, 19, 342-347.

Describes the development and use of the elemental time monitor--a device used to aid time and motion analysis.

3. Army School of Instructional Technology. How to Conduct a Job Analysis and Write a Job Specification. London: Ministry of Defense, 1970.

This guide has been produced as the first part of a more detailed investigation into the application of job analysis techniques in the Army and has involved a survey of past and present projects in the British Armed Services, in the US and Canadian Services, and in industry. The aim is to outline methods of job analysis and the writing of job specifications which can serve as a basic guide to the non-expert.

4. Autonetics. Film Analysis Techniques for Methods and Measurements Autonetics, Anaheim, California, March 1971 (AD 808-483L)

The report discusses techniques of film analysis that allow thorough, accurate, and timely use to be made of methods and measurement data gathered through this medium for both the industrial engineer and the manager. Particular emphasis is placed upon the novel technique of dual camera, syncronized filming that provides complete viewing of electronic microscope work stations.

5. Barnes, R. Motion and Time Study: Design and Measurement of Work. John Wiley and Sons, New York 1968 (6th Edition).

Classic text on time and motion study.

6. Bennett, C. A. Toward empirical, practicable, comprehensive task taxonomy. Human Factors, 1971, 13, 229-235.

Considerable interest has developed in task taxonomy. Rational approaches are too simple. Empirical classifications based on performance will ultimately be forthcoming. A more readily available technique is described and illustrated where judgments of task verbs serve as data which are intercorrelated and factor-analyzed. In the study, four broad task dimensions were found: cognitive, social, procedural, and physical. Major problems in task taxonomy include the use of job-oriented rather than worker-oriented verbs and the inability to define the level of a task. A well-developed task taxonomy would aid both system designers and researchers on task performance.

7. Betke, R. L. Application of behavioral sciences to the practice of Industrial Engineering, Journal of Industrial Engineering, 1967, 18, 293-298.

This article describes an experiment in applying concepts of behavioral science to the practice of Industrial Engineering to implement a work measurement program. The purpose of the program was to control manpower and reduce costs through the analysis and measurement of the activities of 700 people by using the appropriate engineering techniques such as MTM, work sampling, and time study, with the understanding that human considerations can mean the difference between success and failure. The Industrial Engineers were given training to help them develop a behavioral science approach. Results of the experiment showed that when the Industrial Engineer understands and uses behavioral science concepts, the traditional reactions to his efforts are changed, resulting in significant benefits for this company.

8. Boling, R. A Model for Analyzing Systems Involving Sequential Crews. Stanford University, September 1969 (AD 693-983).

A model is described which can be used to analyze the behavior of sequential crew systems. Such systems consist of two or more crews following one another in a fixed sequence with each crew completing a particular task on a unit being constructed, repaired, or serviced. The model is useful in those cases where crew service times can be approximated by one of the family of Erlang distributions. An analysis of the general behavior of sequential crew systems is included.

9. Bongers, L. Factors Affecting Retrieval of Task-Time Data from Human Store, UCLA School of Engineering and Applied Science, August 1969, (AD 696-985)

A methodology for obtaining time estimates from human subjects was developed which was consistent with current theory and the empirical data. The methodology was tested on 20 subjects. Subjects were asked to estimate task completion times based on their total past experience and to assign a probability of occurrence to each time value. The end products were probability distributions of task completion times, which were then compared with actual task time measurements made by methods and standards personnel. Estimated times from when a 'learning curve' correction was made. Some variables affecting human judgment of time duration were investigated. The need for further research was discussed and proposals were outlined.

10. Brumback, G. and Vincent, J. Factor Analysis of Work Performed Data for a Sample of Administrative, Professional, and Scientific Positions, Personnel Psychology, 1970, 23, 101-107.

This article reports on a factor analysis of the work performed by Commission Corps Officers who occupy a wide range of administrative, professional, and scientific positions in the United States Public Health Service (USPHS). The findings from this study will provide the framework for the eventual development of a new officer performance rating instrument.

11. Burger, W., Knowles, W., Wulfeck, J. Validity of Expert Judgments of Performance Time. Human Factors 1970, 12, 503-510.

An apparatus and a method for validating estimates of performance time and reliability against empirical measures of human performance time and reliability are described. Measures of performance time were obtained on five tasks and were correlated with estimates of performance times obtained from eight judges in a previous study. Median observed and estimated performance times were highly correlated (x = .98). Estimates of maximum performance time corresponded to the 95th to 100th percentiles of the observed distribution of performance time, but estimates of minimum performance time were high and scattered over the lower percentiles. The significant validity coefficient suggests the feasibility of using estimates of performance time, at least for some simple tasks, in system-analytic models when empirical data are lacking and are too expensive to obtain.

12. Chowdry, B. G. and Christ, C. F. Sample Size in Stopwatch Time Study. Journal of Industrial Engineering, 1968, 19, 434-439.

The object of this research is to compare two methods for estimating the number of observations required for determination of normal time; the Barnes' method and Krick's method. A criterion was developed for choosing between the two methods based on which method would result in a normal time closer to the true normal time.

13. Christensen, J. M. Arctic Aerial Navigation: A Method for the Analysis of Complex Activities and Its Application to the Job of the Arctic Aerial Navigator. Mechanical Engineering, 1949, 71, 11-16.

This report describes a method employed in gathering activity data under rather unusual and difficult circumstances. The chief merits of the method are simplicity and flexibility of application. Data were acquired regarding the following:

(1) How often each item of equipment was used.

(2) The amount of time required to obtain the information the equipment was designed to supply.

(3) The general sequence in which operations were performed and equipment was used.

14. Christensen, J. M. A Sampling Technique for Use in Activity Analysis. Personnel Psychology 1950, 3, 361-368.

Employment of sampling principles offered a simple, inexpensive and flexible approach to the job analysis type of problem. The technique has been used successfully in operational situations in the United States Air Force. The technique yielded data from which was inferred: (a) the frequency with which specified activity elements occur, (b) the proportion of total time devoted to each activity element, and (c) the sequence of activities. The analysis and interpretation of such data make possible recommendations regarding equipment design and development, workplace layout, the duties of crew members, and manning requirements.

15. Christian, R. W. Work Measurement Today. Factory 1963, 121, 123-8.

Survey of improvements in time study and work sampling at various companies; specific developments announced by leading consultants in industrial work measurement.

16. DeGreene, K. Systems Psychology, McGraw-Hill: New York, 1970, page 108-112.

Presents an overview of task analysis; definition, conducting a task analysis and task demands analysis.

17. DeJong, J. R. The Contribution of Ergonomics to Work Study. Ergonomics 1967, 10, 579-588.

In the course of this work study has come to concern itself more and more intensively with all kinds of work systems and, after the one-sided stress placed initially on motion study and work measurement, has gradually given an increasing measure of attention to all systems elements. As is evident, among other things, from the textbooks on work study, training course syllabi and examination requirements, interest in ergonomics has shown a marked increase of recent years. Considering the desirability of giving ergonomics the widest possible application, it is recommended that this subject be included in all work study training courses, with particular emphasis not so much on the imparting of knowledge, as on effective ways of putting it into practice and on the use that can be made of ergonomics data.

18. Dickmann, R. The Use of Functional Job Analysis as an Aid to Personnel, Washington, D. C. American Personnel and Guidance Association, January 1969.

Functional Job Analysis (FJA) is based on the premise that every job requires a worker to function in relation to Things, Data and People (factors) in varying degrees. A level is determined for each of the three areas for each worker function. A measure of emphasis was developed by assigning percentages to weight each factor. The level at which a worker functions in relationship with Things, Data and People together with the weights form a functional profile. Highlights of the use of FJA include: (1) inexperienced analysts can determine correct functional levels and weights easily, and (2) a performance appraisal instrument can be developed so ratings are made in direct relationship to functional profiles.

19. Dumas, N. and Muthard, J. Job Analysis Method for Health-Related Professions. Journal of Applied Psychology 1971, 55, 458-465.

A method for analyzing work of health personnel was devised and applied in a physical therapy service. Procedures for developing the special language for describing the tasks performed by physical therapists and methods for training observers to prepare sequential reports of the ongoing work of staff are presented. Observers were able to reliably report the detailed characteristics of the tasks in a physical therapy service over an extended period of time. Implications of the method are discussed.

20. Farina, A. Development of a Taxonomy of Human Performance: A Review of Descriptive Schemes for Human Task Behavior. Pittsburgh, American Institute for Research, January, 1969.

This report reviews a number of schemes designed to describe the human behaviors occurring during task performance. The purpose of the review was to assess whether such schemes would be useful in classifying tasks per se. Included in the review were schemes which employed such conceptual units as functions, abilities, and overt behaviors. In general, the available schemes are hampered by one or more of several factors (a) imprecise terms; (b) little measurement capability; (c) lack of development of the scheme to a point where it may be readily applied to real world tasks. The logic of describing tasks in behavioral terms is examined with a final conclusion being reached that tasks per se are more appropriately described in terms of non-behavioral task characteristics.

21. Jeanneret, P. and McCormick, E. J. The Job Dimensions of "Worker Oriented" Job Variables and of Their Attribute Profiles as Based on Data from the Position Analysis Questionnaire, Lafayette, Indiana, Occupational Research Center, Purdue University, June 1969.

This study was designed to investigate the hypothesis that there is some structure underlying the domain of human work, and that this structure can be defined in terms of one or more sets of job dimensions. The basic approach to the derivation of these dimensions involved the characterization of the job activities and work situations in behavioral or "worker-oriented" terms using a job analysis instrument known as the Position Analysis Questionnaire (PAQ). Two major data sources were developed and structured in terms of the behavioral job elements comprising the PAQ. Three different multivariate procedures were used to construct several sets of job dimensions. There were noticeable similarities between all of the dimensions, and it was concluded that there is a certain structure to the world of work that can be identified. Implications for the use of such dimensions, particularly in the synthetic validity context, are noted.

22. Jones, M., Hulbert, S., and Haase, R. A Survey of the Literature or Job Analysis of Technical Positions, Personnel Psychology, 1953, 5, 173-194.

This paper presents a survey of the literature on job analysis of technical positions. A technical position is defined as one which is not of professional level, but which requires considerable background of knowledge in a rather narrow area, and some knowledge of general principles. Very little work has been published dealing with these positions, but there is some indication that they are more difficult to rate than are standard factory and office jobs. It is concluded that rather thorough study of technical positior is in order and that considerable emphasis must be placed on skills & knowledge rather than on supervisory factors.

23. Mansoor, E. and Yadin, M. On the Problem of Assembly Line Balancing, Israel Institute of Technology, Haifa, April 1969 (AD-692-127).

Assembly line balancing involves the sequencing of jobs and their assignment to work stations, according to given precedence relations and the work content of each job, in order to minimize the maximum work content of the jobs which are assigned to each of the stations, that is, to minimize the so-called 'cycle time'. There are two approaches: one being to determine the optimal cycle time for a given number of stations, and the other, being to minimize the number of stations for a given cycle time.

24. McCormick, E. J., Jeanneret, P., Mecham, R., A Study of Job Characteristics and Job Dimensions as Based on the Position Analysis Questionnaire. Lafayette, Indiana: Occupational Research Center, Purdue University, June 1969.

This is the final report of a research project relative to the analysis of human work in terms of "worker oriented" or behavioral job elements. It was hypothesized that, across the spectrum of jobs, there is some underlying "structure" of human work in terms of the human behaviors involved. The project was directed toward the identification of behavioral job elements and their organization into job dimensions, and the exploration of certain possible practical applications of job data based on such job elements or dimensions. Principal components analysis procedures were used in the analyses of two types of data based on the PAQ.

These analyses resulted in the identification of reasonably satisfying job dimensions, with some of the dimensions derived from the two data sets having considerable congruence. Data based on the PAQ were used experimentally in the prediction of wage and salary rates for a sample of jobs. In addition, the PAQ was used as the basis for developing synthetically-derived job requirements for a sample of 179 jobs. These were "tested against" test data from the U. S. Employment Service for corresponding jobs, with distinctly positive results; if data based on a larger sample of jobs confirm the present indications, it might then be possible to derive a statistical procedure for developing job requirements for individual jobs from data based on the Position Analysis Questionnaire (PAQ).

25. McCormick, E. J., Jeanneret, P., Mecham, R., The Development and Background of the Position Analysis Questionnaire. Lafayette, Indiana, Occupational Research Center, Purdue University, June 1969.

This report deals with the background and the development of the Position Analysis Questionnaire (PAQ), which was used as the basic job analysis instrument in the research program covered by this contract. The PAQ (Form A) used in the study includes 189 job elements of an essentially "worker-oriented" nature, these elements generally characterizing work activities of a behavioral nature (or that have strong implications in behavioral terms), and elements that characterize certain aspects of the context within which human work is performed. The job elements of the PAQ have been used as the basis for deriving various sets of job dimensions, and for studies of an exploratory nature that deal with the potential use of the PAQ as the basis for developing synthetically-derived job attribute requirements, and for job evaluation purposes. This particular report describes the development of the PAQ, Form A, from earlier job analysis instruments, and the more recent development of a modified version of the PAQ, Form B.

26. McKnight, J., Butler, P., and Behringer, R. An Analysis of Skill Requirements for Operators of Amphibious Air Cushion Vehicles (ACV's) Alexandria, Virginia, HumRRO, November 1969.

This report describes the skills required in the operation of an amphibious Air Cushion Vehicle (ACV) in Army tactical and logistic missions. The research involved (a) an analysis of the ACV characteristics, operating requirements, and environment, (b) results of a simulation experiment. The analysis indicates that ACV operation is complicated by (a) an inherently slow vehicle response in certain control dimensions, (b) a need for complex control coordinations in performing certain necessary maneuvers, and (c) the ACV's sensitivity to various aspects of the natural and man-made environment.

27. Merrill, P., Task Analysis--An Information Processing Approach. Tallahasse, Florida: Florida State University, Tech Memo No. 27, April 1970.

Several concepts and techniques used to design computer simulation of human performance were used in developing an information processing approach to task analysis. This new approach was compared and contrasted with Gagne's hierarchical task analysis model. Neither hierarchical nor information processing analysis would be sufficient for all types of tasks. A hierarchical analysis would be appropriate where lower ordered skills generate positive transfer to higher level skills, while an information processing analysis would be utilized where the output of one task subskill or operation is required as input for a succeeding operation.

28. Miller, R. B. Suggestions for Short Cuts in Task Analysis Procedures. Pittsburgh: American Institute for Research, December, 1954.

This report is the result of a study into methods for reducing the time and effort expended in task analysis phase preparatory to making design recommendations for training devices specifically.

29. Moores, B. Ergonomics--or Work Study? Applied Ergonomics 1972, 3, 147-154.

After reviewing the nature of the Ergonomics and Work Study disciplines, the author discusses Performance Rating, which provides a general target from particular performances, and Compensating Relaxation Allowances, which indicate how much rest is required. He quotes from studies on the efficacy of ratings and allowances and discusses the variabilities that can arise.

After examining progress in adopting physiological and psychological measurements of work intensity to determining work loads, he concludes by considering some of the present relationships between Ergonomists and Work Study Officers, and between them and managements and men.

30. Morgan, et al., Human Engineering Guide to Equipment Design. McGraw-Hill, New York, 1963, page 3-13.

General introduction to system analysis. Presents various modes of presenting task or system analysis data. Discussed are functional analysis, decision analysis, activity analysis, flow analysis, and job analysis.

31. Morsh, J. Job Analysis in the United States Air Force, Personnel Psychology, 1964, 17, 7-17.

Describes the job analysis methods used in the Air Force, indicating advantages and disadvantages of each, as well as their reliability and validity.

32. Morsh, J. E. and Archer, W. B. Procedural Guide for Conducting Occupational Surveys in the U. S. Air Force. Lackland AFB, Texas: Personnel Research Laboratory, PRL-TR-67-11, September, 1967.

This procedural guide sets forth in detail the procedures for collecting, organizing, analyzing, and reporting information describing work performed by Air Force officers and airmen. Specific steps in the application of the Air Force method of job analysis are presented in chronological order. The guide has been designed to (a) provide guidance to Air Force and other agencies who proposed to construct and administer job inventories, (b) assemble information about the Air Force method of job analysis which is now available only from scattered sources, (c) indicate problems found in applying the Air Force method and suggest possible solutions, (d) summarize hitherto unreported experiences gained during occupational surveys, (e) acquaint using agencies with the products of occupational surveys, and (f) provide briefing material where summary information about the Air Force method is required.

33. Mosel, J., Fine, S., and Boling, J. The Scalability of Estimated Worker Requirements. Journal Applied Psychology, 1960, 44, 156-160

Study investigated the extent to which estimated trait requirements can be said to constitute a scalable domain in the sense proposed by Guttman. That is, do such commonly used requirements as verbal ability and motor speed represent undimensional attributes on which jobs can be placed. Interest and personality requirements had acceptable scalabilities, but only three of the 10 aptitude requirements proved scalable.

34. Niebel, B. Motion and Time Study. Richard Irwin, Inc., Homewood, Illinois, 1972, (5th Edition)

Classic text on time and motion study. Describes the what, how, and why of time and motion analysis.

35. Peters, D. L. The Scaling of Jobs and Job Tasks in Terms of Selected Physical and Sensory Dimensions. AD-710-826.

The general purpose of the study was to provide information about scaling techniques which could be used for rating work activities or work behaviors. The initial phase was concerned with the development of numerically anchored scales for use in rating job tasks and job titles on certain physical and sensory dimensions. A later phase was devoted to the construction of job task anchored scales, these scales incorporating previously scaled job tasks as benchmarks to represent scale levels. In a final phase, a comparison was made of the relative effectiveness of the scales which had been constructed of job task anchored benchmarks as opposed to scales based on numerically anchored ones.

36. Prien, E. and Ronan, W. Job Analysis: A Review of Research Findings. Personnel Psychology 1971, 24, 371-396.

The scope of this review is not limited to the research literature dealing with the definitions and measurement of work and of necessity touches some areas tangential and peripheral to the main theme. As such, some of the literature in sociology and anthropology is related to the complete understanding of what constitutes work in modern society. The review is organized into sections covering the historical, cultural, and societal etiological determinants of what constitute work. Second, the methodological approaches to the analysis of jobs. Third, job function taxonomies. The fourth section is concerned with the results of research designed to define and analyze jobs in contemporary industrial psychology. The final section, five, is devoted to the delineation and examination of the various applications of job analysis methods and results and the questions remaining to be answered through continuing research.

37. Rigney, J. and Towne, D. Computer Techniques for Analyzing the Microstructure of Serial-Action Work in Industry. Human Factors 1969, 11, 113-122.

Three computer-based techniques for analyzing and simulating serial action tasks are described. The first, called BETS, measured the efficiency, in terms of expected information, of tests made by technicians who were troubleshooting. It computed efficiency ratios for a technician's detailed time and motion analyses from gross descriptions of serial action tasks and man-machine interfaces and computed the time costs of these tasks. The third technique incorporates a general model of the action-goal structure of serial action work. This program, called TASKSYM, can generate all alternative correct ways to accomplish serial-action work and can track a subject through the performance of this work. The model includes an anti-goal structure which identifies action sequences leading to catastrophic error.

38. Singleton, W. T. Techniques for determining the causes of error. Applied Ergonomics 1972, 3, 126-131.

After reviewing attempts to classify errors, emphasising the distinction between causes, effects and remedies, also between system and human problems, the author considers analytical techniques. These include statistical, critical incident and observation methods. Remedies proposed include better displays and controls, improved monitoring of performance, and incentives. The article concludes with some examples of error research in forestry, keyboard operation, and control rooms.

39. Smith, R. and Siegel, A. A multidimensional scaling analysis of the job of civil defense director. Journal of Applied Psychology 1967, 51, 476-480.

An examination was performed, through multidimensional analytic scaling techniques, of the complex job of the Office of Civil Defense (OCD) Director. Three bipolar factors emerged from the subsequently factored matrix: (1) internal vs. external system maintenance, (2) routine vs. emergency programming, and (3) resource use vs. resource evaluation. A fourth factor, labeled emergency system integration, was less clear and appeared unipolar. It is concluded that multidimensional scaling analysis is a practical approach for defining complex jobs. Such defining would permit subsequent unidimensional measurement. The factors found may be used for selection, training, etc. of OCD directors.

40. Stevens, A. Activity Sampling or Building Sites. Building Research Station, Watford, England, May 1969 (AD-692-586).

The building research station has been using sampling techniques to obtain detailed information on the labor expended on site allocated to various categories of work. This involves up to 1000 recordings being made daily with each recording containing several pieces of information. To speed up the work of the analysis the station has been developing the use of special recording forms which can be read directly into an optical reader. After dealing briefly with the practical aspects of the sampling technique this paper concentrates on the snags that occurred when using these forms in the field and how information obtained from the analysis and explains how this is presented by the computer.

41. U. S. Department of Labor. Handbook for Analyzing Jobs, Washington, D. C. Department of Labor, Manpower Administration, 1972.

Reference for conducting job analyses according to U. S. Department of Labor procedures. Discusses job analysis and its uses, concepts, and principles in job analysis and details the procedure, including standard form, for conducting a job analysis study-including a staffing schedule, organizational and process flow charts and the narrative reports. Bulk of the report defines Department of Labor terms and codes.

42. U. S. Department of Labor. Task Analysis Inventories: A Method for Collecting Job Information. Washington, D. C. U. S. Department of Labor, Manpower Administration, 1973.

The inventories in this publication were developed in accordance with the basic criteria established for the analysis of jobs, as contained in the Handbook for Analyzing Jobs. They will be used as supplementary aids to in-depth job studies and will provide an abbreviated method for collecting job analysis data in situations where complete job analyses are not required or not feasible. They will also provide a tool for job data collection by persons who are not trained in job analysis techniques.

43. Zacks, S. Determination of Optimal Sample Size for Some Work Measurement Procedures. International Journal of Production Research 1962, 1(4), 43-53.

Work measurement procedures for estimation of Ratio-Delay and Average Performance Time are reconsidered; statistical models corresponding to these procedures are formulated in terms of various sources of variation in work production systems; optimum number of observations for each relevant time period, and optimum number of time periods are derived in terms of sampling cost, available budget and required confidence intervals for estimates of characteristics being measured.