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JOB SAFETY ANALYSIS

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ABSTRACT

The concepts and techniques for the development and performance of an effective job safety analysis (JSA) are presented and discussed. The elements of an analytic tree are identified. These elements include management controls, identification of a method for job selecting, analysis of the job, incorporation of the JSA into operational systems and monitoring a JSA program. The contribution of employees based on their experience and knowledge is illustrated.

GLOSSARY

CS&R - Codes, Standards, and Regulations (Federal, state and local requirements)

dB - Decibel Unit that expresses the relative intensity of sound on a scale from zero for the average least perceptible sound to about 130 for the average pain level

DOP - Detailed Operating Procedure

JSA - Job Safety Analysis

PPE - Personal Protective Equipment

RSO - Reported Significant Observation

SOP - Standard Operating Procedure

SWP - Safe Work Permit

TWA - Time Weighted Average

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PREFACE

The purpose of this guide is to identify the elements necessary to develop and evaluate a job safety analysis program. Illustrating how employees may contribute their personal experience and knowledge in the design of a JSA; and gives the concepts and techniques necessary to perform and maintain an effective JSA program.

The analytic tree is structured to identify management's responsibility, how to select a job, how to perform a JSA on that job, how to implement the analysis and how to monitor the effectiveness of the analysis. This guide may also be used to evaluate an existing JSA program.

All necessary management controls are not developed in detail. Some of the identified JSA elements may require further elaboration. Therefore, the ideas presented in this guide will enable the readers to refine additional material.

I. INTRODUCTION

Job Safety Analysis (JSA) is a technique for the review of a job. Its purpose is to uncover inherent or potential hazards which may be encountered in the work environment. When properly used, the JSA will be an effective tool for training and orienting the new employee into the work environment. A JSA can also be used to retrain the older employee.

During the development of a JSA, supervisors will learn more about the jobs they supervise. Employees who are encouraged to participate will develop a better attitude and knowledge of safety. The program will develop safer job procedures and create a better working environment.

An analysis includes five steps:

1. Select a job.

2. Break the job down into steps.

3. Identify the hazards or determine the necessary controls of the hazards.

4. Apply the controls to the hazards.

5. Evaluate the controls.

To increase the effectiveness of a JSA, a complete program must be developed in which management is involved with the employee, supervisor, and safety. Therefore, this guide is designed for a complete JSA program. The following five major elements are necessary to establish and maintain the JSA program:

1. Management controls

2. Identification of a method for job selecting

3. Analysis of the job (perform JSA)

4. Incorporation of the JSA into operational systems

5. Monitoring a JSA program.

II. ANALYTIC TREE

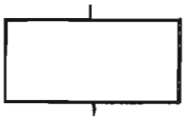
The JSA analytic tree shown in Figure 1 is a representation of the necessary elements for a JSA program. The following logic symbols are used on the analytic tree:

AND-Gate Symbol

Coexistence of all inputs required to produce output.

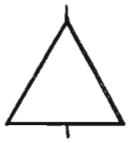
OR-Gate Symbol (Nonexclusive)

Output will exist if at least one input is present.



RECTANGLE

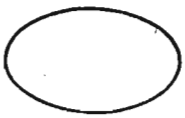
An event resulting from the combination of more basic events acting through logic gates.



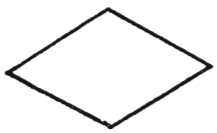
TRIANGLE

A connecting or transfer symbol. All tree construction below the "out" triangle is transferred to the tree at "in" triangle location(s).

CONSTRAINT Symbol



Applies conditions or constraints to basic logic gate or output event. When applied to basic AND-gate or OR-gate, it creates special conditional gate such as Exclusive Or, and "Priority AND".



DIAMOND

An event not developed. Sequence is terminated for lack of information or consequences.

The purpose of the analytic tree is the design of a new JSA program or the evaluation of an existing one. The following constraints on the tree must be considered:

Training

Routine or one-time tasks

Compliance to codes, standards and regulations.

The participants in the JSA program should receive appropriate training on the performance of a JSA. The analysis could be used in all phases of industry from construction, installation, operation, and maintenance through decommission. Analyses performed on one-time tasks are as important as analyses of routine jobs. All Federal, state and local regulations must be complied with in the JSA.

Objective
Establish/maintain job safety analysis program

- Provide JSA training
- Routine or one time tasks
- CS&R compliance

Management controls 1.0

Establishing a method for selecting jobs 2.0

Selection of tasks for analysis 2.1

Line function 2.1.1

Employees 2.1.1.1

Line supervisors 2.1.1.2

Upper management 2.1.1.3

Staff function 2.1.2

Safety 2.1.2.1

Design 2.1.2.2

Quality assurance 2.1.2.3

Others 2.1.2.4

Prioritization of tasks 2.2

Σ

Optimize decision by considering more than one selection criteria

Accident severity 2.2.1

Accident frequency 2.2.2

Judgment and experience 2.2.3

Routine jobs 2.2.4

Job changes 2.2.5

Anticipated ease or difficulty 2.2.6

Analysis of the job (perform JSA) 3.0

Hazards identification 3.1

Organizational structure and personnel will determine who analyzes the task

Group discussion method, analysis 3.1.1

A

Break job down step by step A.1

Record significant observations A.2

Record hazards A.3

Direct observation method, analysis 3.1.2

Supervisor 3.1.2.1

A

Systems analyst 3.1.2.2

A

Management 3.1.2.3

A

Safety engineer 3.1.2.4

A

Eliminate or control hazard 3.2

Σ

Sufficient combination of individuals to maximize solutions

Group discussion method 3.2.1

B

Less hazardous way to do the job 3.2.1.1

Change conditions which create hazards 3.2.1.2

Change job procedure 3.2.1.3

Reduce frequency of doing job 3.2.1.4

Personnel protective equipment 3.2.1.5

Direct observation method 3.2.2

Supervisor 3.2.2.1

B

Systems analyst 3.2.2.2

B

Management 3.2.2.3

B

Safety engineer 3.2.2.4

B

Review the analysis and potential solutions 3.3

All except persons performing the analysis and solutions

Worker on the job 3.3.1

Supervisor 3.3.2

Management 3.3.3

Systems analyst 3.3.4

Safety engineer 3.3.5

Implement the JSA into operational systems 4.0

Step by step procedures 4.1

Safety professional cognizance 4.2

Informal safety processes 4.3

JSA used for training new and old employees 4.4

Monitoring a JSA program 5.0

Use of RSO 5.1

Observation of task 5.2

Accident records 5.3

Feedback 5.4

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Figure 1

Adequate data for the elements of the analytic tree have been compiled and are listed below. The subsection numbering system is analogous to the numbering system of the analytic tree.

1. MANAGEMENT CONTROLS

Management controls are needed to establish an effective JSA program. The entire program must be directed and supported through the management controls. Some aspects of management controls are:[a]

Policies

Directives

Responsibilities (line and staff)

Vigor and example

Accountability

Budget.

[a] For further information on management controls for an effective program, refer to the MORT Users Manual SSDC-4.

2. ESTABLISHING A METHOD FOR SELECTING JOBS

Potential jobs for analysis should be tasks with sequential steps. The work goal is attained when these steps have been performed.

Some jobs can be broadly defined in general terms of the goal. Making paper, building a plant and mining iron ore are examples. Such broadly defined jobs are not suitable for a JSA. Similarly, a job can be narrowly defined in terms of a single action. Pulling a switch, tightening a screw and pushing a button are examples. Such narrowly defined jobs are sometimes not suitable for a JSA. Sometimes pulling a switch or tightening a screw is very critical. In those cases, the job should be broken into single action steps.

To use the program effectively, a method must be established to select and prioritize the jobs to be analyzed. One method for selecting tasks to be analyzed is for a supervisor to list jobs performed by employees. The supervisor then selects the jobs which represent the greatest injury potential for analysis. Different approaches depend on the organizational structure and objectives.

2.1 Selection of Tasks for Analysis

The structure and objectives of a company will determine the individual who selects the tasks. If the employee turnover rate is high, the management might choose the supervisor or foreman to determine potential tasks for analysis. An alternative to this approach is for the safety engineer to develop the list. In some companies, safety engineers are responsible for more than one facility and may sufficiently

not be familiar with each area to suggest jobs for analysis. Therefore, the employee, supervisor, and safety engineer might combine their knowledge and effectively develop a list. The group discussion method will usually benefit the overall safety program (see Section 3). The most knowledgeable individuals should be used to determine potential tasks for analysis regardless of the method used.

Jobs suitable for JSA are the jobs assigned by a line supervisor. Operating a machine, tapping a furnace, and piling lumber are good subjects for job safety analysis. They are neither too broad nor too narrow. Assignments which require the performance of a number of sequential steps to accomplish the task are good candidates for job safety analysis. The following are examples of this kind of job:

Material handling (heavy drums)

Work on high energy ($\geq$ 480 V) electrical systems

Acid/caustic cleaning

Crane repair

Crane operation

Trenching and excavating

Erection and use of scaffolding

Beryllium, zirconium machining

Repairing caustic/acid tanks

Car/bus service on hoists

Operation of X-ray, low power laser unit.

The index of Jobs to be Analyzed is another method for selecting potential jobs for analysis used by United States Steel Corp. In it, all of the occupations or earner groups are listed. Each occupation is further divided into the jobs performed. (See Appendix A.)

2.2 Prioritization of Tasks

The establishment of priorities for the jobs selected is the next step. The tasks must be ranked in the order of greatest accident potential (injury and illness or property damage). The tasks with the highest risks should be analyzed first. To achieve this ranking of tasks, the following criteria should be used. The use of more than one selection criterion will optimize decisions. Caution must be exercised when selecting jobs for analysis if the employees are inexperienced. Analyses should begin with a simple task and proceed to more complex jobs.

2.2.1 Accident Frequency. A job that has repeatedly produced accidents is a candidate for a JSA. The greater the number of accidents associated with the job, the greater its priority should be.

2.2.2 Accident Severity. Every job that has produced a disabling injury should be analyzed. The injuries prove that the preventive action taken prior to their occurrence was not successful. Some jobs may not have a history of accidents but may have the potential for a severe injury.

2.2.3 Judgement and Experience. Many jobs qualify for immediate job safety analysis because of the potential hazard involved. Such type of hazard might be identified as "it hasn't happened yet, but when it does -- watch out." A good example is a job involving explosion possibilities or one involving the lifting of exceptionally heavy equipment. Such jobs involve fatality possibilities can cause fatalities even though they have not occurred.

2.2.4 Routine Jobs. In routine or repetitive tasks with inherent hazards, the employee is exposed repeatedly to these hazards. For example, exposures to high levels of noise (>85dB TWA) over a period of time will affect the hearing of an employee.

2.2.5 Job Changes. Changes in processes, equipment, or materials can introduce new hazards which may not be apparent. Changes can also increase the workload of an employee and overtax his ability. It is not necessary to wait until there is an accident on such jobs before making a job safety analysis study.

These five criteria help establish the sequence in which jobs are to be analyzed. They also help to identify some of the hazards associated with the job.

3. ANALYSIS OF THE JOB (PERFORM JSA)

To develop a JSA for any job, management must determine who will:

(a) Analyze the job (step-by-step breakdown).

(b) Provide technical support (solutions to identified hazards).

(c) Review the completed analysis.

Methods for performing the JSA are based on group discussion and direct observation.

Group Discussion Method

In the group discussion method, the supervisors meet with their employees to perform an analysis of a job. The job then is broken into a step-by-step process with identification of all associated hazards. Changes in the work procedures or in the physical environment will eliminate or reduce the identified hazards.

The following basic advantages are obtained from the group discussion method:

(a) Sharing of experiences by a group of employees will generally produce a more thorough analysis of potential hazards. One employee may identify a potential hazard which has been overlooked by others. The combined experience is also valuable in analyzing possible changes for the reduction or elimination of the identified hazards.

(b) Group discussion of this kind will serve as an effective safety training program. The employees will learn from each other. They learn what "potential hazards" are. They share ideas, and usually every person knows a little more safety as a result of the discussions.

(c) The employee assumes an active role in the safety program. The safety program will benefit because the employee will be more inclined to accept the procedures in the JSA.

Of course these advantages are not automatic. They depend upon how skillfully the discussions are conducted. If they are handled poorly without preparation or skill, the results will be meager.

Direct Observation Method

In direct observation method, either the supervisor or safety engineer observes the employee performing the task from start to finish. The job must be broken down step by step. The hazards associated with the job must be identified. The elimination or reduction of the identified hazards should be attempted. There is no reason why the supervisor or safety engineer cannot consult with the employee doing the job.

The advantage of the direct observation method is that the supervisor or safety engineer does not have to try to recall or visualize how the job is done because the performance is seen.

The organizational structure and personnel determine the method most benefical for a company. A combination of both methods may also be used. The flow chart in Figure 2 illustrates the two methods of job analysis.

3.1 Hazards Identification

Break the job down into a step-by-step sequence. Avoid the common error of: (a) making the breakdown so detailed that an unnecessarily large number of steps result, or (b) making the job breakdown so general that basic steps are omitted. Record each step of the job in the order in which it occurs. Each step describes what is done, not how it is done. Record and examine each step involved with the job to determine possible hazards.

In identifying potential hazards associated with each step consider the following questions:

(a) Is there a danger of striking against, being struck by or otherwise making injurious contact with an object? (For example, being struck by a suspended drill casing or piping as it is moved into place.)

(b) Can the employee be caught in, on, or between objects? (For example, an unguarded v-belt, gears, or reciprocating machinery.)

(c) Can the employee slip, trip, or fall on some level, or to another? (For example, slipping in an oil-changing area of a garage, tripping on loose worn carpet, or falling from a scaffold.)

(d) Can the employee strain him/herself by pushing, pulling or lifting? (For example, pushing a file cabinet into place or pulling it away from a wall in a confined area.) Back injuries are common in every type of industrial operation; therefore, do not overlook the lifting of heavy or awkward objects.

(e) Is the environment hazardous-toxic-gas, vapor, mist, fumes or dust, heat, ionizing or nonionizing radiation? (For example, arc welding on galvanized sheet metal produces toxic fumes and nonionizing radiation.)

A list of energy sources which may be involved in analyzing potential hazards is given in Appendix B.

Review each step as many times as necessary to identify all hazards or potential hazards.

Another area for analysis is that of error in performance of a job (human error). Some errors in performance of a job may not generate problems or few problems; however, the same error at an inopportune moment can be catastrophic. An example is the sinking of the submarine Stickleback off Oahu in June 1958. The Stickleback and the destroyer escort Silverstein were simulating attacks and counterattacks on each other. The submarine made an attack and then dove to evade the Silverstein's counterattack. Soon after the submarine submerged, the Stickleback lost power and uncontrollably rose to the surface in the path of the destroyer. The Silverstein rammed the submarine forward of the control room, where she began to fill. The submarine sank in 9000 feet of water. The 8 officers and 64 men of the Stickleback boarded the Silverstein.

A board of inquiry established that a crew member had turned a rheostat in the wrong direction, so the submarine had lost its power at a critical instant. The loss of power and subsequent rise of the submarine to the surface at any other time would not have generated a problem.

The following basic factors should be considered in evaluating human error in a job:

1. Equipment can be utilized incorrectly. What effects could there be if used incorrectly?

2. Personnel tend to take shortcuts to avoid arduous, lengthy, uncomfortable, or unintelligible procedures.

3. Equipment that is difficult to maintain will suffer from lack of maintenance.

4. Requirements for special employee training should be kept to a minimum.

5. Written procedures which are difficult to understand without further explanation may result in employee confusion.

6. Stress in the work environment and in private life.

3.2 Hazards Elimination or Control

The final step in evaluating a job is to develop a safe job procedure to eliminate or reduce the identified hazards. The following criteria should be considered:

1. Find a less-hazardous way to do the job. (engineering revision)

   To find an entirely new way to do a job, determine the work goal, and then analyze the various ways of reaching this goal to see which way is safest. Consider work-saving tools and equipment.

2. Change the physical conditions that created the hazard. (engineering revision)

   If a new, less hazardous way to do the job cannot be found, then try to change the physical conditions which are creating the hazards. Possible changes in the physical conditions may be tools, materials, equipment, or the environment which will eliminate or reduce the identified hazards.

   When changes are found, study them carefully to determine the potential benefits. Consider if the changes possess latent, inherent hazards which may be equally as hazardous as the original condition. In this case, assess both conditions to determine which will be less hazardous. Then refer the decision to the proper level of management for approval and acceptance.

3. To eliminate those hazards which cannot be engineered out of the job, change the job procedure.

   Changes in job procedures to help eliminate the hazards must be studied carefully. If the job changes are too arduous,

lengthy or uncomfortable then the employee will take risky shortcuts to circumvent these procedures.

Caution must be exercised when changing job procedures to avoid creating additional unforeseen hazards. Two questions which might be asked to help determine the effectiveness of procedural changes are:

(a) What should be the action of the employee to eliminate this particular hazard or prevent this potential accident?

(b) How should the employee do it?

Answers must be specific and concrete if new procedures are to be useful and effective. Answers should precisely state what to do and how to do it.

4. Try to reduce the necessity of doing the job or at least reduce the frequency that it must be performed.

Often maintenance jobs require frequent service or repair of equipment which is hazardous. To reduce the necessity of such a repetitive job, ask "What can be done to eliminate the cause of the condition that makes excessive repairs or service necessary?" If the cause cannot be eliminated, then try to improve the condition.

5. Finally, use personal protective equipment (PPE). This would include acid suits to protect the employee from acid splashing, ear plugs for protection from high noise levels, and respirators to protect against toxic chemicals. The use of PPE should be the last consideration in eliminating or reducing the hazards the employee is subjected to because PPE can be heavy, awkward, uncomfortable and expensive to maintain. Therefore, try to engineer the identified hazards out of the job.

A lengthy format of the JSA chart is less effective than a short and concise format. A format with the job steps, hazards, and how to eliminate hazards on a single page is more beneficial than one page with job steps, another with hazards and a third page with how to eliminate the hazards. Figures 3 and 4 illustrate two common formats. Since employees will not read lengthy explanations, brevity is desirable. In Appendix C are two examples of completed JSA charts.

3.3 Review the Analysis and Potential Solutions

After the JSA is completed it must be formally reviewed by qualified individuals who did not participate in the analysis. For example, if the direct observation method was used, the JSA performed by the supervisor can be reviewed by the safety professional. But in the case where the safety professional participated in the job safety analysis, then he/she must not review the JSA. This independent review will help ensure a higher quality analysis.

4. IMPLEMENT THE JSA INTO OPERATIONAL SYSTEMS

The completed, reviewed and approved JSA must be incorporated into the operation. In the past, JSA have been developed but were filed and never used effectively. After some time a plant will accumulate a great many JSA which may be lost or outdated. Therefore, a filing system must be implemented for effectiveness. One method which has proven successful in the past is the Key Word Index.

When a JSA is distributed, the supervisor's first responsibility is to explain its contents to the employees and, if necessary, to provide individual training. The entire JSA must be reviewed with the employees concerned so that they will know how the job is to be done without accidents.

4.1 Step-By-Step Procedure

Step-by-step procedures include Detailed Operating Procedures (DOP) and Standard Operating Procedures (SOP). The step-by-step procedure may be developed from the JSA if the task is to be repeated a number of times, or JSA information may be integrated into an existing operational procedure.

4.2 Safety Professional Cognizance

This level of safety analysis involves concurrence by a safety professional that hazards can be adequately controlled without documented, detailed analysis or procedures. Examples are safe work permits, purchase requisition approvals and job release sign-offs. The safety professionals will use the data in a JSA in assessing job hazards.

4.3 Informal Safety Processes

The informal safety processes include worker judgment, supervisory attention, and general professional safety attention. A JSA provides these employees with information about the hazards in the jobs they perform.

4.4 JSA's for Training New And Old Employees

New and old employees must be trained in the basic job steps. They must be taught to recognize the hazards associated with each job step and must learn the necessary precautions that must be taken to prevent injuries. A well-prepared JSA can be vital in this training.

5. MONITORING A JSA PROGRAM

It is not enough just to develop and utilize JSA for a potentially hazardous job, but a monitoring program must be established to determine the following:

(a) How effective is the JSA in eliminating or reducing the hazards associated with the task?

(b) Does the JSA need to be revised to update changes in the physical environment which may have introduced unforeseen hazards?

(c) Is the JSA followed by the employees performing the task? If not, then why not? What hazards are introduced?

The following techniques can be used to monitor a JSA:

(a) Reported Significant Observation (RSO)

(b) Observation of task by management, safety professional or others concerned

(c) Review of accident records

(d) Feedback

The Reported Significant Observation (RSO) technique will provide information about a JSA from employees who may want to remain anonymous. For further development of the RSO technique refer to ERDA-76-45-5 SSDC5 document.

The observation of a task in a JSA provides management and safety with an opportunity to review the task in actual practice. It also shows the employees that management and safety are concerned with their well-being.

Reviewing accident records may reveal possible deficiencies in a job which has been analyzed or indicate jobs which should be analyzed.

The feedback technique allows the employee, supervisor, and safety professional to discuss possible deficiencies in the JSA. It also gives the employee an active role in safety practices.

GROUP DISCUSSION AND DIRECT
OBSERVATION METHODS USED TO
ANALYZE A JOB

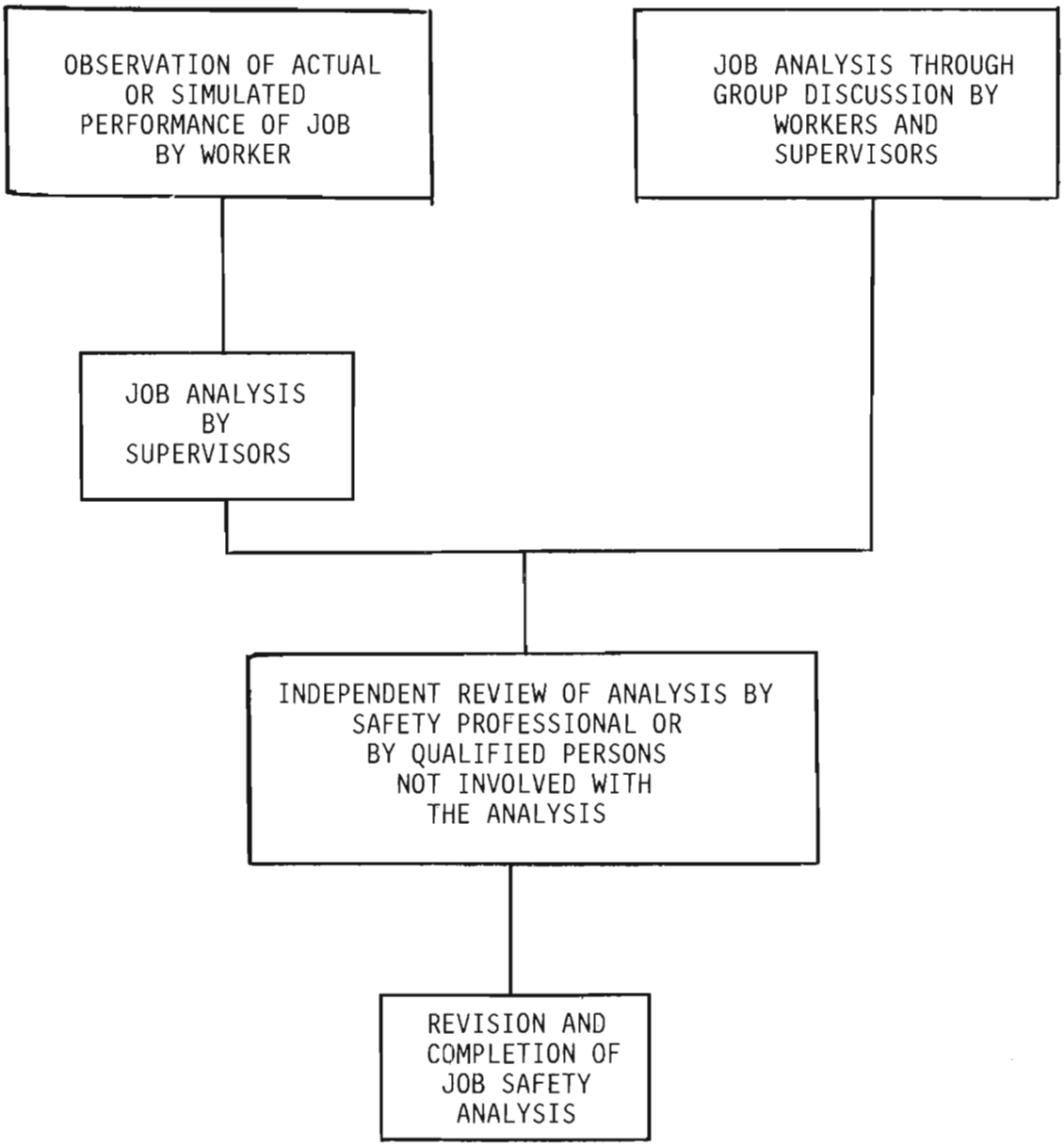

FIGURE 2

JOB SAFETY ANALYSIS	JOB:	DATE:
TITLE OF EMPLOYEE:	SUPERVISOR/FOREMAN:	ANALYSIS BY:
DEPARTMENT:	SECTION:	REVIEWED BY:
JOB STEPS	HAZARDS	RECOMMENDED SAFE JOB PROCEDURE

JOB SAFETY ANALYSIS

JOB TITLE

Job Step	Hazard	How to Eliminate Hazards
Break the job down step by step. List the steps in order of performance.	List any identified hazards associated with each step.	For each identified hazard, list the solutions for eliminating or reducing the potential hazard.

CONCLUSION

A well-defined safety program will consist of many elements, with each element designed for a specific purpose. JSA is only one element in a complete safety program and it should be treated as such.

When a JSA program is established, it usually is emphasized and implemented heavily, but as time goes on, the enthusiasm wears thin and the program begins to sag. Changes in the work environment are overlooked until an accident brings them to mind. The employee may wonder about the lack of attention toward the JSA or feel that all the hazards in his/her job may no longer exist. Therefore, he/she will be less attentive toward safety in the job. For a JSA program to be successful, it must be established and maintained with an equal amount of effort; the same amount of effort must be given in maintaining a JSA program as there was in establishing it.

References

[1] United States Steel, Principles of Accident Prevention in United States Steel, U.S. Steel, 1968

[2] National Safety Council, Accident Prevention Manual for Industrial Operations. National Safety Council, Seventh Edition, 1974

[3] Hammer, Willie, Handbook of System and Product Safety, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1972

[4] R. W. Eicher, Reported Significant Observation (RSO) Studies, ERDA-76-45-5, SSDC-5 (March 1976)

APPENDIX A

INDEX OF JOBS TO BE ANALYZED

The Index of Jobs to be Analyzed for the shipping department begins with the occupations since these are known and can be fully and completely determined. Start the preparation of the Index of Jobs to be Analyzed by using one sheet for each occupation. This permits adding to the list of jobs as discussion and investigation identifies additional job units performed by the occupation. Following this plan, the General Foreman or Department Superintendent preparing the Index of Jobs to be Analyzed would have one index for the occupation of loader, one for the occupation of car blocker, one for the occupation of checker, one for skid bander, and one for craneman. Considering first the occupation of loader, the loader must inspect the truck to make sure it is capable of carrying the product to the customer destination without damage. The job of "inspect truck" would be listed under the job column opposite the occupation of loader on the Index of Jobs to be Analyzed. Another job and not necessarily in sequence is "to load the truck." Since two product groups are shipped -- flat product and coil product -- the job of loading the truck will be loading for flat products and loading for coil products. Flat products are sometimes loaded by means of a sheet lifter attached to an overhead traveling crane, in other cases by wire rope slings attached to an overhead crane, and by forklift tractor; so the job of loading flat products onto a truck is in reality three jobs depending upon the lifting or material handling device used. In like manner, if coil product is being shipped, it may be by overhead traveling crane with a "C" hook attached or by using wire rope slings. If it is by mobile equipment, it may be by ram-type tractor or a piece of equipment identified (locally) as a "cady." From this information the General Foreman or Department Superintendent putting together the Index of Jobs to be Analyzed for the occupation of loader in the shipping department would then have an "index sheet" which resembles that shown in Figure 5.

Considering the occupation of car blocker next, it is obvious that if trucks are to be used for shipment, the type of blocking employed will depend on whether it is a van-type truck or a flat-bed truck. So on another index sheet list the occupation of car blocker and the jobs as block truck - van, and block truck - flat bed. Since shipment could also be by railroad car, blocking of railroad cars would appear as a job for the occupation. Here again the way in which the car is blocked depends on whether it is a damage-free car or a regular car. These two possibilities will also be listed as jobs along with the job of banding and blocking, regardless of the type of car. The Index of Jobs to be Analyzed for the car blocker in the shipping department now resembles that shown in Figure 6.

The position of checker performs a job of inspecting the truck. This would be listed opposite the occupation of checker in the job column. The occupation of skid bander performs the jobs of cutting bands, banding, and packaging. These would be listed in the job column opposite the occupation of skid bander.

The General Foreman or the Department Superintendent who is coordinating the job safety activities of the shipping department then compiles these separate indices into a master Index of Jobs to be Analyzed for

the shipping department. This will resemble the Index of Jobs To Be Analyzed shown in Figure 7.

Notice in this example (Figure 7) the coordinator has left sufficient space in the job column of each occupation that he/she may add as additional jobs or work units are performed by this occupation.

It is not necessary that the list of jobs performed by occupations be 100% complete. It is desirable that it be as complete as possible when job safety analysis is undertaken so that the true scope and range of the task may be known. However, job safety analysis activities should not be delayed pending the development of a 100% complete Index of Jobs to be Analyzed.

INDEX OF JOBS TO BE ANALYZED - SHIPPING DEPT. FIGURE 5

OCCUPATION	JOB	CODE NUMBER	ASSIGNED DATE	ASSIGNED FOREMAN	REVIEWED AND APPROVED BY	DATE DIST.
1. Loader	1. Inspect Truck					
	2. Load Truck A. Flat Product 1. Sheet Lifter 2. Wire Rope Sling 3. Fork Lift B. Coil Product 1. "C" Hook 2. Wire Rope 3. Fork Lift 4. Cady					

INDEX OF JOBS TO BE ANALYZED - SHIPPING DEPT. FIGURE 6

OCCUPATION	JOB	CODE NUMBER	ASSIGNED DATE	ASSIGNED FOREMAN	REVIEWED AND APPROVED BY	DATE DIST.
1. Car Blocker	1. Blocks Trucks A. Van B. Flat Bed 2. Blocks RR Cars A. Bulkheads 1. DF 2. Regular B. Bands C. Blocking					

INDEX OF JOBS TO BE ANALYZED - SHIPPING DEPT. FIGURE 7

OCCUPATION	JOB	CODE NUMBER	ASSIGNED DATE	ASSIGNED FOREMAN	REVIEWED AND APPROVED BY	DATE DIST.
Loader	1. Inspect Truck					
	2. Load Truck A. Flat Product 1. Sheet Lifter 2. Wire Rope 3. Fork Lift B. Coil Product 1. "C" Hook 2. Wire Rope 3. Fork Lift 4. Cady					
Car Blocker	1. Block Trucks A. Van B. Flat Beds					
	2. Block RR Cars A. Bulkheads-DF-Regular B. Bands C. Blocking					
Checker	1. Inspect Truck					
Skid Bander	1. Cuts Bands 2. Bands 3. Package					
Craneman						

Appendix B

Electrical

Battery Banks
Diesel Units
High Lines
Transformers
Wiring
Switchgear
Underground Wiring
Cable Runs
Service Outlets and Fittings
Pumps
Motors
Heaters
Power Tools
Small Equipment

Nuclear (Out-of-Reactor)

Vaults
Temporary Storage Areas
Receiving Areas
Shipping Areas
Casks
Burial Grounds
Storage Tanks
Canals and Basins
Reactor In-Tank Storage Areas
Dollies
Trucks
Hand Carry
Cranes
Lifts
Shops
Hot Cells
Assembly Areas
Inspection Areas
Laboratories
Pilot Plants

Nuclear (In-Reactor)

Reactors
Critical Facilities
Subcritical Facilities

Kinetic/Linear (In-Plant)

Fork Lifts
Carts
Dollies
Railroad
Surfaces
Obstructions (Collision With)
Shears
Presses
Crane Loads in Motion
PV Blowdown
Power Assisted Driving Tools

Kinetic/Linear (Vehicle)

Cars
Trucks
Buses

Kinetic/Rotational

Centrifuges
Motors
Pumps
Cooling Tower Fans
Cafeteria Equipment
Laundry Equipment
Gears
Shop Equipment (Grinders, Saws, Brushes, etc.)
Floor Polishers

PV-KD (Pressure, Tension)

Boilers
Heated Surge Tanks
Autoclaves
Test Loops and Facilities
Gas Bottles
Pressure Vessels
Coiled Springs
Stressed Members
Gas Receivers

MGH (Falls & Drops)

Human Effort
Stairs
Bucket and Ladder
Trucks
Elevators
Jacks
Scaffolds and Ladders
Crane Cabs
Pits
Excavations
Elevated Doors
Canals
Vessels

MGH (Cranes & Lifts)

Lifts
Cranes
Slings
Hoists

Flammable Materials

Packing Materials
Rags
Gasoline (Storage and in Vehicles)
Oil
Coolant Oil
Paint Solvent
Diesel Fuel
Buildings and Contents
Trailers and Contents
Grease
Hydrogen (Including Battery Banks)
Gases - Other
Spray Paint
Solvent Vats

Corrosive

Acids
Caustics
"Natural" Chemicals (Soil, Air, Water)
Decon Solutions

Radiation

Canals
Plug Storage
Storage Areas
Storage Buildings
Radioactive Sources
Waste and Scrap
Contamination
Irradiated Experimental and Reactor Equipment
Electric Furnace
Blacklight (e.g., Magniflux)
Laser
Medical X-Ray
Radiography Equipment and Sources
Welding
Electric Arc - Other (High Current Circuits)
Electron Beam
Equipment Noise
Ultrasonic Cleaners

Thermal Radiation

Furnaces
Boilers
Steam Lines
Lab and Pilot Plant Equipment
Sun

Thermal (Except Radiant)

Convection
Heavy Metal Weld Preheat
Exposed Steam Pipes
Electric Heaters
Fire Boxes
Lead Melting Pot
Electrical Wiring and Equipment
Furnaces

Explosive Pyrophoric

Caps
Primer Cord
Dynamite
Power Metallurgy
Dusts
Hydrogen (Including Battery Banks
and Water Decomposition)
Gases - Other
Nitrates
Electric Squibbs
Peroxides-Superoxides

Toxic/Pathogenic

Acetone
Fluorides
Carbon Monoxide
Lead
Ammonia and Compounds
Asbestos
Trichloroethylene
Dusts and Particulates
Pesticides-Herbicides-Insecticides
Bacteria
Beryllium and Compounds
Chlorine and Compounds
Sandblast
Metal Plating
Asphyxiation-Drowning

Appendix C

JOB SAFETY ANALYSIS

CUTTING OR WELDING OUTSIDE APPROVED WELDING SHOPS

Job Step	Hazard	How to Eliminate Hazard
1. Job preparation		
A) Complete Safe Work Permit	A. --	A. --
B) Call Safety Engineer to go with workmen to job site.	B. --	B. --
C) Load tools and equipment, including fire extinguisher.	C. Faulty equipment	C. Check hoses, flash arrestors in place, tips, regulators, etc.
D) Two employees to be assigned if no other crafts are on the job.	D. Possible fires caused by cutting or welding.	D. Second person to serve as fire watch in the event no other workers are involved.
E) Notify Radio and Alarm or make sure safety engineer does if work is done at PBF reactors or other areas with alarm	E. Smoke and fire alarms may activate due to welding or cutting.	E. Radio and Alarm to deactivate system temporarily while work is being done; process form 187.
2. Proceed to job area	--	--
3. Check with the Safety Engineer on arrival at job site and have Safe Work Permit completed.		
4. Proceed with job after all procedures above have been completed.		
A) Compliance with safety and HP requirements as noted in SWP.	A. Flammables in area	A. Materials or flammable liquids to be covered or moved.
	B. Holes in floor or walls	B. Cover all holes.
	C. Other people in area.	C. Weld curtains or signs and barriers if required.

JOB SAFETY ANALYSIS (Continued)
CUTTING OR WELDING OUTSIDE APPROVED WELDING SHOPS

Job Step	Hazard	How to Eliminate Hazard
	D. Ventilation	D. Sufficient air movement to dissipate smoke and fumes.
	E. Contaminated or toxic atmosphere	E. Respiratory protection.
	F. Radioactive contamination	F. Protective clothing, and dosimetry as required.
B) Fire watch	B. Possible fires by torch hot slag or weld machine.	B. Fire watch to monitor area during operation and 30 minutes after the welding operation.
5. Clean up area, remove tools and equipment	--	--
6. Notify the following as necessary on job completion		
A. Area supervisor		
B. Safety Engineer and/or Radio and Alarm		
C. Job supervisor		

JOB SAFETY ANALYSIS
CUTTING OR WELDING OR CUTTING ON VESSELS, CONTAINERS, OR DRUMS

	Job Step	Hazard	How to Eliminate Hazard
1.	Prepare the Job	The following items should be checked prior to beginning the Job.	Process Safe Work Permit
		A. Flammable liquids, gases, or solids inside the vessel	A. Have Safety personnel check with combustible gas detector and then recommend cleaning procedure.
		B. Cutting torch igniting flammable solid, liquid, or gas inside vessel.	B. If possible, do cutting mechanically rather than with a cutting torch.
		C. Fire starting in area as a result of welding or cutting.	C. Have portable fire extinguisher within 50 feet.
2.	Move necessary repair equipment to job site	Equipment falling when moved	Use carts for moving welding unit; if moved by vehicle secure cart and cylinders in vehicle.
3.	Prepare work surface	Grinder sparks, dust from wire brushing	Wear Safety glasses or goggles. make sure guard is on grinder.
4.	Have vessel filled with water or inert gas as per attached instructions as required by Safe Work Permit.	-----	-----
5.	Complete the Job.	See A. B and C above	See A, B and C above
		Vessel exploding	At frequent intervals make sure CO_2 or NO_2 concentration is sufficiently high. Keep head and arms away from top of container as much as possible. Repair leaks on the sides before repairing the top.

JOB SAFETY ANALYSIS (Continued)
CUTTING OR WELDING OR CUTTING ON VESSELS, CONTAINERS, OR DRUMS

	Job Step	Hazard	How to Eliminate Hazard
		Inadequate ventilation when water or inert gas is not used.	Remove bungs from drums, open any valves, drains, or manholes when practical.
6.	Clean up area and return equipment.	-----	-----

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