

## APPENDIX E - CHANGE ANALYSIS

Change Analysis looks at a problem by analyzing the deviation between what is expected and what actually happened. The evaluator essentially asks what differences occurred to make the outcome of this task or activity different from all the other times this task or activity was successfully completed.

This technique consists of asking the questions: What? When? Where? Who? How? Answering these questions should provide direction toward answering the root cause determination question: Why?

Primary and secondary questions included within each category will provide the prompting necessary to thoroughly answer the overall question. Some of the questions will not be applicable to any given condition. Some amount of redundancy exists in the questions to ensure that all items are addressed.

Several key elements include the following:

- Consider the event containing the undesirable consequences.
- Consider a comparable activity that did not have the undesirable consequences.
- Compare the condition containing the undesirable consequences with the reference activity.
- Set down all known differences whether they appear to be relevant or not.
- Analyze the differences for their effects in producing the undesirable consequences. This must be done with careful attention to detail, ensuring that obscure and indirect relationships are identified (e.g., a change in color or finish may change the heat transfer parameters and consequently affect system temperature).
- Integrate information into the investigative process relevant to the causes of, or the contributors to, the undesirable consequences.

Change Analysis is a good technique to use whenever the causes of the condition are obscure, you do not know where to start, or you suspect a change may have contributed to the condition.

Not recognizing the compounding of change (e.g., a change made five years previously combined with a change made recently) is a potential shortcoming of Change Analysis. Not recognizing the introduction of gradual change as compared with immediate change also is possible.

This technique may be adequate to determine the root cause of a relatively simple condition. In general, though, it is not thorough enough to determine all the causes of more complex conditions.

Figure E-1 shows the six steps involved in Change Analysis. Figure E-2 is the Change Analysis worksheet. The following questions help identify information required on the worksheet.

WHAT?

- What is the condition?
- What occurred to create the condition?
- What occurred prior to the condition?
- What occurred following the condition?

- What activity was in progress when the condition occurred?
- What activity was in progress when the condition was identified?
  - Operational evolution in the work space?
    - Surveillance test?
    - Power increase/decrease?
    - Starting/stopping equipment?
  - Operational evolution outside the work space?
    - Valve line-up?
    - Fuel handling?
    - Removing equipment from service?
    - Returning equipment to service?
  - Maintenance activity?
    - Surveillance?
    - Corrective maintenance?
    - Modification installation?
    - Troubleshooting?
  - Training activity?
- What equipment was involved in the condition?
  - What equipment initiated the condition?
  - What equipment was affected by the condition?
  - What equipment mitigated the condition?
  - What is the equipment's function?
  - How does it work?
  - How is it operated?
  - What failed first?
  - Did anything else fail due to the first problem?
  - What form of energy caused the equipment problem?
  - What are recurring activities associated with the equipment?
  - What corrective maintenance has been performed on the equipment?
  - What modifications have been made to the equipment?
- What system or controls (barriers) should have prevented the condition?
- What barrier(s) mitigated the consequences of the condition?

#### WHEN?

- When did the condition occur?
- What was the facility's status at the time of occurrence?
- When was the condition identified?
- What was the facility's status at the time of identification?

- What effects did the time of day have on the condition? Did it affect:
  - Information availability?
  - Personnel availability?
  - Ambient lighting?
  - Ambient temperature?
- Did the condition involve shift-work personnel? If so:
  - What type of shift rotation was in use?
  - Where in the rotation were the personnel?
- For how many continuous hours had any involved personnel been working?

#### WHERE?

- Where did the condition occur?
- What were the physical conditions in the area?
- Where was the condition identified?
- Was location a factor in causing the condition?
  - Human factor?
    - Lighting?
    - Noise?
    - Temperature?
    - Equipment labeling?
    - Radiation levels?
    - Personal protective equipment required in the area?
    - Radiological protective equipment required in the area?
    - Accessibility?
    - Indication availability?
    - Other activities in the area?
    - What position is required to perform tasks in the area?
  - Equipment factor?
    - Humidity?
    - Temperature?
    - Cleanliness?

#### HOW?

- Was the condition an inappropriate action or was it caused by an inappropriate action?
  - An omitted action?
  - An extraneous action?
  - An action performed out of sequence?
  - An action performed to a too small of a degree? To a too large of a degree?
- Was procedure use a factor in the condition?

- Was there an applicable procedure?
- Was the correct procedure used?
- Was the procedure followed?
  - Followed in sequence?
  - Followed "blindly"--without thought?
- Was the procedure:
  - Legible?
  - Misleading?
  - Confusing?
  - An approved, current revision?
  - Adequate to do the task?
  - In compliance with other applicable codes and regulations?
- Did the procedure:
  - Have sufficient detail?
  - Have sufficient warnings and precautions?
  - Adequately identify techniques and components?
  - Have steps in the proper sequence?
  - Cover all involved systems?
  - Require adequate work review?

## WHO?

- Which personnel:
  - Were involved with the condition?
  - Observed the condition?
  - Identified the condition?
  - Reported the condition?
  - Corrected the condition?
  - Mitigated the condition?
  - Missed the condition?
- What were:
  - The qualifications of these personnel?
  - The experience levels of these personnel?
  - The work groups of these personnel?
  - The attitudes of these personnel?
  - Their activities at the time of involvement with the condition?
- Did the personnel involved:
  - Have adequate instruction?
  - Have adequate supervision?
  - Have adequate training?
  - Have adequate knowledge?
  - Communicate effectively?
  - Perform correct actions?
  - Worsen the condition?
  - Mitigate the condition?

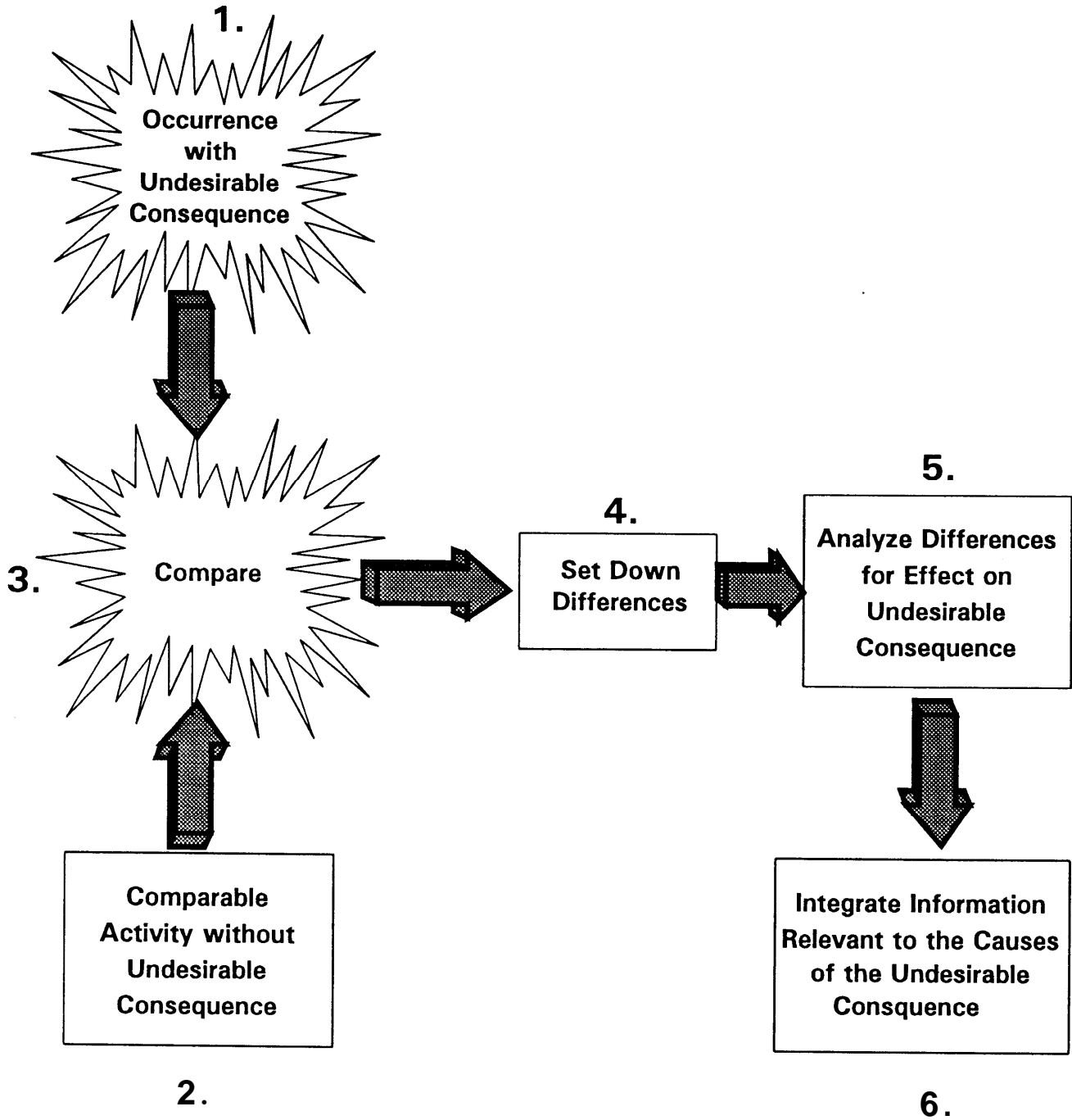


Figure E-1. Six Steps Involved in Change Analysis

## Change Analysis Work Sheet

Change Factor	Difference/Change	Effect	Questions to Answer
<b>What</b> (Conditions, occurrence, activity, equipment)			
<b>When</b> (Occurred, identified, plant status, schedule)			
<b>Where</b> (Physical location, environmental conditions)			
<b>How</b> (Work practice, omission, extraneous action, out of sequence procedure)			
<b>Who</b> (Personnel involved, training, qualification, supervision)			

Figure E-2. Change Analysis Worksheet