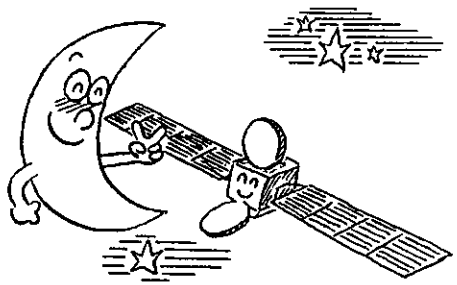
1. バリエーションツリーによる不具合の再構築

1.1 バリエーションツリーとは

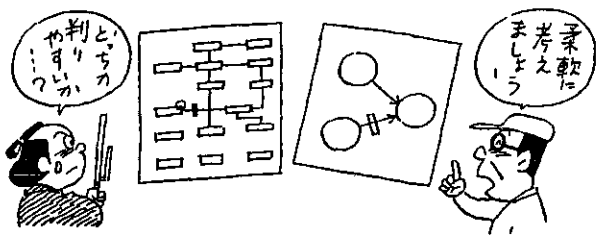
普段通りに作業が行われた場合には，不具合はもちろん発生しません　したがって，不具合が発生した場合には，いつもとは異なる作業のやり方をしていたり，連絡が伝わっていなかったり，というような，通常どおりでない作業や，状態が存在しているはずです



バリエーションツリーは，これらの通常とは異なるもの（総称して「変動要因」と呼びます）を時間経過に沿って記述したものであり，不具合の発生経緯をわかりやすく図示することを目的とした手法です

客観的に不具合を記述することで，誰の目からみても，不具合の構造が明らかになり，多くの人から意見を聞くことが可能になります　不具合の分析は正しい答えがない以上，共通認識を持つことは，誤った分析結果や，偏った分析結果を導き出すことを防止する上で，非常に重要になります

不具合発生経緯が明らかな場合には，バリエーションツリーを使用する必要はありませんが，問題点が複数ありそうな場合や，不具合の発生に多くの部署，企業が関係しているような場合には，全体像が理解しやすくなることから，利用することをお勧めします



1.2 バリエーションツリーの多様性

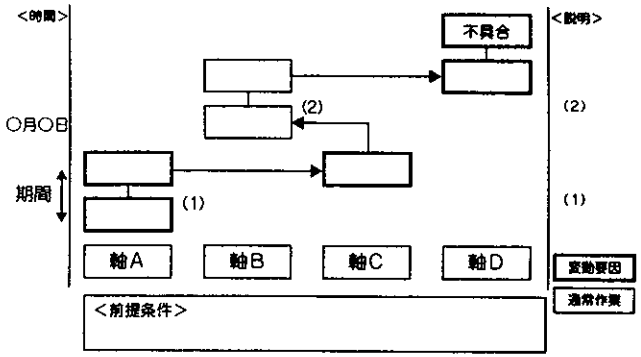


図1-1　バリエーションツリー基本形

図1-1が，バリエーションツリーの基本的な形です　不具合の発生経緯を図式的にあらわす中央のツリー部と，ツリー部を詳しく説明する欄外から構成されています

ツリー部には，不具合発生に関係した企業，部署等をあらわす軸ごとに，変動要因か時間経過を整理して並べられます　時間は下から上に向かって経過し，頂上が最終的に発生した不具合をあらわします　ツリー中の，太線で囲まれた四角のシンボルは通常通りてない変動要因をあらわし，細線のシンボルは発生経緯をわかりやすくするために，普段どおりの工程や作業を記したものです

欄外左側は日時や期間，右側は変動要因の追加説明，下側は不具合の背景となる前提条件の記入箇所で，中央のツリー部の補足説明として使用されます

ハリエーションツリーは，現在，他の分野でも広く利用されています　各分野ては，適用にあたり様々な工夫を凝らしています　これらは，宇宙開発分野におけるハリエーションツリーを作成する上でも参考になりますので，いくつか適用例を見てみましょう

ア）鉄道分野におけるバリエーションツリー適用例[1)]

図1-2は，下り線の信号切替工事の際に，上り線の切替も合わせて行い，運行中の上り列車に支障を与えた事例の分析結果です　関係する人，物が多いために，1つのバリエーションツリーで記述しようとすると，軸が多くなって，複雑になってしまいます　このため，簡略化したツリーで全体像を作成し（図1-2(a)），その上で，特に問題となる変動要因について，サブツリーを作成して，より深く分析しています（図1-2(b)）　また，実施しなかった行動を点線の四角で記すことで，作業の抜け落ちをわかりやすくしています

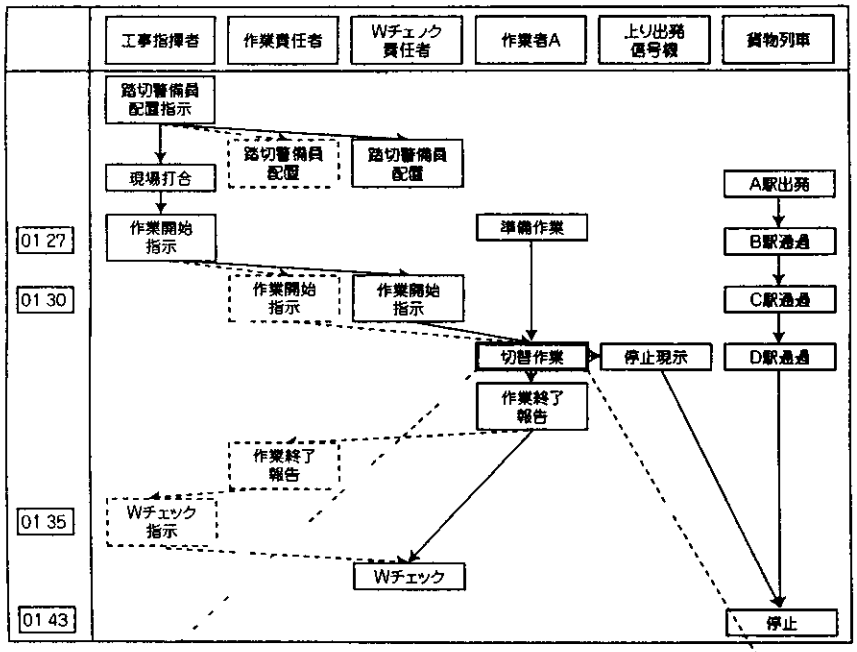
イ）航空機事故におけるバリエーションツリー適用例[2)]

ボイスレコーダーを用いることで，事故に至る過程における，会話の内容を分析対象とすることができます　ツリー中には，パイロットの操作や航空機の状態だけでなく，管制官との交信やコックピット内での会話を記述し，コミュニケーションの行き違いが，誤った行動にどのように結びついたのかをみることができるようにしています

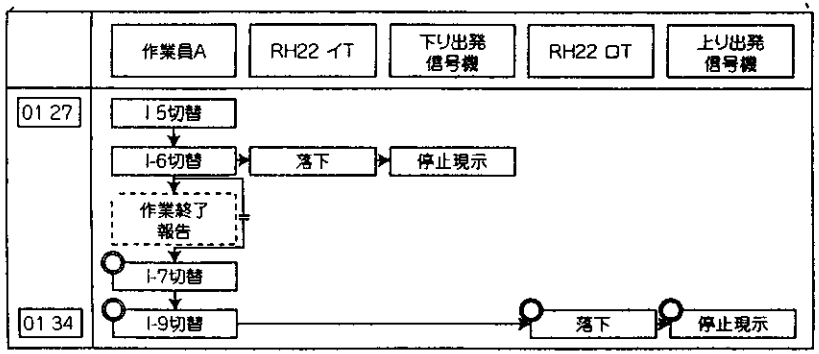
ウ）建設業におけるバリエーションツリー適用例[3)]

日常的な作業工程の中に変動要因を位置づけることで，災害発生経緯をわかりやすく伝えられるようにしています　その上で，変動要因のみを取り出して，人的　物的要因（ヒューマンエラー）と管理的要因　背後要因に分類し，それぞれをさらに下位のカテゴリーに分類した結果，および対策をあわせて1枚のシートにまとめ，作業員への対策の浸透や，安全意識の向上に利用しています

次節では，宇宙開発分野におけるハリエーションツリーの作成方法を説明します　分析の負担の軽減をねらい，他分野での活用例を踏まえて，ハンドブックの作成方法をより簡便なものに改めました　なお，不具合の分析は，分析をすること自体が目的なのではなく，あくまでも対策を導き出すことが目的です　バリエーションツリーは，他の分析手法に比べて，記法が自由な手法ですので，作成要領にとらわれすきることなく，自由に活用してください



(a)メインツリー



(b)サブツリー

図1-2 鉄道分野におけるバリエーションツリー分析例(一部)
(文献1を基に作成)

1.3 宇宙開発分野におけるバリエーションツリー分析法

ここでは，バリエーションツリーの作成を，不具合の調査，ツリー部の作成，欄外の作成の順に説明します これらは，説明をする上でのまとまりであって，この順番を守らなければならないわけではありません ツリーを作成しながら，あわせて欄外も記述した方が，考えをまとめやすい場合もありますし，ツリーを作成する過程で疑問が生じ，再調査を行うこともあるでしょう 特に後者は，ヒューマンファクターに関わる不具合を分析する上で，しばしば見受けられることです こうしたことは誰が分析をしても起こりうることなので，関係者にはあらかじめ再調査の必要性を理解しておいてもらった方が良いでしょう

1.3.1 不具合発生経緯の調査

現場調査，不具合品調査，インタビュー調査により，事実の把握を行いますはじめから特定の原因を決めつけないように注意しなければなりません このため，調査の際には，原因に着目するのではなく，「通常とは異なるもの」がなかったかを調べます 調査の漏れがないように，以下の5W1Hを用いるのが良いでしょう

表1-1 5W1H

5W1H	内容	調査内容
Who	誰が	担当者，作業者
When	いつ	時間，時期
Where	どこで	場所
Why	なぜ	目的と必要性
How	どのようにして，何に基づいて	方法と手順
What	何が，何を	対象物

5W1Hを用いることにより，例えば，担当者の変更や，経験が浅い(Who)，実施順序が逆，時間がかかりすぎる(When)，実施した場所が異なる(Where)，必要のないことを実施(Why)，実施方法の違い，実施の際の基準が不明確(How)，誤った実施，未実施(What)など，様々な視点から変動要因を見つけることが可能になります

１３２　ツリー部の作成（不具合の再構築）

ア）軸の設定

次に，調査で見つかった変動要因を，不具合発生に関与した企業ごと，部署ごと，個人ごとに軸を設定して分類します　軸の並び順は特別に決まっていませんが，同種の不具合を比較するときに　軸の順番が異なるとわかりづらくなりますので，右の並び順を参考にしましょう

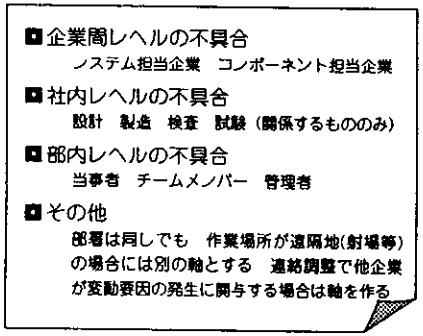


図1-3　軸の設定方法

イ）時間軸に沿った記述

軸ごとに分類された変動要因を，時間の流れを基準にして，整理して並べます　連続する工程や，連絡，物品の移動がある場合は，対応するシンホルを線てつないて示します

この際　「連絡忘れ」や「改訂扁れ」等か実施されなかった行動を，ツリー内部に記述することて，不具合発生経緯はよりわかりやすくなりますたたし，この場合には実施していないことかわかるように，点線の四角て囲って示すようにしてください

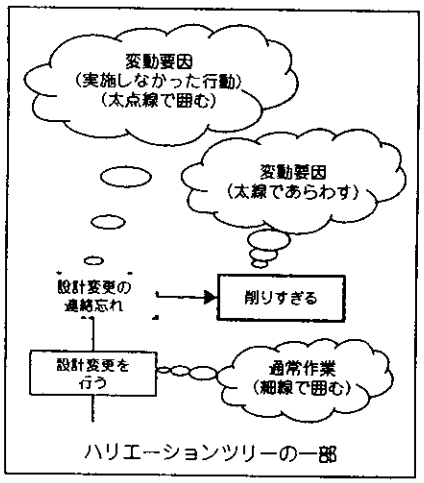


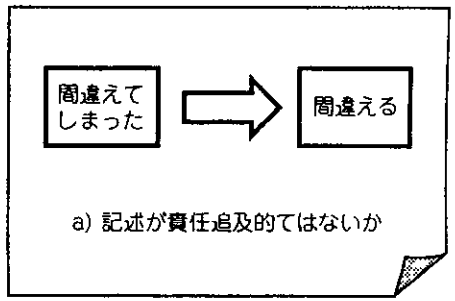
図1-4　シンボルの線について

また，変動要因を並べただけでは不具合発生状況がわかりづらい場合は，通常の作業工程を記入することによっても理解しやすくなります　この際には，変動要因かどうかを明確にするために，変動要因は太線(実施していない行動の場合は太点線)，それ以外の通常作業は細線の四角て記します

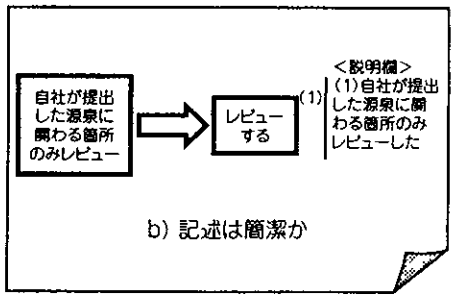
言葉遣いに注意！！

変動要因を記述する場合の言葉遣いにも注意しましょう　気をつけなければならないのは以下の点です

1)「～した」と書くと，そこが問題の中心であるかのように受け取られ，他にもあるかもしれない問題点が見過ごされてしまう可能性があります　文章はできるだけ体言止め（例えは「～に連絡」）もしくは現在形にしましょう



2) シンボル中の文章は，できる限り簡潔にしましょう　長い文章が多くなると，完成したツリーが大きくなり，わかりづらくなります　この場合には，欄外の「説明欄」を使って，詳しく説明するようにしましょう



3)「～と判断し，　　を実施」のように，シンボルの中に2つの内容を書くと，どちらに問題があったのかがわからなくなります　「～と判断」，「　　を実施」というように2つのシンボルに分割して書くようにしましょう

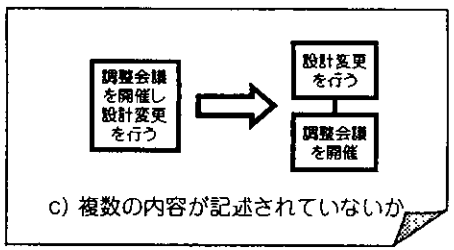


図1-5　言葉遣いで注意する点

133　欄外の記述

ツリー部が完成したら，次に欄外の記述を行います

欄外右は「説明欄」です　説明欄には各変動要因の補足説明や，調査で十分明らかにされなかった情報を記述します　説明か必要な場合には，説明を加えるシンボルの右肩に番号を付与し，番号と対応する説明事項を記載します　なお，番号はツリーの下から上に向かって順番につけます

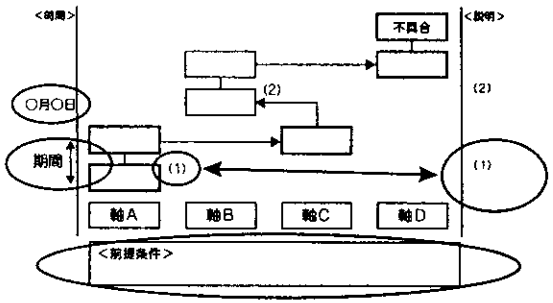


図1-6　欄外の記述

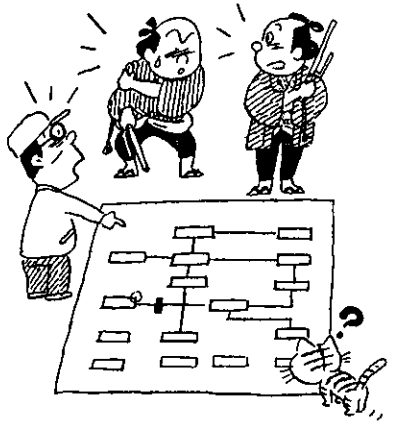
欄外左側は「時間軸」です　時間軸には，ツリー中に記載された作業の行われた日時をわかる範囲て明記します　また，特定の期間を示す場合には，両矢印をつけて記載します

ツリーの下部には「前提条件」を記載します　前提条件とは不具合発生の全般にわたって影響を及ぼしている要因て，ツリー中には書くことの難しいものをあらわします　現場の雰囲気や，設計思想，作業形態，管理方式などがこれにあたります　ただし，1件，1件の不具合分析から前提条件を明らかにするのは難しいてすから，この欄は無理に埋めようとしなくても構いません

ここまてて，ハリエーションツリーによる不具合の再構築は一旦終了です

完成したと思ったら・・・

内容の間違いや，変動要因の漏れかないか確認しましょう　作成したバリエーションツリーは，発生した不具合の全体像を表しているはずです　ツリーを見て，発生経緯がよくわからなけれは，抜け落ちや間違いがあることになりますこの場合は，おかしいと思われる箇所に焦点を絞り，再調査を行わなけれはなりません　しかし，<u>最も重要なのは，ストーリーを作ることではなく，事実を把握することです</u>　どうしてもわからない場合には，不明のままで残しても構いません　自分で架空の話を作ってしまわないように，他の人にも確認してもらったほうが良いでしょう



以下には，忘れがち，間違いがちな点について示します

1）変動要因発生のきっかけとなった，上流の変動要因の記述忘れ

それぞれの変動要因がなぜ発生したのかを考えましょう　上流に発見されていない変動要因が潜んでいるかもしれません　時間がないので詳細設計審査を前倒しにしたこと，未決のまま通過させたこと，十分議論する時間を取らずに走り出したことなどがある場合には，これらも変動要因になります

2）変動要因が引き金となって発生する，その後の変動要因の記述忘れ

設計変更か伝わらずに，古い図面で加工をした場合，その後の検査て，この箇所が検査項目になっていなけれは，検査を通過します　しかし，実際には加工間違いを残したまて検査を通過しているわけてすから，このような場合には変動要因とする必要があります

3）説明欄に変動要因が潜んでいることがある

ツリー内部と欄外の説明欄への記述の区別にこだわりすきると　説明欄を見れはその行動や状況が変動要因であることが明らかなのに，変動要因になっていないという問題が起こります　分析者が検査方法に問題かあると先入観を持っているような場合には，設計や製造段階ての問題か説明欄に書かれることか多くなる傾向がありますので，注意しましょう

1.3.4 対策策定ポイントの検討

ハンドブックでは，対策を策定しなければならない，及び策定することのできるポイントとして，「排除ノード」と「ブレイク」箇所を特定するように求めています　排除ノードは，それが発生しないようにすることで，不具合を防止できる変動要因を指し，ブレイクは，変動要因が発生することはやむを得ないとしても，その影響が以後の工程に及ばないようにするために，何らかの対策を講じることのてきる箇所を指しています

これらのポイントは，図1-7のような概念図を用いると，容易に理解することができます

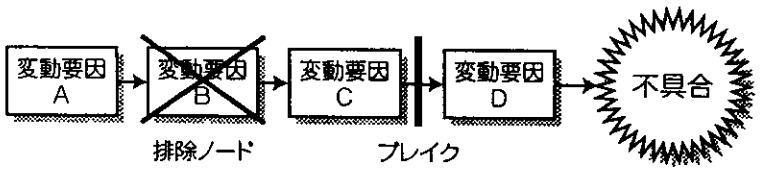


図1-7　排除ノードとブレイクの考え方

しかし，概念図を離れて，実際の不具合でこれらの場所を特定しようとする場合には，こう単純にはいきません　特に，変動要因間に複数の通常作業がある場合のブレイク箇所の設定は非常に困難であり，分析者によって結果が異なるケースか多く見られました

それゆえ，排除ノートやブレイクを特定した後に，これらをさらに掘り下けるなせなせ分析も，結果にはらつきがでやすくなります　しかし，なぜなぜ分析は，分析結果を検証する方法が存在しない反面，完成した分析結果は一見してもっともらしく見えてしまうために，不足や間違いがあったとしても気づきにくいという問題点かあります

そこて2章では，排除ノードやブレイクを特定せずに，変動要因の発生に関与した要因を探索する方法として，PSF (Performance Shaping Factor) を紹介することにしました　それゆえ，本書を用いて不具合分析を行う場合には，排除ノートとブレイク箇所を特定する必要はありません

＜資料３＞

AC120-35B（1990）

Line-Oriented Flight Training

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: LINE OPERATIONAL SIMULATIONS
LINE-ORIENTED FLIGHT TRAINING,
SPECIAL PURPOSE OPERATIONAL TRAINING,
LINE OPERATIONAL EVALUATION

Date: 9/6/90 **AC No:** 120-35B
Initiated by: AFS-210 **Change:**

1 PURPOSE. This advisory circular (AC) presents guidelines for the design and implementation of Line Operational Simulations, including Line-Oriented Flight Training (LOFT), Special Purpose Operational Training, and Line Operational Flight Evaluation This document does not interpret the regulations; interpretations are issued only under established agency procedures

2 CANCELLATION Advisory Circular 120-35A, Line-Oriented Flight Training Programs, dated August 11, 1981, is cancelled

3 RELATED FEDERAL AVIATION REGULATIONS

a. Part 121, Certification and Operations Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft, Subpart N - Training Program, Appendix F - Proficiency Check Requirements, Appendix H - Advanced Simulation Plan

b Part 135, Air Taxi Operators and Commercial Operators, Subpart H - Training

c Special Federal Aviation Regulation (SFAR) No 58, Advanced Qualification Program

4 RELATED READING MATERIAL

a. AC 120-51, Cockpit Resource Management Training

b AC 120-40, Airplane Simulator Qualification, as amended

c AC 120-45, Airplane Flight Training Device Qualification, as amended

5 BACKGROUND

a. Training which uses flight simulators and flight training devices is an important element for ensuring the qualification of flight crewmembers, both as individuals and as part of a crew In the mid-1970's, the concept of

LOFT was introduced as a form of simulator training for a complete crew LOFT was later allowed to be substituted for alternate proficiency checks under recurrent training programs In 1980, LOFT was allowed under an Advanced Simulation Plan as a means to provide most or all flight crewmember training in flight simulators

b Since the early 1980's, as the technology of flight simulators and flight training devices advanced, the number of training applications has increased. These training applications are now grouped under the general term of Line Operational Simulations The increase in the number of individual training applications requires clarification and updating of applicable guidelines These guidelines are presented in this AC and cover the following

(1) Up-to-date details on implementing LOFT for a complete crew under both recurrent training programs and Advanced Simulation Plans.

(2) Guidelines on implementing other types of Line Operational Simulations (for purposes other than those in (1) above) These include Special Purpose Operational Training (e g , training in cockpit resource management skills, differences training) and Line Operational Flight Evaluation (i.e , LOFT-like training which includes an evaluation component)

6 COMMENTS INVITED Suggestions or comments on this AC should be addressed to the Director Flight Standards Service, Federal Aviation Administration, 800 Independence Avenue SW , Washington, DC 20591

D. C. Beaudette
Director, Flight Standards Service

CONTENTS

CHAPTER 1 INTRODUCTION

1. PURPOSE The purpose of this advisory circular is to provide updated guidance in designing and implementing Line Operational Simulations, which includes LOFT, Special Purpose Operational Training, and Line Operational Evaluation

2 BACKGROUND

a The use of flight training devices and flight simulators has become increasingly important in training flight crewmembers As the level of sophistication in simulators increased, air carriers have come to rely on simulators for part or all of their flight training programs Since the mid-1970's, some FAR Part 121 and Part 135 operators have implemented alternative simulator training, which is now known as LOFT, to train crewmembers. LOFT is training in a simulator with a complete crew using representative flight segments which contain normal abnormal, and emergency procedures that may be expected in line operations FAR § 121 409(b) delineates the requirements of LOFT, FAR § 121 441 allows LOFT to substitute for alternate proficiency checks In 1978 and 1981, AC's 120-35 and 120-35A, respectively, provided guidance for the use of LOFT in recurrent training programs and set forth guidelines for its design and implementation This type of LOFT is now termed "Recurrent LOFT " In 1980, the FAA published the Advanced Simulation Plan in FAR Part 121, Appendix H This plan provides the option of providing most or all crewmember flight training in flight simulators Appendix H mandates LOFT to facilitate flight crewmember transition from training in advanced simulators to operational flying This type of LOFT is now termed "Qualification LOFT "

b. LOFT is a useful training method because it gives crewmembers the opportunity to practice line operations (e g , maneuvers, operating skills, systems operations, and the operator's procedures) with a full crew in a realistic environment Crewmembers learn to handle a variety of scripted real-time scenarios which include routine, abnormal, and emergency situations They also learn and practice cockpit resource management skills, including crew coordination, judgment, decisionmaking, and communication skills The overall objective of LOFT is to improve total flightcrew performance, thereby preventing incidents and accidents during operational flying Since the early 1980's, new issues that are related to the requirements of FAR § 121 409, Part 121, Appendix H, and expanding opportunities for the use of LOFT or other Line Operational Simulations have emerged Issues which require an updating of applicable guidelines are

(1) Requirements of FAR § 121 409 Section 121 409(b) delineates the requirements of Recurrent LOFT, which may be substituted on an alternate basis for the proficiency check requirement as specified in FAR § 121 441 Section 121 409(b) requires a complete crew to be utilized in Recurrent LOFT, but does not provide detail on what constitutes a complete crew The guidance provided in this AC recognizes a complete crew as one which is Line Qualified (See definitions in Chapter 2)

(2) Requirements of FAR Part 121, Appendix H. Part 121, Appendix H, contains guidelines for operators who choose to provide flight crewmember training under an Advanced Simulation Plan While Appendix H provides a detailed description for implementing training, the specific LOFT components are not clearly described This AC presents guidelines for implementing Qualification LOFT as required under Appendix H or as may be used within any other approved training program This AC discusses how Qualification LOFT is designed to help flight crewmembers transition from a training environment to operational flying

(3) Special Purpose Operational Training New training concepts and training media have identified a need for other types of training in operational simulations called Special Purpose Operational Training This type of operational simulation includes the concepts listed below In addition, other types of Special Purpose Operational Training may evolve over time

(1) Both the FAA and industry have recognized the importance of Cockpit Resource Management (CRM) in crewmember training CRM training addresses human factors (e g., leadership, communication skills time management, situational awareness, and attitudes in flight operations) Training to improve performance in these areas has been identified as a factor in reducing the number of airline accidents and incidents CRM training is designed for a complete crew environment Application of CRM skills appears to be an integral part of safe and successful line operations This AC addresses the relationship of CRM to Special Purpose Operational Training, as well as to LOFT

(11) Current regulations do not presently address the use of Special Purpose Operational Training for Differences Training This AC presents guidelines in conducting Special Purpose Operational Training for Differences Training

(4) Line Operational Evaluation Recently, a new concept related to the training, qualification, and evaluation of flight crewmembers has emerged In February 1989, the FAA published a proposed Special Federal Aviation Regulation (SFAR) No 58, which would authorize the establishment of an Advanced Qualification Program (AQP), i e , a voluntary training and evaluation program as an alternative to meeting the training and qualification requirements of FAR Part 121 or Part 135 The proposed SFAR allows greater flexibility in designing training programs that reflect recent advancements in aircraft technology as well as the development of new training and evaluation techniques Requirements of an AQP include training and evaluation in operationally accurate flight simulations using realistic line-oriented scenarios Evaluation is a necessary element of this process to provide initial and subsequent assessments of flightcrew and individual flight crewmember competency Simulations using realistic, line-oriented scenarios as a training and evaluation tool have been demonstrated to provide effective instruction The element of evaluation in this new proposal is distinct from LOFT as a training vehicle because unlike LOFT the proposed simulations will now involve evaluation Therefore, the term "Line Operational Evaluation" is used to describe operationally oriented simulations that involve evaluation (See chapter 6 for further detail)

3. SUMMARY This AC identifies four types of Line Operational Simulations (1) Recurrent LOFT (in reference to FAR §§ 121 409, 121.427, 121.433, 121.441, and Part 121, Appendix F), (2) Qualification LOFT (in reference to FAR Part 121, Appendix H), (3) Special Purpose Operational Training, which is training that may be used for various unique purposes such as aircraft differences or CRM training, and (4) Line Operational Evaluation, which is designed for persons participating in an AQP, or for persons who meet the general training requirements of FAR § 121 401 or § 135 323 and wish to conduct operational evaluations. It defines the terms used in describing Line Operational Simulations. It provides guidance for designing and conducting LOFT, Special Purpose Operational Training, and Line Operational Evaluation It defines the role of instructors and evaluators

4 -8 RESERVED

CHAPTER 2 DEFINITIONS

9 GENERAL The following terms are used throughout this advisory circular and are defined as follows

a Line Qualified Describes a flight crewmember or instructor who is current and qualified to conduct actual flight operations in an assigned aircraft and duty position

b Line Familiar Describes a flight crewmember or instructor who is familiar with a certificate holder's line operations This person is either line qualified or otherwise qualified by participation in an approved line observation program (An acceptable line observation program would include observation from the cockpit jump seat of a line crew on at least two operational flight segments This should be accomplished twice annually, and the line observation program should be included as a part of the approved training program)

c Task Familiar Describes a flight crewmember who is familiar with and can satisfactorily accomplish the duties of a particular cockpit duty position though not qualified for that duty position For example, a second-in-command (SIC) candidate who performs the duties of the pilot-in-command (PIC) during simulator training

d Qualification LOFT An approved flight simulator course of LOFT to facilitate transition from training using flight simulation to operational flying. Qualification LOFT meets the requirements of FAR Part 121, Appendix H

e Recurrent LOFT An approved flight simulator course of LOFT which may be used to meet recurrent flight training requirements and to substitute for alternate proficiency checks Recurrent LOFT meets the requirements of FAR § 121 409 as allowed under FAR § 121 441(a)

f Line Operational Evaluation An evaluation of crewmembers and crews in a flight training device or flight simulator during real-time Line Operational Simulations

g Special Purpose Operational Training An approved course of operationally oriented flight training, conducted in a flight simulator or flight training device, which may be used to learn, practice, and accomplish specific training objectives, e g , training in variant aircraft or special aircraft equipment

CHAPTER 3. BASIC ELEMENTS OF LOFT

10 GENERAL. Certain elements about LOFT must be understood to ensure that its primary objective, to provide realistic line-oriented training, is met These elements apply to both Recurrent and Qualification LOFT and are described in this chapter. (NOTE· Some or all of these elements may also apply to Special Purpose Operational Training and Line Operational Evaluation See chapters 5 and 6 for more information on how these concepts apply to these types of Line Operational Simulations)

11 CREW COMPOSITION AND PARTICIPATION. LOFT should take place in a line operational environment with a complete crew. A complete crew will always be scheduled and every effort will be made to maintain crew integrity During LOFT, each crewmember performs both as an individual and as a member of a team, as is expected during line operations

12 REAL-WORLD SITUATIONS LOFT should contain scenarios of real-world, line operational situations, which progress in real time These scenarios should be representative of flight segments where an entire en route operation is completed. In cases of flights involving repetitive events, the en route segments may be compressed. However, enough time should be allotted to allow crewmembers to become sufficiently familiar with the scenario to ensure that if the scenario is compressed, crewmembers will be able to resume or restart the scenario without confusion

13 NO-JEOPARDY TRAINING. LOFT is "no-jeopardy" training, i e , the instructor does not issue a passing or failing grade to a participating crewmember. As a LOFT scenario progresses, it is allowed to continue without interruption so crewmembers may learn by experiencing the results of their decisions. Decisions which produce unwanted results do not indicate a training failure, but serve as a learning experience If the LOFT instructor identifies crewmember performance deficiencies, additional training or instruction will be provided This training or instruction may be in any form, including additional LOFT Before the crewmember may return to line operations, the performance deficiencies will be corrected and the instructor will document the training as satisfactorily completed The "no-jeopardy" concept allows crewmembers to use their full resources and creativity without instructor interference At the end of a LOFT session and after debriefing, the instructor certifies that the training has been completed

14. UNINTERRUPTED TRAINING LOFT scenarios run full-length, with no interruption by the instructor permitted The effects of crewmember decisions are allowed to accrue and influence the rest of the flight The concept is that crewmembers will learn more effectively if they are allowed to learn from their experiences, rather than being interrupted and corrected by an instructor In rare cases, and only during Qualification LOFT, an instructor may choose to intervene if he determines negative learning is taking place

15 FEEDBACK LOFT includes feedback to crewmembers on their performance in the scenario. This takes place during the debriefing phase (See the following paragraph for further detail on feedback and debriefing)

16 PHASES OF LOFT. LOFT scenarios should contain the following phases briefing, preflight planning documents and activities, flight time, and debriefing These are described in the following paragraphs

a. Briefing Before the flight segment begins, the instructor should brief crewmembers on the LOFT scenario, including the training objectives, and the role of the instructor (i e., the instructor is considered "not present," except as an Air Traffic Controller (ATC) or as another ground base entity) The role of the flightcrew should be discussed in the briefing (i.e , flight crewmembers should perform their duties just as they would in line operations) Information about "the environmental setting of the scenario" should also be discussed

b. Preflight Planning Documents and Activities. Preflight planning documents (e g , weather reports and flight plans) should be prepared with the operator's particular training objectives in mind For example, the operator may choose to have crewmembers learn how to handle unfavorable weather conditions or how to correct improper fuel loads Preflight activities include cockpit setup, computation of takeoff data, etc

c. Flight Segment The flight segment includes taxiing, takeoff, flying, and landing. It should also include the time in which communication with ATC and other ground agencies takes place

d. Debriefing. Debriefing should include feedback to crewmembers on their performance. Positive comments regarding crew performance should be emphasized in the debriefing as well as crew performance which needs improvement The debriefing involves instructor critiques of individual crewmembers and of the crew as a team. Also, it is important that crewmembers be given the opportunity to critique and analyze their own performance and review key points of the video record, if used (See paragraphs 21 and 22 for further discussion of critiques, debriefing, and use of video records)

17 TRAINING HOURS, RECURRENT AND QUALIFICATION LOFT Both recurrent and qualification LOFT sessions should be based on at least 4 hours of total crewmember training activity, which should include at least 2 1/2 hours of LOFT scenarios Reasonable amounts of time should be allowed for problem solving (e.g , consulting minimum equipment lists and operations manuals, preparing takeoff data, as well as other crew actions which are occasioned by the training scenario) For qualification LOFT, the 4 hours of crewmember training should include cockpit preparation, preflight activities, crew briefings, and interactions with flight dispatch and other ground agencies For Recurrent LOFT, any additional hours of training, beyond the 2 1/2 hours of LOFT scenarios necessary to comply with FAR § 121 409(b) may, subject to the approval of the FAA, be utilized for other specific training requirements All crewmembers participating in a LOFT session are credited with 4 hours of training time

18. LOFT SCENARIOS LOFT scenarios should be constructed with the following guidelines in mind

a. Objectives The operator should assign specific training objectives to each scenario These training objectives should be based on the particular needs of the operator For example, if an operator is experiencing an unusual frequency of a specific operational problem, such as wet or icy runways, then the scenarios should be designed to include exposure to that particular operational problem Training objectives may also be identified by the FAA based upon documented trends Other specific objectives may include winter operations training, unusual airport or runway operations, alternate operation of automated systems, etc

b Constructing Scenarios A variety of scenarios can be constructed by choosing different combinations of elements from the suggested categories listed below Scenarios should normally be representative of the flight segment appropriate to the operations being conducted by the operator

(1) Origin, routing, and destination (e g , short vs long routes)

(2) Revised arrival procedures (e g , an unexpected runway change)

(3) Alternate operation of flight management systems

(4) Abnormal and emergency conditions, including simple conditions (e g , a potential hot start) and complex conditions which continue for the entire flight (e g., a failed essential A.C bus)

(5) Adverse weather conditions

(6) Partial or full loss of integrated flight management systems

c Timing Scenarios should run in real time This may include inactive time to realistically resemble actual operations

d Realism Scenarios should contain realistic circumstances, e g , messages from the ATC, or flight attendant interruptions

Operators may use these elements to design full-length, real-time scenarios, as well as shorter scenarios which teach specific skills (e g , windshear, special navigation equipment, TCAS, etc) Scenarios should also be developed to observe checklist management procedures, standard callouts, leadership qualities, assertiveness, crew coordination, and communication Scenarios should be updated periodically to ensure they continue to meet training objectives Just as crewmembers could not anticipate all flight operational situations, operators should try to prevent crewmembers from anticipating the entire content of the scenarios

19. APPROVAL OF SCENARIOS Scenarios will be approved by the FAA When submitting LOFT scenarios for approval, operators should state what training objectives are expected to be attained through completion of the LOFT Operators may elect to submit specific LOFT scenarios or a description of a

system which uses a menu of different flight situations and environmental conditions which can be selected randomly to construct a variety of LOFT scenarios. In any case, scenarios which comply with the elements provided in this AC and meet the operator's stated training objectives may be approved Detailed scripts of the scenarios need not be considered for approval When updated, scenarios should conform to the same guidelines that apply to original approval

20 LOFT AND CRM. LOFT scenarios should contain CRM skills, whereby crewmembers utilize and reinforce various CRM concepts CRM skills should be integrated into each operator's manuever/procedure learning objectives In addition, focused CRM training could be provided independently during separate Special Purpose Operational Training (For further information on CRM skills, see AC 120-51, Cockpit Resource Management Training)

21 CRITIQUE OF CREWMEMBER PERFORMANCE Critique of crewmembers should take place during the debriefing by the instructor Critiques should include positive feedback regarding crew performance Critiques should include discussion of individual and flightcrew performance by the instructor as well as assessment by the crewmembers of their own performance The critique should consider the crewmember's judgment and the crew's interaction with all resources in handling problems This includes interaction with ATC, company communications, software materials (e g., company operations manuals and flight manuals), workload-reducing devices (e g , autopilot and flight management systems), and other crewmembers

22 USE OF AUDIOVISUAL EQUIPMENT Recorded audiovisual feedback is very useful as a debriefing aid for most types of LOFT because it allows crewmembers to view themselves from a third person perspective This feedback helps crewmembers to better understand their performance identify and accept their weak areas, and build upon their strong areas, thereby encouraging positive changes in attitudes and behavior. Recorded audiovisual feedback should be destroyed at completion of the debriefing

23 ADDITIONAL TRAINING/LOFT COMPLETION Decisions which produce unwanted results do not indicate a training failure, but serve as a learning experience which may indicate need for additional instruction or modified training activities The additional training could be any form, including additional LOFT In any case, required additional training shall be provided and documented as satisfactorily complete prior to the crewmember's return to line operations Although additional training for a particular individual may be necessary, each LOFT scenario will be recorded as "complete" at the end of the debriefing stage

24 BASIC ELEMENTS OF LOFT SUMMARY LOFT is defined by the following basic concepts

a It takes place in a simulated line operational environment

b It uses a complete crew with total participation

c It contains real-world incidents, unfolding in real time

d It is "no-jeopardy" training

e It contains scenarios and segments which run uninterrupted

f It contains scenarios tailored to the operator's learning objectives

g It incorporates CRM skills

h It provides critique of individual and crew performance

25 FAA PHILOSOPHY REGARDING LOFT

a The FAA believes that the effectiveness of LOFT is dependent on four important aspects First, the use of the highest fidelity simulator available Second, ensuring that only line qualified crewmembers are scheduled to participate in Recurrent LOFT, and that only crewmembers who are in training for a particular duty position or line qualified crewmembers are scheduled to participate in Qualification LOFT Third, that LOFT scenarios run their full, uninterrupted course. Fourth, that a variety of scenarios, fully compatible with training objectives, are available and periodically updated to ensure that the LOFT experience does not become repetitive or stale

b In keeping with this philosophy the FAA expects that an operator, who has available a range of flight simulators for a particular model aircraft, will conduct LOFT in the flight simulator with the most fidelity For example, if the operator has both a Level A and a Level D B-737-300 simulator at its training facility, the FAA expects the operator will conduct LOFT in the Level D simulator

c The FAA believes that the training value of LOFT can be seriously diminished when inappropriate crew substitutions are made Operators should not schedule any person other than "line qualified" crewmembers for Recurrent LOFT For Qualification LOFT, operators should schedule only line qualified crewmembers or those crewmembers who are in training for a particular duty position In both cases, the FAA expects operators to make every reasonable effort to meet these scheduling guidelines When, due to reasons beyond the control of the operator, the need for substitution arises, the substitution tables in this AC may be used However, these tables are intended to be used only after the operator has made all reasonable efforts to provide a substitute crewmember of equal status to the person originally scheduled The FAA recommends that the operator have an identified pool of cockpit crewmembers available to serve as substitutes in LOFT This pool might include reserve crewmembers and/or newly qualified crewmembers (Newly qualified crewmembers could benefit from the additional experience they would receive by serving as substitutes) In any case, the FAA would expect operators to use the contingency features of the substitution tables only to permit continuation of scheduled training for extraordinary and infrequent situations