SFAR 88/Related Operating Rules Special Maintenance Requirements & Compliance Planning Briefing

Operators, FAA Inspectors and Engineers

November 7, 2002

Presented by:

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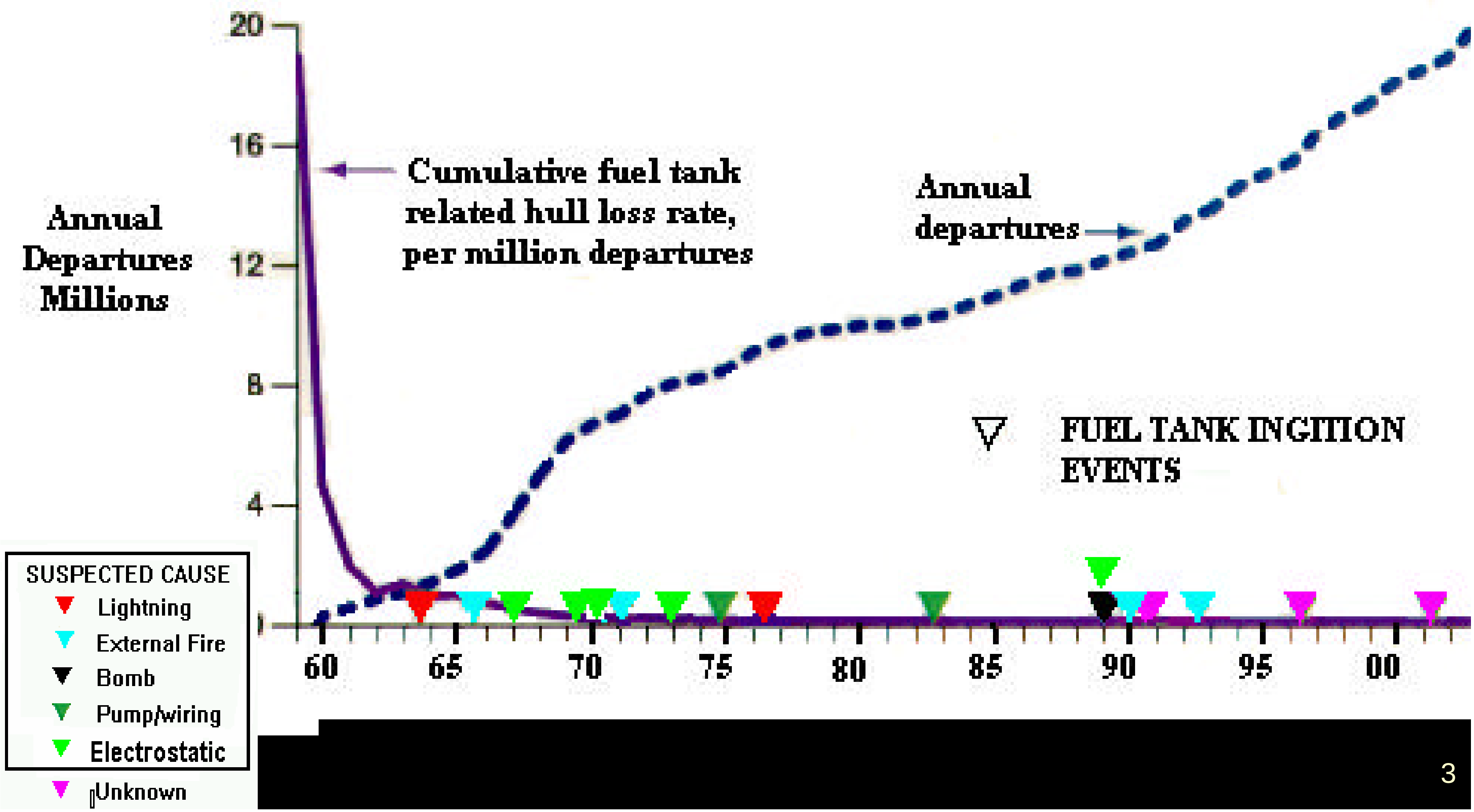
Service History Summary

- Since 1959 there have been 17 fuel tank ignition events, resulting in:
  - 542 fatalities,
  - 11 hull losses
  - 3 others with substantial damage
- Causes:
  - 3 unknown
  - 4 caused by external wing fires
  - 4 electrostatics
  - 2 lightning
  - 2 pumps or wiring suspected
  - 1 by small bomb
  - 1 maintenance action.

Chronology of Ignition Events Since 1959



Historical review

- **MILITARY -** 12 hull loss accidents on military version of B-707 and B52 airplanes
  - All tanks fueled with higher volatility JP-4 fuel
    - Military has converted to low volatility JP-8
  - 10 of 12 occurred in body or center wing tanks
  - 7 occurred on ground during refueling or maintenance
  - 5 in flight - specific cause not identified in many incidents- pumps and fuel quantity indicating system (FQIS) wiring suspected
  - Military has imposed new dry run requirements on pumps

KEY COMMERCIAL ACCIDENT SPECIFICS

- **1963 - B-707 Elkton Maryland**
  - 3 year old airplane
  - Empty wing tank explosion
  - JP-4 fuel, approx. 95 degree F ambient temp.
  - 81 fatalities
  - Lightning strike during decent

- **1970 - DC-8 Toronto Canada**
  - Less than 5 year old airplane
  - JP-4 fuel
  - 106 fatalities
  - External fuel fire caused tank explosion

KEY COMMERCIAL ACCIDENT SPECIFICS

- **1974 - B-747-100 Spain- Iranian Air Force**
  - 3 year old airplane
  - Empty wing tank explosion
  - Lightning strike during decent
  - 8 fatalities
  - JP-4 fuel, approx. 95 degree F ambient temp.
  - NO IGNITION SOURCE IDENTIFIED - Three airworthiness directives (AD) issued

- **1989 - B-727-Bogata Columbia**
  - Empty CWT explosion during climb
  - Small bomb placed in carry on in passenger cabin causes tank explosion
  - 107 fatalities
  - Jet-A fuel, approx. 95 degree F ambient temp.

KEY COMMERCIAL ACCIDENT SPECIFICS

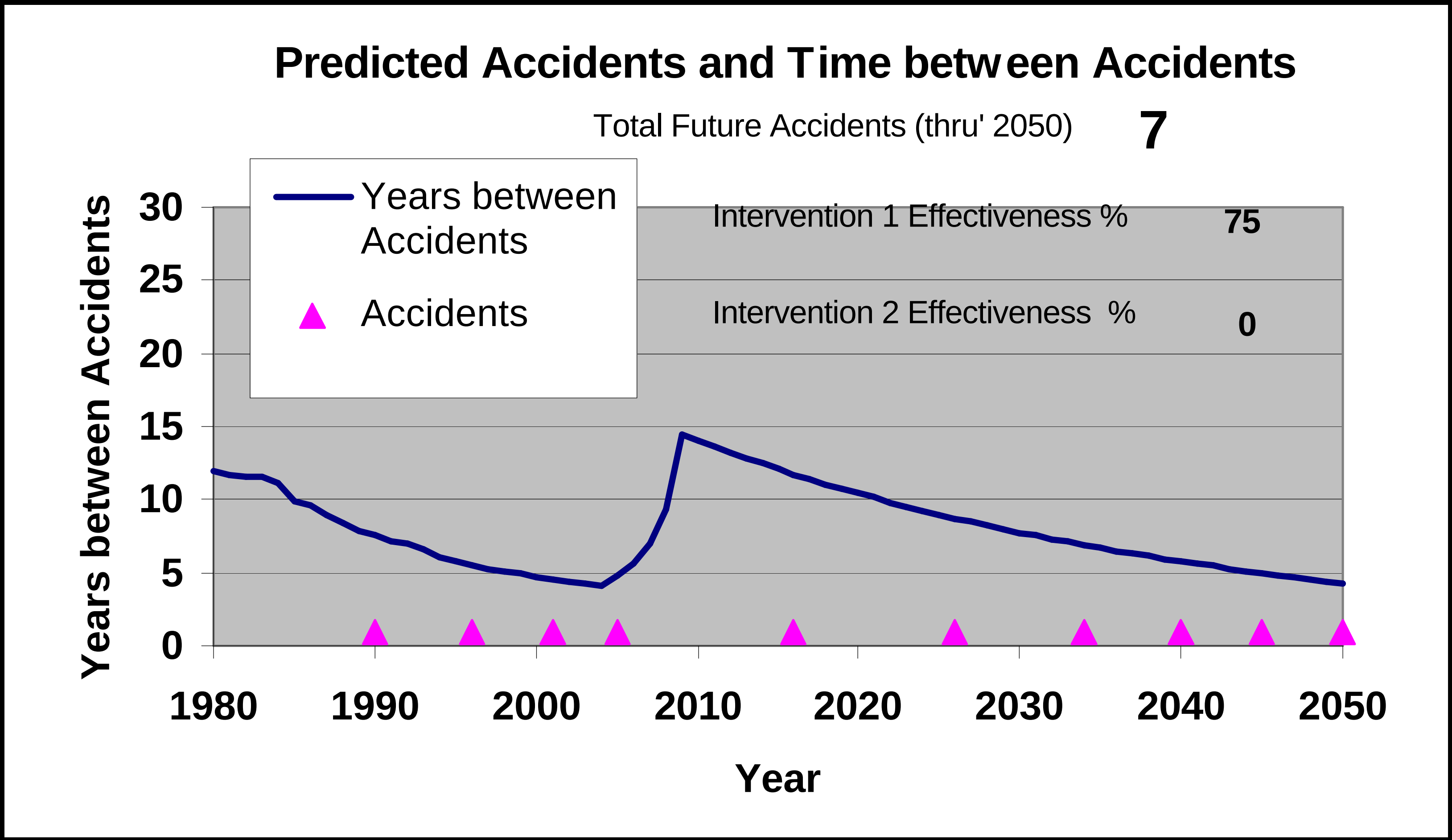
- **1990 - B-737-300 Manila, Philippine**
  - Almost new airplane
  - Empty CWT explosion during pushback from gate
  - CWT pumps operating at time of explosion
  - 8 fatalities
  - Jet-A fuel, approx. 95 degree F ambient temp.
  - NO IGNITION SOURCE IDENTIFIED

- **1996 - B-747, TWA 800, JFK**
  - 25 year old airplane
  - Empty CWT explosion during climb
  - 230 fatalities
  - Jet-A fuel, approx. 120 degree F tank temp.
  - NO IGNITION SOURCE IDENTIFIED however, the NTSB believes the likely energy source was a short circuit outside of the CWT the allowed excessive voltage to enter the CWT through the FQIS wiring. Also the NTSB believes that a contributing factor may have been a heat source from the air conditioning systems located below the CWT

KEY COMMERCIAL ACCIDENT SPECIFICS

- **2001 - B-737-400 Bangkok Thailand**
  - 10 year old airplane
  - Empty CWT explosion minutes after refueling
  - CWT pumps operating at time of explosion
  - 1 fatality
  - Jet-A1 fuel, approx. 97 degree F ambient temp.
  - NO IGNITION SOURCE IDENTIFIED

SFAR Alone (Highest Effectiveness)



Fuel System Safety Compliance Data

Phase One
SFAR Rule
Implementation

June 6, 2001
SFAR 88 Rule became effective. Applicable TC, STC holders have compliance date of December 6, 2002

Phase Two
FAR Rule
Implementation

June 6, 2001
FAR Parts 25, 91, 121, 125, 129 amended to require instructions for maint. and inspection of the fuel tank system be incorporated into the operators Maint. Program and be FAA approved by June 7, 2004

PART 21

-"Certification Procedures for Products and Parts"

Summary

- Part 21 - Certification Procedures
  - New Special Federal Aviation Regulation (SFAR)
    - Applies to "the holders of type certificates, and STCs that may affect the fuel tank system of turbine powered transport category airplanes"
    - 30 passengers or more or
      - 7500 lbs payload or more, certified after 1/1/58
    - Requires fleet review of fuel tank system designs
      - Addresses lessons learned
      - Demonstrate design precludes ignition sources
      - Develop all design changes necessary to meet requirements
      - Develop all necessary maintenance and inspection instructions
      - Submit a report to ACO
    - Compliance time is 18 months after the effective date of the final rule
      - For existing certification projects, 18 months after certification date or 18 months after SFAR effective date, whichever is later

SOME AFFECTED MODELS

A300	B747-100,-200,/300/400	F 27	EMB 145
A310	B717	F 28	Shorts 360
A320	B777	F50	Dornier 328
A330,340	B757	F100	Bombardier CRJ
ATR72, ATR42	B767-200/300ER, -400		SAAB 340, 2000
	DC8	BAE ATP	
B707	DC9	BAE 41	L 1011
B727	DC10	BAE 146	DHC 7,-8
B737-100/200,	MD11		
737-300/400	MD80 series		
B737-500,600,700,800	MD90,		

Part 25 - Airworthiness Standards Amendment 25-102

- Amended § 25.981 <u>Ignition Prevention Requirements</u>
  - New § 25.981(a) & (b) apply to SFAR 88
    - Maintains existing Autoignition Requirements
    - Adds explicit requirements for analysis to demonstrate the design precludes failures that can cause ignition sources
    - Includes a design review (system safety analysis) requirement
      - Maintains powerplant regulation philosophy of considering latent failures
    - Requirement for Instructions for Continued Airworthiness

Amendment 25-102 (Continued)

- New § 25.981(c) Flammability Requirement
  - Minimize development of flammable vapors, OR
  - Mitigate effects of ignition of flammable vapors
    - Based on ARAC recommendation
    - Applies to new designs changes
  - Does **NOT** apply to SFAR 88 design reviews

Note: SFAR 88 amendment issued Sept. 10, 2002 allows equivalent safety provisions for fuel tank system fault tolerance evaluations. If an aircraft were equipped with a fuel tank "inerting" system, it could mitigate some of the ignition prevention requirements of SFAR88.

Amendment 25-102
(Continued)

- Part 25, Appendix H (H25.4) Airworthiness Limitations section.
  - Requires including fuel tank safety limitations in the Instructions for Continued Airworthiness.
  - Revised Appendix H applies to new type design changes through the existing § 21.50, "Instructions for continued airworthiness and manufacturer's maintenance manuals having airworthiness limitations sections."

ICAs

- Revised Appendix H to Part 25 - Instructions for Continued Airworthiness
  - (a) The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth--
  - (1) Each mandatory replacement time, structural inspection interval, and related structural inspection procedures approved under Sec. 25.571; and
  - **(2) Each mandatory replacement time, inspection interval, related inspection procedure, and all critical design configuration control limitations approved under Sec. 25.981 for the fuel tank system.**

ICA's – cont'd

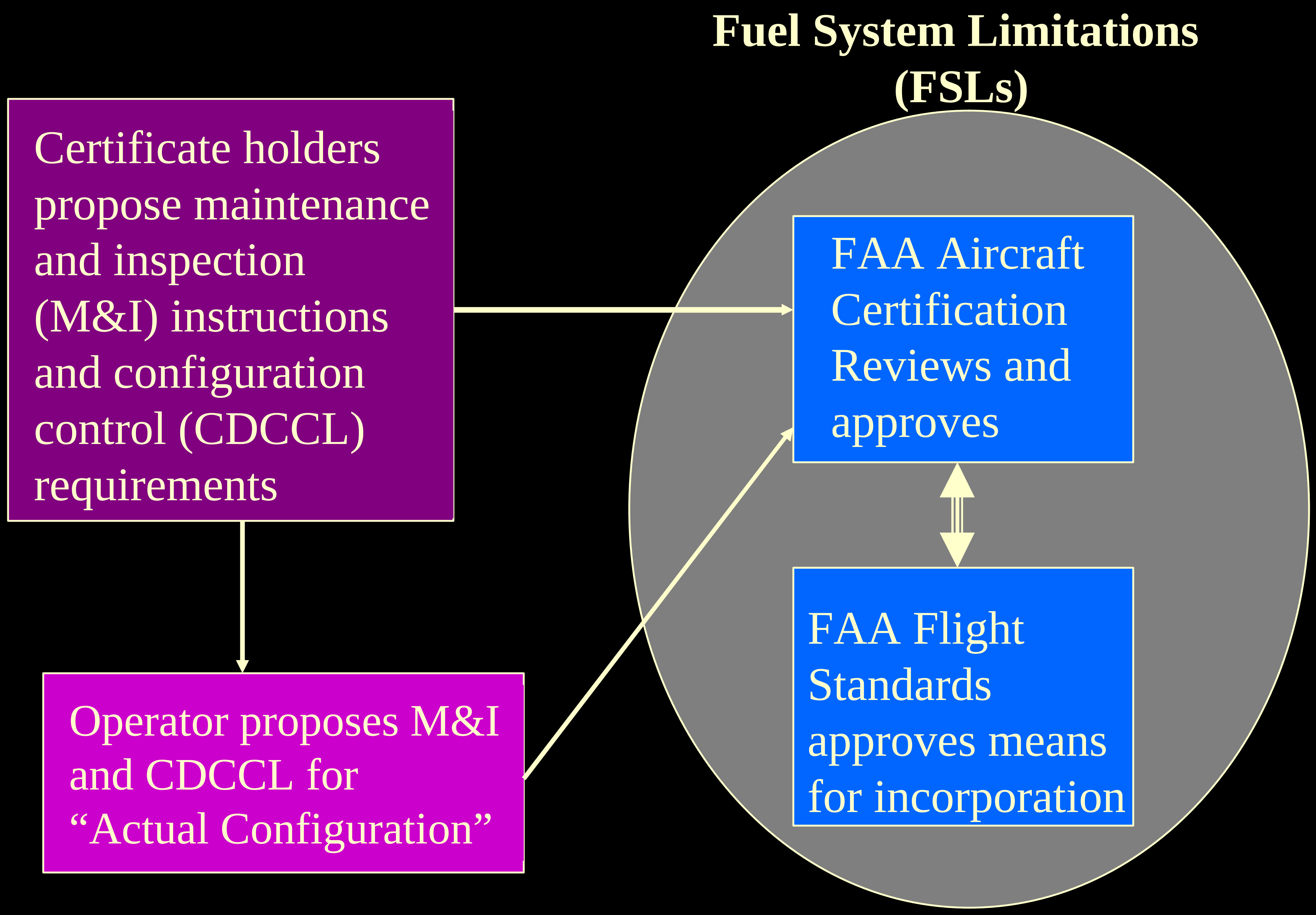
- Not CMR's
  - The concept of this rule goes beyond the current CMR process. CMR's only address mandatory maintenance that is applied to the airplane at the time of original certification. The requirement of this rule for configuration design control limitations will address not only **MANDATORY** maintenance actions, but also design features that cannot be **ALTERED** except in accordance with the Instructions for Continued Airworthiness (ICA).

Critical Design Configuration Control Limitations (CDCCL)

- Defined by design approval applicants subject to SFAR 88

- Features of an airplane design, such as wire separation, explosion proof features of a fuel pump, maintenance intervals for transient suppression devices, minimum bonding jumper resistance levels, etc., where any maintenance actions or subsequent changes to the product made by operators or the manufacturer **MUST NOT DEGRADE** the level of safety of the original type design.

Note: The definition of critical design configuration control limitations does not include ``all of the features inherent'' in the design; it only includes information that is necessary to ensure safety of fuel tank systems.


Fuel System Limitations (FSLs)
Certificate holders propose maintenance and inspection (M&I) instructions and configuration control (CDCCL) requirements
FAA Aircraft Certification Reviews and approves
FAA Flight Standards approves means for incorporation
Operator proposes M&I and CDCCL for "Actual Configuration"

Fuel System Limitations (FSLs)

- Industry established the FSL term for clarity/segregation.
- All FSLs are Airworthiness Limitations Items derived from safety review:
  - contains the instructions for maintenance and inspection of the fuel tank SYSTEM, including initial and repetitive inspection frequencies, required instruments, pass/fail criteria, etc. and
  - any applicable critical design configuration control limitations
- Operator's FSLs for a specific aircraft model will include:
  - OEM/STC FSLs (where applicable)
  - Major alteration, field approval, etc. FSLs (where applicable)
- All affected OEM FSLs will be clearly identified and listed in an applicable manufacturer's Maintenance Program Document, such as the Boeing MPD, Section 9.

FSLs - cont'd

- Affected operator's submit FSLs through the Principal Inspectors prior to submittal to FAA Aircraft Certification for review and approval.
- The Operator's Maintenance Program must identify FAA Aircraft Certification approved FSL applicability for EACH specific aircraft contained in the Operator's Aircraft Listing (D085).
- All FAA Aircraft Certification approved FSLs must have operator work instructions (Job Cards, Task Cards, Aircraft Maintenance Manual (AMM) procedures) completed and submitted to the Principal Inspectors for review PRIOR to Operations Specifications approval by June 7, 2004.

FSLs - cont'd

- All operators must have tooling/training requirements completed prior to actual accomplishment of FSLs.

Note: In addition to new maintenance and inspection tasks, it is likely that some of the present fuel tank system zonal inspection items using the General Visual Inspection (GVI) technique will become FSLs requiring Detailed Visual Inspections (DVIs). Some DVIs may require a one time fleetwide conformity inspection and/or accelerated inspection frequencies.

Related Guidance Information

- AC's available on the web
  - http://www.faa.gov/avr/air/acs/achome.htm
- AC 25.981-1c: Fuel Tank Ignition Source Prevention Guidelines
  - Acceptable method for demonstrating compliance with ignition prevention requirements
  - Including demonstrating compliance with the SFAR design review
  - Includes a listing of lessons learned
- AC 25.981-2: Fuel Tank Flammability Minimization
  - Acceptable method for the demonstrating compliance with fuel tank flammability requirements
- FAA drafting guidance on expected content of FSLs and the roles and responsibilities of the ACOs, AEGs and Flight Standards principal inspectors.

Special Maintenance Program Requirements

- Rules Amended
  - 91.410(b), 121.370(b), 125.248(b) and 129.32(b)
- Applicability
  - turbine-powered transport category airplanes
  - type certificate issued after January 1, 1958,
  - either a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7,500 pounds or more

- Sec. 121.370 Special maintenance program requirements.
- (b) After June 7, 2004, no certificate holder may operate a turbine-powered transport category airplane ..., unless **instructions** for maintenance and inspection of the fuel tank system are incorporated in its maintenance program. These instructions must address the **actual configuration** of the fuel tank systems of each affected airplane and must be approved by the FAA Aircraft Certification Office (ACO/TAD) ... Operators must submit their request through an appropriate FAA Principal Maintenance Inspector, who may add comments and then send it to the manager of the appropriate office.

  Thereafter, the approved instructions can be revised **only** with the approval of the FAA Aircraft Certification Office (ACO/TAD)... Operators must submit their requests for revisions through an appropriate FAA Principal Maintenance Inspector, who may add ...

Special Maintenance Requirements

- Instructions for maintenance and inspection (a.k.a. instructions for continued airworthiness (ICA) of the fuel tank ***system*** are required to be incorporated in the operator's maintenance program by June 7, 2004.
- ICA determination based on design review of the fuel tank system
- ICAs approved by ACO
  - Possible design changes
  - Mandatory inspection/maintenance tasks

Note: The system may include items pertaining to other areas such as pneumatics and air conditioning.

Special Maintenance Requirements Driven by the Design Review

- The design review is a failure modes and effects analysis that considers “multiple failures”
  - **Excerpt from § 25.981 Fuel tank ignition prevention Amendment 102**
    - Demonstrating that an ignition source could not result from each single failure, from each single failure in combination with each latent failure condition not shown to be extremely remote, and from all combinations of failures not shown to be extremely improbable.

Vs.

  - MRB use of MSG-3
    - Considers only hidden plus one
  - MRB use of MSG-2
    - Considers only single failures
  - Not 25.1309

Special Maintenance Requirements ACO Approved

- Why?
  - Because of the required design review
    - FAA engineering expertise required to review and approve acceptability of analysis
      - Type Certificate (TC) and Supplemental Type Certificate Holders (STC) Holders
  - Interaction of Multiple Configurations
    - 35 transport category models affected
    - 600 plus STCs highly likely to be impacted (Category 1)

    (see website http://www.faa.gov/certification/aircraft/SFAR88/stc-list.cfm)
    - 20,000 plus STCs less likely to be impacted (Category 2)
    - Operator and/or Airplane specific “actual configuration”

Design Review

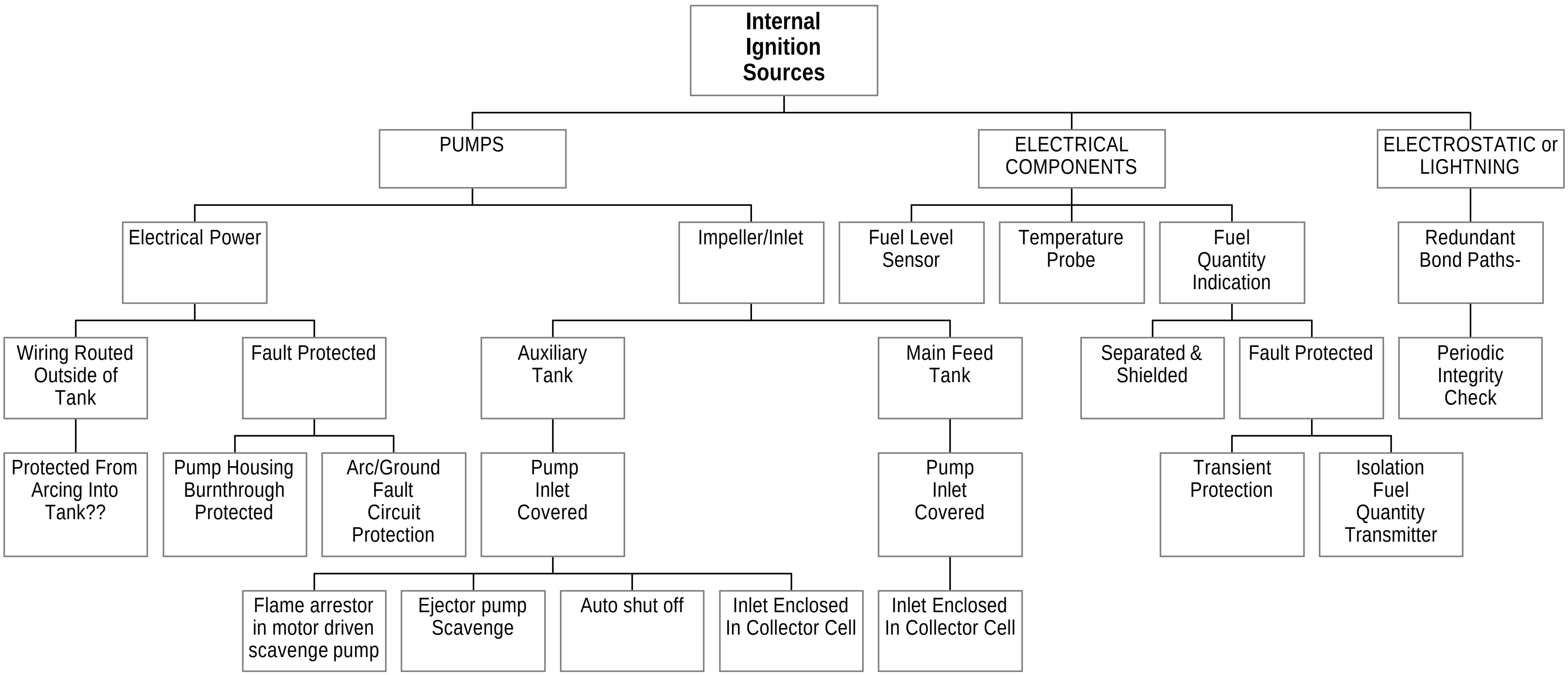
- The level of evaluation that is intended depends upon the basic design and type of modification. In most cases a simple **QUALITATIVE** evaluation of the design/modification in relation to fuel tank system safety, and a statement to the cognizant ACO that the change has no effect on the fuel tank system safety, would be all that is necessary. In other cases where the initial qualitative assessment shows that there may be an affect on fuel tank system safety, **A MORE DETAILED DESIGN** review would be required to substantiate that the airplane fuel tank system design/modifications, including all necessary design changes, meets the requirements of §§ 25.901 and 25.981(a) and (b).

Analysis Considerations

- QUALITATIVE ANALYSIS - Analytical processes that assess system and airplane safety in a subjective non-numerical manner, e.g., development of flightcrew procedures to mitigate inflight failure conditions

- QUANTITATIVE ANALYSIS - Analytical processes that apply mathematical methods to assess system and airplane safety, e.g., using failure rate probabilities to determine safety risk

Fuel Tank Ignition Source Consideration



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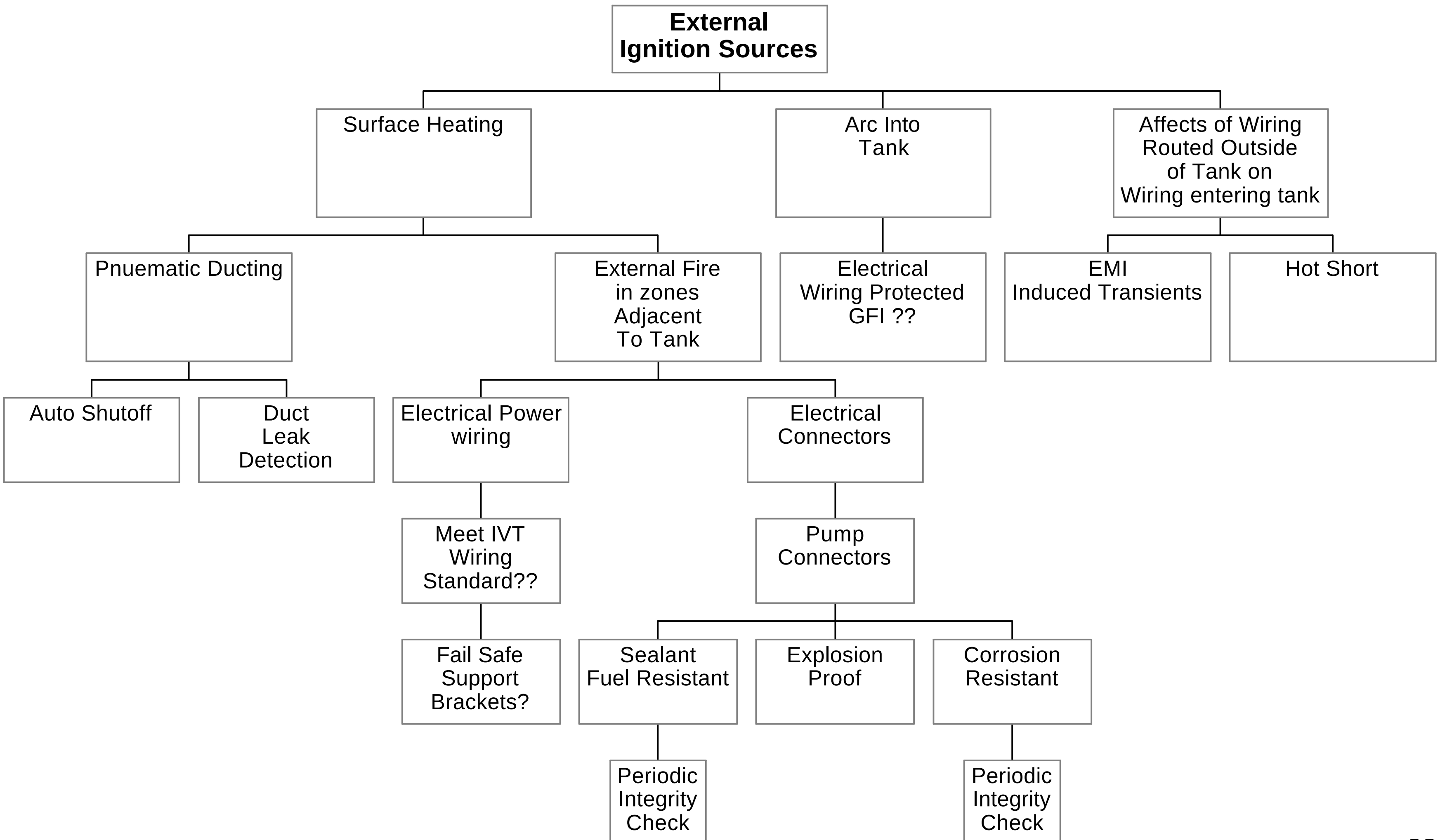

Compliance Planning

- TC and STC Holders’ Responsibilities
- Operators’ Responsibilities
- Principal Inspectors’ Overview and Responsibilities

Compliance Planning TC/STC Holders

- Provide design review report by 12/6/2002 to ACO that includes:
  - Design changes **NECESSARY** to comply with SFAR
  - Identification of safety **CRITICAL** fuel tank system design features.
  - Identification of the appropriate marking for those features so future maintenance actions do not **DEGRADE** the intended level of safety.
  - **ALL** maintenance and inspection instructions necessary to maintain the design features required to preclude the existence or development of an ignition source within the fuel tank system throughout the operational life of the airplane
  - **COMPARABILITY** of design review required inspection and maintenance
  - **COMMUNICATE** with operators regarding progress of the design review and probable outcomes

STC Holders Dependency on OEM

- STC holders may not have access to information from respective OEM’s
  - Basic OEM system descriptions, wiring diagrams and/or the OEM’s limitations
- Lacking this information, STC holders may not be able to determine what are the OEM’s critical systems
- STC holders may therefore be unable to compile a complete SSA for their installation.

Completing STC Reviews

- For Example:
- STC holders conducting a SSA concerning the possible effects of their STC wiring on the fuel tank system safety have three options.

Completing STC Reviews

- Option 1:
  - Work with the OEM to determine what modifications to the airplanes will be made to provide fail-safe features
  - In many cases transient suppression devices will be developed & installed
  - This would facilitate the SSA for the STC wiring
  - Critical Design Configuration Control Limitation (CDCCL) information would be available from the OEM so that a complete evaluation would be possible

Completing STC Reviews

- Option 2:
  - Assume that wiring may be routed with critical fuel system wiring (even though no knowledge of what is critical)
  - STC holder's submittal might include a statement that the STC wiring exceeds intrinsically safe energy/current levels
    - Describe voltage and current levels (Normal/Failure)
    - Wire is installed in accordance with standard wiring practices
      - i.e. it may not be separated from fuel tank system wires
    - State the subject wire must be installed and maintained in accordance with CDCCLs & FSL defined by the OEM

Completing STC Reviews

- Option 3:

- Complete SSA for the STC installation at least to the OEM's interface.
- Then, provide the following limitation, along with any other appropriate limitation(s) for their STC:

  "This STC complies with Special Federal Aviation Regulation No. 88 when installed in accordance with all critical design configuration control limitations approved by the FAA for this STC and for the airplane model(s) listed in this STC"

- This type of limitation will allow STC holders to proceed with their SFAR 88 package submittal

Design Review - Items That May Be Missed

- Not a 25.1309 analysis
- Latent failures must be combined with single failures unless the latent failure probability, considering exposure time and failure rate, is extremely remote (10^{-7}).
- Assumptions:
  - Environmental conditions must be considered to be present (P=1 on a per flight basis). These include lightning, HIRF, etc.
  - Fuel tank and adjacent spaces (e.g. leading and trailing edge, wheel well, pack bays etc.) contain flammable vapor,
  - Foreign object debris (FOD) exists in rotating parts of pumps
  - Undetected FOD exists on fuel tank electrical sensors and circuits (e.g., FQIS probes, etc.)
  - Analysis must consider the operational life of the airplane models, and not just the design life. This was discussed in the preamble to the final rule. (e.g., Long range airplane typically have a life in excess of 100,000 flight hours)

Other Considerations

- The effects of manufacturing variability, aging, wear, corrosion, and likely damage must be considered.
- OEM is responsible for validating vendor analyses.
- Any safety claims for LRUs must be substantiated.
- Consider hazards of sulfur deposits.
- All fuel tank components should be evaluated for silver content.
- Assumptions should be based on overall Lessons Learned by the transport airplane fleet, as stated in the preamble. Lessons Learned should include information from all transport airplane manufacturers experience that is available (e.g., fuel pump). Available sources of Lessons Learned include AC 25.981-1B, the preamble to SFAR 88 and Airplane Fuel System Safety Program report.

Other Considerations - (cont'd)

- Separation and Shielding Approach:
  - Protecting internal fuel tank wiring by separating and shielding wires and circuits outside the fuel tank would require a one time inspection/replacement of fleet wire configuration and condition (all airplanes).
  - Routing some fuel tank wires together with 115v and/or 28v wires is not acceptable for a separation and shielding approach.
  - Visible means should be applied to identify wire separation requirements on airplanes (critical design configuration control limitations).
  - Separation must also be substantiated and maintained in all components parts of the system, including Line Replaceable Units (e.g. FQIS processor etc).
  - Means to assure maintenance errors, such as omission of a bonding strap must be addressed.
  - Consider use of transient suppression devices at or near the fuel tank connections that would eliminate need for one time inspection and rerouting of airplane wires.

Other Considerations - (cont'd)

- Electrical:
  - The FAA believes a redundant bond path will likely be required to address the requirements of the SFAR. OEMs should provide a failsafe bonding design.
  - In some cases electrical bonding jumpers can fail due to corrosion.
  - For electrical or electronic systems that introduce electrical energy into fuel tanks, such as fuel quantity indicating systems, the energy introduced into any fuel tank should be less than 200 microjoules during either normal operation or operation with failures. To ensure that the design has adequate reliability and acceptable maintenance intervals, a factor of safety should be applied to this value when establishing a design limit. For example, a maximum energy of 20 microjoules is considered an intrinsically safe design limit for fuel quantity indicating systems.

Other Considerations - (cont'd)

- Fuel Pumps
  - Dry Running: The existing design, including collector boxes and auto-shutoff features on some airplane models provides some protection from mechanical spark ignition; however, some designs still permit dry running of pumps which does not meet the requirements of the SFAR.
  - Based upon past experience of fuel pump power supply and internal arcing events, the FAA believes protective means will likely be needed on all fuel pumps to satisfy the requirements of the SFAR.
- Pneumatic Systems
  - Potential heat sources adjacent to fuel tanks, i.e., air cycle machine, heat exchanger, associated ducting, etc.

Listing of Deficiencies

- Basis:
  - The following list summarizes fuel tank system design deficiencies, malfunctions, failures, and maintenance-related actions that have been determined through **service experience** to result in a degradation of the safety features of airplane fuel tank systems. This list was developed from service difficulty reports and incident and accident reports.
  - These anomalies occurred on 990 in-service transport category airplanes operated by 160 carriers despite regulations, policies, current maintenance and inspection programs in place to preclude the development of ignition sources within airplane fuel tank systems.

Listing of Deficiencies - cont'd

- Pumps:
  - Ingestion of the pump inducer into the pump impeller and generation of debris into the fuel tank.
  - Pump inlet case degradation, allowing the pump inlet check valve to contact the impeller.
  - Stator winding failures during operation of the fuel pump. Subsequent failure of a second phase of the pump resulting in arcing through the fuel pump housing.
  - Deactivation of thermal protective features incorporated into the windings of pumps due to inappropriate wrapping of the windings.
  - Omission of cooling port tubes between the pump assembly and the pump motor assembly during fuel pump overhaul.
  - Extended dry running of fuel pumps in empty fuel tanks, which was contrary to the manufacturer's recommended procedures.

Listing of Deficiencies - (cont'd)

- Pumps: cont'd
  - Use of steel impellers that may produce sparks if debris enters the pump.
  - Debris lodged inside pumps.
  - Arcing due to the exposure of electrical connections within the pump housing that have been designed with inadequate clearance to the pump cover.
  - Thermal switches resetting over time to a higher trip temperature.
  - Flame arrestors falling out of their respective mounting.
  - Internal wires coming in contact with the pump rotating group, energizing the rotor and arcing at the impeller/adapter interface.
  - Poor bonding across component interfaces.
  - Insufficient' ground fault current protection capability.
  - Poor bonding of components to structure.

Listing of Deficiencies - (cont'd)

- Wiring to pumps in conduits located inside fuel tanks:
  - Wear of Teflon sleeving and wiring insulation allowing arcing from wire through metallic conduits into fuel tanks.
- Fuel pump connectors:
  - Electrical arcing at connections within electrical connectors due to bent pins or corrosion.
  - Fuel leakage and subsequent fuel fire outside of the fuel tank caused by corrosion of electrical connectors inside the pump motor which led to electrical arcing through the connector housing (connector was located outside the fuel tank)
  - Selection of improper materials in connector design.
- FQIS wiring:
  - Degradation of wire insulation (cracking), corrosion and sulfide deposits at electrical connectors
  - Unshielded FQIS wires routed in wire bundles with high voltage wires.

Listing of Deficiencies - (cont'd)

- FQIS Probes:
  – Corrosion and sulfide deposits causing reduced breakdown voltage in FQIS wiring.
  – Terminal block wiring clamp (strain relief) features at electrical connections on fuel probes causing damage to wiring insulation.
  – Contamination in the fuel tanks causing a reduced arc path between FQIS probe walls (steel wool, lock wire, nuts, rivets, bolts; or mechanical impact damage to probes) .

Listing of Deficiencies - (cont'd)

- Bonding straps:
  - Corrosion to bonding straps.
  - Loose or improperly grounded attachment points.
  - Static bonds on fuel tank system plumbing connections inside the fuel tank worn due to mechanical wear of the plumbing from wing movement and corrosion.
- Electrostatic charge:
  - Use of non-conductive reticulated polyurethane foam that holds electrostatic charge buildup.
  - Spraying of fuel into fuel tanks through inappropriately designed refueling nozzles or pump cooling flow return methods.

Compliance Planning - 18 Months After SFAR 88 Effective Date

December 6, 2002

Cognizant FAA Transport Airplane Directorate's (TADs) and Aircraft Certification Offices (ACOs) are in receipt of all applicable Type Certificate (TC) and Supplemental Type Certificate (STC) Safety Reviews, necessary design changes identified, interim actions, and necessary Maintenance and Inspection Instructions (Instructions for Continued Airworthiness - ICAs).

Modifications that May Affect the Fuel Tank System

- Examples include:
  - Installation of auxiliary fuel tanks
  - Installation of, or modification to, other systems such as the
    - fuel quantity indication system,
    - the fuel pump system (including electrical power supply),
    - airplane refueling system,
    - any electrical wiring routed within or adjacent to the fuel tank, and
    - fuel level sensors or float switches.
  - Modifications to systems or components located outside the fuel tank system may also affect fuel tank safety, e.g.,
    - installation of electrical wiring for other systems that was inappropriately routed with FQIS wiring could violate the wiring separation requirements of the type design

Compliance Planning - cont'd December 6, 2002 to June 6, 2003

- **FAA Aircraft Certification/AEG:**
  - TAD and ACOs will formally review and approve Safety Review Data
  - FAA Aircraft Evaluation Group (AEG) will assist FAA Aircraft Certification in the review process.
    - AEG will review and make recommendations on the maintenance and inspection aspects of the submitted data specifically addressing Airworthiness Limitations Items (ALIs) and Instructions for Continued Airworthiness (ICAs) known as Fuel System Limitations (FSLs).
    - AEG will establish the comparability of the proposed design certificate holders' maintenance and inspection program to the existing instructions.
  - FAA Aircraft Certification and the AEG will work jointly to achieve a thorough, objective, and <u>timely</u> data review.
  - During the review and approval process, the FAA is committed to open communication with the cognizant T/C, STC Holders.

Compliance Planning - cont'd Present to June 6, 2003

- **TC/STC Holders:**
  - Develop process and procedures for incorporation of FSLs into MPD in the ALI Section
  - Develop specific/detailed

    ICAs

    Aircraft Maintenance Manuals

    Task Cards

    Tooling

Note: Recognize that a potential for required data changes subsequent to FAA June 6, 2003 approval.

Operators' Responsibilities

- Need to identify the TC/STC in the operator's fleet that are impacted by the SFAR
- Operators are responsible for reviewing all other STCs on their airplanes to determine applicability
- Contact the applicable certificate holders regarding their progress:
  - In the conduct of the design review
  - Required design modifications and maintenance and inspection tasks
- In the event the operator's STC holder(s) is unable or unwilling to provide the required design review, the operator(s), by June 7, 2004, is responsible to conduct the review and determine associated maintenance and inspection tasks for approval and incorporation into its maintenance program.
- Determine Actual Aircraft Configuration that affect fuel tank system:
  - Type design and supplemental type designs including applicable SBs
  - Field approvals, major alterations and repairs

Operators' Responsibilities (cont'd)

- Conduct design review of **ACTUAL CONFIGURATION**
  - Develop document to substantiate compliance with the SFAR.
  - Identify required maintenance task and inspection intervals for recommendation to FAA for actual configuration of the fuel tank systems of each airplane.
  - Submit the operator's proposed instructions through the appropriate FAA PMI/PAI for review and comments, and route to the appropriate Transport Airplane Directorate/Aircraft Certification Office (TAD/ACO).
  - Obtain FAA TAD/ACO approval for the operator's proposed instructions.
  - Incorporate FAA approved maintenance program into the existing operator's program by June 7, 2004.

Note: The cognizant principal will be responsible for ensuring the operator implements the the FAA Aircraft Certification approved maintenance and inspection instructions including all necessary work instructions, i.e., task cards or job procedure cards.

Actual Configuration (2004)

- As delivered configuration plus modifications:
  - OEM fuel tank system service bulletins
  - Fuel tank system alterations
  - Field approvals affecting fuel tank system
  - Repairs affecting fuel tank system

Actual Configuration – cont'd

- The operator must evaluate the fuel tank systems and **ANY** alterations to the fuel tank system not addressed by the instructions provided by the TC or STC holder.
- Field approvals may also significantly affect the safety of the fuel tank system. The operator of any airplane with such **CHANGES IS REQUIRED** to develop the fuel tank system maintenance and inspection program instructions and submit it to the FAA for approval, together with the necessary substantiation of compliance with the safety review.

Actual Configuration – cont'd

- A repair must restore the airplane to its original or properly altered condition per 14 CFR 43.13. Therefore, repairs **SHOULD NOT** adversely affect fuel tank system safety. Because repair records are not required to be retained permanently, operators may not be aware of their impact on the fuel tank system safety.

- This rule does not require that inspections be conducted solely for the purpose of identifying them. To the extent that **KNOWN REPAIRS** may have changed design features affecting fuel tank system safety, they should be addressed in the maintenance and inspection instructions.

Compliance Planing - cont'd December 6, 2002 to February 6, 2004

- **Operators**:
  - Communicate with TC/STC holders.
  - Communicate with Principal Inspectors.
  - Conduct aircraft configuration checks.
  - Conduct safety reviews of applicable fleet STCs not provided to FAA Aircraft Certification.
  - Conduct safety reviews of applicable in-house fleet modifications, field approvals, etc.
  - Develop proposed AMM revisions, maintenance and inspection task cards for actual configuration.
  - Acquire required tooling.

FAA Actions in Support of Compliance Planning

- Letter to Category 1 STC holders
- Letter to Category 2 STC holders
- Letter to STC holders regarding acceptance of compliance finding
- FAA database identifying STC compliance status
- http://www.faa.gov/certification/aircraft/SFAR88/index.htm

Principal Inspector (PI) Overview

- SFAR 88 and related rule amendment oversight by the FAA will require coordination and cooperation by FAA personnel (Flight Standards and Aircraft Certification) as well as the operators.
- The fuel system design review and resulting FAA approved maintenance and inspection program transcends traditional FAA practices by involving FAA engineering specialists in the approval of maintenance programs.
- The PIs must collaborate with their respective operator(s) to maximize the industry’s ability to understand this new process and succeed in achieving compliance.

PI Overview (cont'd)

- The complexity of this issue mandates comprehensive surveillance of every facet of the aircraft fuel system:

  Fuel Tank(s)

  Distribution

  Indication

  Adjacent Systems

- Consequently, there is no pride of ownership within FAA Flight Standards on this topic.
- The PMI's and PAI's ***must*** collaborate on this issue.

PI Responsibilities

- Contact your operator(s) as soon as practical to discuss SFAR 88 and related rule amendments with them.
- “Encourage” your operator(s) to include the PI’s in all ongoing facets of SFAR 88 and related rule planning and compliance.
- “Encourage” your operator(s) to identify which TC and STC holders may have involvement with their specific aircraft.

PI Responsibilities (cont'd)

- "Encourage" your operator(s) to make contact with those TC and STC holders as soon as practical.
  - Improves awareness of possible design changes
  - Improves awareness of possible maintenance and inspections requirements and their impact
  - Helps early determination of the benefit of design changes on maintenance programs

PI Responsibilities (cont'd)

- Reaffirm to your operator(s) that in the event their STC holder(s) is unable or unwilling to provide the required design review, the operator(s), by June 7, 2004, is responsible to conduct the review and determine associated maintenance and inspection tasks for approval and incorporation into its maintenance program.
- "Encourage" your operator(s) to begin an "Actual Configuration" check of their aircraft as soon as practical.
- Explain to your operator(s) that this check consists of a **records check** to ascertain specific configuration **if the operator(s) records are comprehensive.**

PI Responsibilities (cont'd)

- "Encourage" your operator(s) to "think out of the box" regarding ***any repairs or alterations*** performed via service bulletins, Campaign Fleet Directives, Engineering Orders, etc., that could effect fuel system safety considering SFAR 88, and FAR Part 25 amendments.
- PIs and staff are encouraged to conduct a review of operator's existing maintenance program (operator task cards compared to manufacturer task cards). The review could include onsite surveillance of ongoing heavy maintenance checks.
- Encourage the operator to participate in this review in collaboration with the FAA.

PI Responsibilities (cont'd)

- "Encourage" your operator(s) to develop an enhanced inspection checklist of all fuel tanks and associated plumbing and wiring to be used during "opportunity inspections." Consider "*AC 25.981-1c*" and the transport category airplane "List of Deficiencies".
- "Encourage" your operator(s) to develop a recordkeeping system containing the enhanced in situ inspections and to share the data with the PI's.

PI Responsibilities (cont'd)

- PIs are encouraged to follow-up operator actions:
  - Determination of Actual Configuration
  - Design Review of the Actual configuration
  - Determination of the Actual configuration required maintenance/inspections
- PIs must plan for receipt of the operator's report containing the design review analysis and recommendations for the maintenance program changes for Aircraft Certification approval, NLT Feb. 7, 2004.
- PIs must plan for the implementation of the operator's FAA approved maintenance and inspection instructions via operations specification approval, NLT June 7, 2004.

Note: This approval is predicated on Flight Standards review of operators work instructions, associated tooling, etc.

Compliance Planning - cont'd December 6, 2002 to February 6, 2004

- **Principal Inspectors:**
  - Maintain open communication with the operators during all processes.
  - Ensure inspector workforce is adequately trained for a thorough, objective, and timely review of the operators proposed program.
  - PIs must plan for the receipt of the operator's report containing the safety review analysis and recommendations for the maintenance program changes (FSL's) for the Aircraft Certification approval, NLT Feb. 6, 2004.

Compliance Planning - cont'd February 7, 2004 to March 7, 2004

- **Principal Inspectors:**
  - Perform a thorough, objective and timely review of the operator's proposed program.
    - Review FSLs, manuals, and task cards provided by the design certificate holders and developed by operator for its actual configuration.
    - Review substantiation for any deviation from FAA approved design certificate holders' FSLs.
  - Communicate with FAA Aircraft Certification and AEG during the review process if assistance is needed.
  - Forward operator's proposed FSLs to cognizant TAD or ACO, NLT March 7, 2004.

Compliance Planning - cont'd
March 7, 2004 to June 7, 2004

- **FAA Aircraft Certification:**
  - Cognizant TAD and ACOs will review and subsequently approve the operators' proposed maintenance and inspection programs.
  - FAA AEG will assist in operator's program review, as appropriate.
  - Cognizant TAD and ACOs will advise the operator and the Principal Inspectors in writing of FAA Aircraft Certification approval.

Compliance Planning - cont'd
NLT June 7, 2004

- **Principal Inspectors:**
  - Upon receipt of FAA Aircraft Certification written approval, and completion of the validation of operator task cards and AMM, the Principal Inspectors will sign the Operator's Operations Specifications.
    - This will acknowledge incorporation of the FAA Aircraft Certification approved Fuel Tank System Maintenance and Inspection Program into the operator's existing Maintenance Program for the aircraft listed in the Ops Specs.

SAMPLE LETTER to OPERATOR

Mr. John Doe
FAA Liaison
ABC Airlines
P.O. Box 123
Anywhere,USA 11552

Dear Mr. Doe:

At the conclusion of a major industry study regarding Fuel System Safety, the FAA has issued amendments to certain transport airplane certification and operating rules that requires affected airplane manufacturers and operators to possibly change how airplane fuel tanks are designed, maintained, and operated. These regulations affect certain airplane models in ABC Airline's current fleet and will have significant impact on ABC Airline's maintenance programs in the future.

This office requests that you review the FAA Federal Register Final Rule Vol. 66, No. 88 dated May 7, 2001, as well as SFAR 88, 14 CFR parts 21,25, 91,121,125, and 129 as applicable. These FAA rules, the most comprehensive fuel tank safety initiative ever put forward demands a **proactive approach** by the Airplane Type Certificate (TC) Holders, Supplemental Type Certificate (STC) holders, the Airplane Operators, and the FAA, both Flight Standards and Aircraft Certification Service.

SAMPLE LETTER to OPERATOR - cont'd

In brief, the applicable TC/STC holders must conduct a one-time design review of the fuel tank system for each transport airplane model in the current fleet to ensure no ignition source may be present at each point in the fuel tank or fuel tank system where catastrophic failure could occur due to ignition of fuel or vapors. These TC/STC holders must then design modifications and specific programs for the maintenance and inspection of the tanks to ensure the continued safety of fuel tank systems. These certificate holders must then submit a report for approval to the cognizant FAA Aircraft Certification Office (ACO), or Transport Airplane Directorate (TAD) by December 6, 2002.

Based on the information provided by the TC/STC holders under the SFAR 88 requirements, **you the operator**, must then develop and implement an FAA approved fuel tank maintenance and inspection program tailored to ABC Airlines specific aircraft. In order for ABC Airline's to develop such programs, an **Actual Aircraft Configuration Check, (includes original equipment manufacturers delivered configuration and subsequent modifications, repairs and field approvals)** must be accomplished on all affected aircraft to determine what specific tasks will be required to ensure the enhanced fuel system safety objectives are met. This configuration check may consist of a records check if records are comprehensive, but must include a system safety analysis of all areas that could adversely affect fuel tank system safety.

SAMPLE LETTER to OPERATOR - cont'd

Examples of possible areas of concern are identified in SFAR 88, its preamble, and FAA Advisory Circulars 25.981-1B and 25.981-2. A specific area that may merit analysis on the part of an operator is: Logo Light STC installations that may have wiring routed alongside FQIS wire bundles, or FQIS wiring harnesses with multiple splices. As detailed in the applicable regulations, ABC Airline's may not operate their affected aircraft after June 7. 2004 without an FAA approved program.

As stated in the applicable § 121.370(b) the operator must submit their proposed maintenance and inspection program through an "appropriate FAA Principal Maintenance Inspector" (PMI) to the cognizant ACO, or TAD office. Due to the fact that this fuel tank safety initiative encompasses storage, distribution, indication, and adjacent systems, avionics oversight by the operator, as well as the FAA is prudent. Consequently, the Principal Avionics Inspector (PAI) in collaboration with the PMI will provide ongoing input, oversight, and final review of ABC Airline's proposed program(s) prior to the ACO, or TAD review, and approval. To meet this deadline, ABC Airline's should submit their program(s) to this office no later than February 7, 2004.

SAMPLE LETTER to OPERATOR - cont'd

We encourage ABC Airlines to contact the affected original and supplemental type certificate holders regarding their determination of modifications and/or maintenance and inspection requirements that result from their safety assessments. This information will be critical to ABC Airline's development of acceptable instructions for continued airworthiness.

We would like to meet with you at your earliest convenience to discuss your present fuel tank system maintenance program(s), as well as the compliance planning measures you anticipate implementing. Additionally, we would like to share with you the expectations this office has regarding status report content and frequency, as mutually agreed upon.

Open communication between ABC Airlines and this office, as always, is of vital importance.

Sincerely,

John Brown
Principal Maintenance Inspector

Jane Jones
Principal Avionics Inspector

QUESTIONS?