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MASTER

INTEGRATED OPERATIONS PLAN

FOR THE

VOLUME II - INTEGRATED OPERATIONS PLAN

LAWRENCE LIVERMORE NATIONAL LABORATORY
UNIVERSITY OF CALIFORNIA

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DECEMBER 1981

INTEGRATED OPERATIONS PLAN

FOR THE

UCRL--15430 Vol. 2

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MFTF-B
MIRROR FUSION TEST FACILITY

VOLUME II - INTEGRATED OPERATIONS PLAN

**LAWRENCE LIVERMORE NATIONAL LABORATORY
UNIVERSITY OF CALIFORNIA**

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MFTF-8
INTEGRATED OPERATIONS PLAN

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INTEGRATED OPERATIONS PLAN FOR THE MIRROR FUSION TEST FACILITY - B

1.0 PURPOSE

This document defines an integrated plan for the operation of the Lawrence Livermore National Laboratory (LLNL) Mirror Fusion Test Facility (MFTF-B). The plan fulfills and further delineates LLNL policies and provides for accomplishing the functions required by the program.

2.0 SCOPE

This plan specifies the management, operations, maintenance, and engineering support responsibilities. It covers phasing into sustained operations as well as the sustained operations themselves. Administrative and Plant Engineering support, which are now being performed satisfactorily, are not part of this plan unless there are unique needs.

3.0 BACKGROUND

The MFTF-B will be a national resource with the potential for a major positive contribution to easing the world's energy problems. The magnitude and complexity of this investment require a formal approach to the management of experimentation, operation, maintenance, and engineering support for maximum effective utilization of the test facility.

4.0 CONCEPT

The operational goal of MFTF-B is to produce the best quality and largest quantity of required experimental data practical from the resources committed to this project. This plan's concept for accomplishing this goal includes:

- a. Assuring the theoretical physicist is involved in establishing criteria for every experiment

- b. Relieving the physicist of involvement with details that do not require his expertise
- c. Assuring the documentation and the hardware are in agreement
- d. Providing the traceability of all experiment configurations
- e. Requiring proper review of problems and proposed solutions
- f. Involving the operations personnel in maintenance, improvements, requirement changes, and problem resolution
- g. Insuring all changes are analysed for impact to reliability, logistics, safety, operations, maintenance, other systems, schedules, and cost prior to implementation
- h. Furnishing the manager sufficient programmatic and technical information to permit informed decisions to be made

To achieve the above, the concept requires definitive responsibilities with necessary authority combined to perform (or have performed) all functions inherent in this project. Project positions that are necessary within a larger matrix organization are: MFTF-B Project Manager (PM) for LLNL, Associate Project Manager for Physics (APMP), Associate Project Manager for Operations and Maintenance (APMOM), and Associate Project Manager for Engineering (APME).

The coordination, concurrences, and boards that are cited later in this plan are methods for keeping the responsible position-holders fully informed and to assure the decision-maker has the best possible information on which to base action. Inputs and concurrences are not mandatory prior to taking action, but their omission may endanger good communications and optimum decisions.

5.0 OPERATIONAL RESPONSIBILITIES

Experimental projects utilizing large facilities usually have five distinct elements: project management, experimentation criteria development, facility operations, resulting data analysis, and engineering support. Besides these usual tasks, MFTF-B will involve development of plasma measuring instrumentation, beam source improvement, and expanded use of RF heating. State-of-the-art engineering improvements in fusion reactors, vacuum technology, cryogenic systems, and gas handling equipment may be required to successfully complete the project. Responsibilities for elements can be combined or divided but they must not be ignored for a successful long-range program. This plan proposes to organize these elements into an entity.

5.1 PROJECT MANAGEMENT

The MFTF-B PM is the representative of the contractor to the Department of Energy (DOE) and the purchaser of goods and services from the line and support organizations of LLNL. He shall approve the general criteria for experiments and all schedule milestones and provide resources necessary for performance. He is responsible for the total integration of all elements of this project, including planning, budgeting, and allocation of time and resources. All future requirements, funding, and schedules and their changes shall be controlled by the PM, and he is responsible for all necessary programmatic support.

In accomplishing the duties of project management, the PM will be assisted by a Project Planning and Control Office. The office shall maintain status and advise him as to the conditions of schedules, budgets, funding, expenditures, management effectiveness, changes, and future planning.

As new data develop, the PM must be flexible and resourceful in planning new scenarios and convincing LLNL management or the DOE Program Director of the advisability of increased (or decreased) project scope and required resources. The ability to exploit new opportunities as they develop may well determine the success of the project.

5.2 PHYSICS

The APMP shall prepare an Experimentation Plan for the PM's approval. The plan will be the basis for an agreement with DOE of the project's intermediate goals and the approaches to be used. The Experimentation Plan will be separated by class of objectives and further expanded into Experimentation Criteria by the Physics Experimentation Leaders (for APMP approval). The criteria define the facility beam and diagnostic support and conditions necessary and the data required for analysis.

The Physics Experimentation Leaders will prepare detailed plans for processing the information collected from MFTF-B diagnostics as a result of shots performed in compliance with the Experimentation Criteria. The direct responsibility for data evaluation, interpretation, and report preparation is that of the Physics Experimentation Leaders for the findings produced from his Experimentation Criteria. The results of the analyses may provide a basis for revisions to the Experimentation Criteria. When analyses indicate needed revisions to the Experimentation Plan or to the MFTF-B Facility, the PM will be informed.

Quick look data analyses will be performed after most shots and at the end of each shift. The APMOM will participate in assessing impacts and potential impacts to the facility operations. The results of the shift quick look will be made available to the physics leader of the following shift.

The APMP is responsible for physics input to progress, special, annual, and final Project Reports. Physics report preparation will be prepared under the supervision and for the approval of the APMP.

5.3 FACILITY OPERATIONS

The purpose of this project is to utilize the facility for a succession of experiments to produce data. In addition, the operation of the facility should provide an engineering data base for future fusion devices and may provide a test data base for component development and related engineering research. Facility operations as used here is defined to include:

- a. Performing actual experiments
- b. Collecting experimental data
- c. Preparing, operating, maintaining, and modifying all MFTF-B dedicated facilities and equipment

The APMOM shall be responsible for facility operations and facility availability. The Manager must assure all hardware has the proper configuration; Operations and Maintenance (O&M) Manuals and documentation available to him are current; spares and repair capability are available; and operations, maintenance, and modifications comply with approved schedules. Improvements to increase availability, enhance production, minimize costs, and reduce personnel requirements shall be goals of operations; however, no changes shall be made except in accordance with released documentation. Technical, budget, and schedule proposals will be developed for submittal to the PM upon his request. The APMOM must be able to accommodate frequent changes in daily operations as experimental results, equipment performance, and new areas for investigation impact the daily working plan.

The APMOM is responsible for the onsite safety of the facility, equipment, and personnel during the operating and maintenance cycles. When modifications are being performed under the supervision of the APMOM, safety responsibility also rests with the APMOM.

5.4 ENGINEERING SUPPORT

Support engineering will be required. An APME will be the focal point. Some areas that may demand support are safety, reliability and quality assurance engineering, logistics, documentation control and repository, and design and system analysis (this includes evaluation of proposed changes, design concepts, trade studies, problem investigations, O&M improvements, etc). Proposed budgets of time and resources shall be prepared upon the request of the PM. Engineering experts will serve as consultants to the O&M and physics areas.

6.0 REQUIRED FUNCTIONS

6.1 PROJECT PLANNING AND CONTROL

The PM is solely responsible for the required Project Management functions. The PM is assisted by a Project Planning and Control (PP&C) Office. For the approval of the PM, the office will facilitate the following:

6.1.1 **PROJECT PLAN.** The Project Plan states the long- and short-range program goals, schedules, and estimated costs. A common understanding with DOE must frame the Project for all areas of LLNL. The PP&C will revise the Project Plan as required by program changes. The revisions will be for the approval of the PM.

6.1.2 **FISCAL CONTROL.** The Project operating budgets will be developed utilizing inputs from the APMOM, APMP, and APME. The PP&C will compile and collect justifications for MFTF-B budget and funding requests for the PM. Project expenditures will be controlled by the PM using current funding and expenditure status that is maintained by the PP&C. The project status will convey this datum.

6.1.3 **CONFIGURATION MANAGEMENT.** Configuration Management consists of baselining hardware, software, and documentation, control of changes, and an audit system to identify baseline versus changes at all times. A Configuration Management Plan shall be developed by PP&C for the approval of the PM. The plan will define the steps required for adequate control of the configuration.

6.1.3.1 **Baseline.** After acceptance testing of each subsystem, the Construction Project Management Team shall assure the hardware, software, and the engineering documentation required for operating, maintaining, and design changes are present and in agreement, thus constituting the MFTF-B configuration baseline. No change shall be made to this hardware, software, or documentation that modifies fit or function without the prior approval of the PM.

6.1.3.2 Change Control. Changed requirements, operational improvements, problem resolutions, cost reductions, and reliability/safety improvements shall be analysed and scheduled with the resources allocated and approved prior to any changes to the baseline. Figure 1 depicts the processing of changed requirements, product improvements, cost reductions, or other types of changes to the baseline. Upon approval of the change, a Configuration Control Board Directive will be issued. Figure 2 shows the activity required when the directive requires a design to be prepared. PP&C will maintain the status of all approved and unapproved changes.

6.1.3.3 Auditing. Support Engineering must continually maintain the documentation baseline plus all approved released changes. The operators shall maintain equipment/facility logs that will identify the history of hardware changes and other significant events. These two data bases of technical facts, supplemented by PP&C status of unapproved changes and approved but unreleased modifications, will furnish a complete audit trail of all actions affecting the baseline.

6.1.3.4 Configuration Control Board (CCB). The CCB functions as an aid to the PM by assuring each organization impacted is fully informed and is given the opportunity to be heard prior to decisions on establishing new baselines and on proposed changes to requirements, hardware, documentation, and software that affect baselines. PP&C is the secretariat to the board. Physics, O&M, and Engineering have permanent members and Hazards Control should have a representative who can be called upon when that area of expertise is needed by the board. Each board member must coordinate within his own organization to assure all involved skills and activities are fully represented.

6.1.4 PROJECT STATUS. The LLNL Management Information System (MIS) combined with the Work Breakdown Structure (WBS) will serve as the primary system for project status. The MIS will track all open work including changes. Each organization supporting MFTF-B shall submit a report of its progress (or lack of progress) for inclusion into the MIS.

Figure 1. Change Request Processing

Figure 2. Design Change Directive Processing

6.1.5 AUTOMATION COMMITTEE. At his discretion, the Project Manager may establish special committees. An example could be an Automation Committee to review project operations, data processing and reduction, or proposed major modifications. The objective of the Committee would be to determine the kind and amount of automation most effective in view of on hand personnel and equipment, the changes planned for the future, and the latest advancements in equipment. Members on the Committee should represent the involved areas (hardware system designer, system operator, computer hardware, computer software, and project planning and control). Findings shall be in the form of recommendations to the Project Manager with rationale.

6.2 PHYSICS

The following physics functions will be required during the project. To ensure organization and control while allowing the necessary flexibility, each plan will be reviewed and revised to reflect new information provided by experiments, new theoretical developments, budget changes, technological developments, reactor designs and other external factors. Technical, schedule, and cost changes must be approved by the PM.

6.2.1 EXPERIMENTATION PLAN. This plan shall add detail to the Project Plan and can be an input into the Project Plan. After review by facility operations and support engineering and approval by the PM, the plan shall become a control document within the MFTF-B Project. Revisions may be approved by the PM as required.

6.2.2 EXPERIMENTATION CRITERIA. Criteria must be developed to furnish the facility operations firm guidance as to the desired and minimum acceptable configurations and experimental data. Within the approved schedule, a more detailed matrix of requirements with associated diagnostics shall be developed by each Physics Experimentation Leader to allow a selection of shots. Preplanned directions will be furnished the "quick look team" assuring the proper decisions will be made between shots and between shifts.

6.2.3 DATA REDUCTION AND INTERPRETATION. The experiment is not complete until the information collected is analyzed, the phenomenon interpreted as far as desired, and the results are adequately documented.

6.2.4 NEW CONFIGURATION CONCEPTS. Series of experiments may introduce as many questions as they answer. Changes in configuration must be considered. If new configuration concepts need engineering investigation or study, support may be obtained by using the Engineering Support Request form and process in accordance with figure 3. For baseline changes see figure 1.

6.2.5 DIAGNOSTIC DEVELOPMENT. The results of experimental runs may well indicate the need for new, additional, or expanded diagnostic measurement systems. As in 6.2.4 above, support or changes may be requested.

6.3 OPERATING THE FACILITY

All preparation, operations, maintenance, and modifications, as well as assuring the required normal and special support are available when needed, are activities encompassed by the team operating the facility.

6.3.1 SPECIAL EQUIPMENT OPERATION. Certain equipment and diagnostics are at the limits of the state-of-art for routine operations. Physics Specialists may be attached to the operating team. The specialist will have two goals - successful equipment performance and reducing the operation to a documented routine that can be carried through by a trained technician or a computer program.

6.3.2 MAINTENANCE. Maintenance is defined as those actions necessary to retain an item in or to restore it to a specified condition. The maintenance concept is to remove and replace to the functional line replaceable unit (LRU) level, either on a scheduled basis as determined from design characteristics or on an unscheduled basis as determined from malfunction. Repair-in-place may be accomplished only when justified by the results of the maintenance analysis or associated trade studies. Maintenance must be accomplished in a manner that will provide support of operational time constraints, prevent deterioration of reliability and operating safety, and accomplish this support and protection at minimum practical costs. In implementing the Integrated Logistics Plan (See

REQUESTS FOR INVESTIG.^

(A) GENERAL
REQUESTS FOR INVESTIGATIONS AND STUDIES

Figure 3. Engineering Support Request F1

(A) GENERAL
INVESTIGATIONS AND STUDIES

Figure 3. Engineering Support Request Flow(General)

appendix II), the operator will be involved in the preplanned preventive maintenance program to the largest extent practical to assure maximum facility availability for experimentation.

6.4 ENGINEERING

The experimental nature of the project and research goals of the facility indicate the strong need for a highly responsive and skilled group of engineers. To attain and operate with high efficiency and reliability will involve product improvements. Developing new configurations to take advantage of new knowledge will demand flexibility. Supporting MFTF-B will require dedicated effort to establish and maintain the engineering configuration baseline under real time pressures. Functions required to accomplish follow.

6.4.1 SYSTEM ENGINEERING. Using the classical breakdown, the system engineering functions are as follows.

6.4.1.1 Analysis. Investigations, trade studies, alternatives, life cycle costs, and change impacts fall into this area. For Engineering Support Request Flow see figure 3.

6.4.1.2 Logistics. Maintainability, maintenance studies, human factors, O&M documentation, and provisioning activities are performed as a part of this effort. Inputs to the living integrated logistics plans will originate from this work.

6.4.1.3 Reliability, Quality Assurance, and Safety. Engineering assisted by O&M will maintain a Reliability, Quality Assurance, and Safety Plan. See appendix I. Failures, problems, and their trends; requested improvements and changes; and new designs and modifications will be assessed and recommendations will be made to assure safe and reliable operating conditions are maintained.

6.4.2 DESIGN. The required design activities will involve the classic disciplines. The design group will furnish a stable pool of expertise to the project to aid in problem resolution; impact assessment of changes; design of modifications; and preparation of technical packages for procurement, fabrication, installation and acceptance testing of hardware and software.

6.4.2.1 Mechanical. Structures, cryogenics, fluids, and mechanical systems will require design attention as requirements change, product improvements develop, and new concepts evolve.

6.4.2.2 Electrical/Electronic. Power, controls, beam sources, measuring systems, computer with software and peripheral equipment, and data links are typical subjects for design effort.

6.4.3 DOCUMENTATION. For good operations and communications, current and readily available documentation is required. The engineering documentation furnishes one part of the configuration baseline; therefore, the documentation must be controlled.

6.4.3.1 Engineering Documentation Control. The maintenance of accurate records of the engineering document releases by date, effectivity, and authorization is mandatory. The approved documentation baseline will be readily available. Control will identify all Project actions (ESR's, CR's, etc.) into the engineering organization and close or suspense each as needed.

6.4.3.2 Repository. A file of all released MFTF-B engineering will be maintained. The repository will arrange for reproduction and distribution of documents when requested by the Document Release Authority (DRA) or by authorized personnel. The repository will serve all Project personnel.

6.5 INTEGRATED LOGISTICS

The Integrated Logistics Plan for MFTF-B (see appendix II) contains details of logistic planning. Certain following logistics-related functions are of general interest.

6.5.1 O&M MANUALS. All major subsystems will have O&M manuals to furnish the operator when he assumes responsibility for the equipment. Simplified O&M procedures shall be written by the APMOM for review by Engineering. If an engineering change affects a procedure, either a revision to the O&M manual or O&M criteria sheet(s) will specify mandatory actions. The APMOM shall update procedures as necessary.

6.5.2 BASELINE DOCUMENTS. Drawings and specifications required for fabrication, construction, and installation will probably greatly exceed O&M and baselining requirements. Early in the transition to an operational facility, the PM shall have the minimum documentation list for each subsystem defined. After agreement, Engineering will maintain only listed documents. New schematics or other new documents may be highly desirable, but PM's approval must be given prior to expenditure for preparation.

6.5.3 SPARES. A maintainability analysis will be performed as part of the design process to assure ready access, assist in troubleshooting, and that needed special tools will be provided. The support engineer shall recommend (or endorse manufacturer's recommendation) spares, who and where they will be stored, which items are to be thrown away, which items are to be repaired, and what contracts are needed (if any). Provisioning conferences composed of a responsible operator, maintainer, designer, logistician, and a representative of the PM should determine a joint position on all items not normally available at LLNL through normal supply. The PM should approve and fund the agreement and the maintainer should adjust maximum/minimum stock levels as experience dictates.

6.5.4 TRAINING DOCUMENTATION. The goal is to require no special training documentation. Care shall be taken to assure all O&M procedures, drawings, and other data are understandable by a qualified technician, thus avoiding misinterpretation and the necessity for special training documentation.

6.6 HAZARDS CONTROL EDUCATION

The LLNL Hazards Control Educational Services will be used to train MFTF-B personnel concerning the hazards of radiation, high pressures, high vacuums, high voltages, cryogenics, oxygen-starved atmospheres, hydrogen-enriched atmospheres, and high magnetism. Each will be potentially encountered in operations of the facility. Each supervisor is responsible for requiring the proper training of all subordinates that may enter a hazardous MFTF-B area.

ATTACHMENT 1

FORMS

Enclosed are:

- 1.a CHANGE REQUEST
Form used in Figures 1 and 3
- 1.b TECHNICAL IMPACT AND COST ESTIMATE
Form used in Figure 1
- 1.c CONFIGURATION CONTROL BOARD DIRECTIVE
Form used in Figures 1 and 2
- 1.d ENGINEERING SUPPORT REQUEST
Used in Figure 3, Appendix I Figure 2, and Appendix II
- 1.e HAZARD ANALYSIS SHEET
Used in Appendix I Figure 3
- 1.f DOCUMENT CONTINUATION SHEET
Used with any of the previous forms as needed for additional space.

MFTF

MIRROR FUSION TEST FACILITY

CHANGE REQUEST

1. CR NO.

2.

PAGE ____ OF ____

3. WORKS

4. INITIATING
ORGANIZATION

5. CHANGE TITLE

6. EFFECTIVITY/EVENT

7. SCHEDULE IMPACT

8. USER NEED DATE

9. DESCRIPTION OF CHANGE

10. REASON FOR CHANGE

11. IMPACT IF CHANGE IS NOT MADE

12. SIGNATURE

ORG.

DATE

SIGNATURE

ORG.

DATE

SUBMITTED BY

APPROVED BY

LAWRENCE LIVERMORE LABORATORY

CHANGE REQUEST INSTRUCTIONS

1. GENERAL INSTRUCTIONS

An MFTF Change Request (CR) shall be used when initiating changes to MFTF-B controlled baselines. If the information requested by a block on the form is not known, or cannot be assessed at the time, that fact shall be noted on the form. Any backup data, sketches, drawings, etc., which will assist in evaluating the change shall be attached to the CR and the document(s) referenced on the CR. Document Continuation Sheets shall be used as necessary to fully document the proposed change.

If the change impacts MFTF-B Project baselines other than the LLNL MFTF-B controlled baseline, the Project Manager will prepare the necessary documents requesting the change to be approved by the proper program authority.

2. COMPLETION INSTRUCTIONS

- 1 The CR number will be provided by Project Planning and Control
- 2 The Work Breakdown Structure (WBS) numbers will identify the facility/system/items to be changed.
- 3 Enter the page number and the total number of pages. Use Document Continuation Sheets as necessary.
- 4 Enter the name/symbol for the organization in which the change originates.
- 5 The change title is a brief statement by which the change can be recognized.
- 6 Identify the mission/event for which the change is proposed to support.
- 7 Identify any potential impact to major program or mission milestones.
- 8 Coordinate with the user prior to making this entry.
- 9 The description of the change includes a statement of the present baseline and a statement of the proposed change.
- 10 Enter a statement detailing the pertinent reason(s) for the proposed change.
- 11 Describe the impact to the project/experiment of not approving the change.
- 12 Obtain the approval signature(s) of the individual(s) authorized to submit change requests for the submitting organization.

MFTF**MIRROR FUSION TEST FACILITY****TECHNICAL IMPACT AND COST ESTIMATE**

1. DATE

2. PROJECT FY

3. REQUEST NO.

4. DUE DATE

5. ESR NO. (IF DIFFERENT
FROM REQUEST NO.)

TO:

PROJECT PLANNING AND CONTROL

7.

PAGE ____ OF ____

6. FACILITIES/SYSTEMS/END ITEMS AFFECTED

WBS:

8. AFFECTED

☐ BASELINE☐ MAINTENANCE☐ SCHEDULE☐ DOCUMENTATION☐ SPARES☐ COST☐ HARDWARE☐ SAFETY☐ CONTRACTS☐ OPERATIONS☐ RELIABILITY

9.

☐ RECOMMEND APPROVAL (DESCRIBE METHOD OF IMPLEMENTATION BELOW)☐ RECOMMEND ALTERNATE SOLUTION (DESCRIBE BELOW)☐ RECOMMEND DISAPPROVAL (LIST REASONS BELOW)

10. OTHER COMMENTS

11. COST ESTIMATE (COMPLETE A & B, IF APPLICABLE)*

A. ESR IMPLEMENTATION COST (REQUESTED FIX)

B. ESR IMPLEMENTATION COST (ALTERNATE FIX)

DESIGN M/H _____ X \$ _____ = \$ _____

MATERIAL \$ _____

FAB/INSTL M/H _____ X \$ _____ = \$ _____

TOTAL COST \$ _____

DESIGN M/H _____ X \$ _____ = \$ _____

MATERIAL \$ _____

FAB/INSTL M/H _____ X \$ _____ = \$ _____

TOTAL COST \$ _____

**Cost Estimate of Basic Request is Required Whether Recommended for Approval or Disapproval. Where an Alternate Solution is Recommended, a Separate Cost Estimate must also be Shown.*

12. LEAD ENGINEER

APPROVAL SIGNATURE (AS REQUIRED)

ORGANIZATION

DATE

LAWRENCE LIVERMORE LABORATORY

<div style="display: inline-block; vertical-align: middle;"> MFTF MIRROR FUSION TEST FACILITY CONFIGURATION CONTROL BOARD DIRECTIVE </div>			1. DATE (MONTH, DAY, YEAR)		2. CCBD NUMBER	
			5. CHANGE AFFECTS: ☐ DOCUMENTATION ONLY ☐ HARDWARE/SOFTWARE ☐ INSTALLATION/TEST PROCEDURES		3. PAGE PAGE ____ OF ____	
					4. ☐ NEW ☐ SUPERSEDES ☐ SUPPLEMENTS CCBD _____ REV. _____ DATE _____	
7. CHANGE NO., INITIATOR, DATE			6. WORK BREAKDOWN STRUCTURE WBS _____ AFFECTED			
8. CHANGE TITLE						
9. BASELINE DOCUMENTS/END ITEMS AFFECTED			10. OTHER PROJECT ELEMENTS AFFECTED			
11. CATEGORY		12. EFFECTIVITY PROGRAM MILESTONE/EVENT		13. LOCATION		
14. IMPLEMENTATION <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div style="text-align: center;"> DESIGN _____ BY - DATE - MANPOWER </div> <div style="text-align: center;"> PROCUREMENT _____ BY - DATE - COST </div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-end; margin-top: 10px;"> <div style="text-align: center;"> INSTALLATION _____ BY - DATE - MP/COST </div> <div style="text-align: center;"> MOD KIT REQD. _____ BY - DATE - MP/COST </div> <div style="text-align: center;"> MIP REQD. _____ DATE </div> </div>						
15. DISPOSITION/SPECIAL INSTRUCTIONS/REMARKS						
16. PREPARED BY						
PP&C						
17. CONCURRENCES		YES	NO	YES		NO
ASSOCIATE PM FOR PHYSICS				ASSOCIATE PM FOR O&M		
				ASSOCIATE PM FOR ENGINEERING		
18. CCB CHAIRMAN (SIGNATURE/DATE)						
☐ APPROVE ☐ DISAPPROVE
LAWRENCE LIVERMORE LABORATORY						

CONFIGURATION CONTROL BOARD DIRECTIVE (CCBD)

1. COMPLETION INSTRUCTIONS

Complete each block on the form as follows:

- 1 Enter the date the CCBD is released (Month, Day, Year).
- 2 Enter the appropriate CCBD number after the CCB Chairman makes the change decision, signs, and dates the CCBD.
- 3 Insert the page number and the total number of pages for each CCBD. Use Document Continuation Sheets as necessary.
- 4 Place an "X" in the appropriate box to indicate whether the CCBD is new, supersedes, or supplements an active CCBD. The CCBD number, revision code, and date of the active CCBD shall also be entered.
- 5 Place an "X" in the appropriate box(es) to indicate what item(s) the proposed change affects: documentation, hardware/software, or installation/test procedures.
- 6 Enter the Work Breakdown Structure (WBS) no. of the impacted system(s).
- 7 Enter the identifying numbers of the proposed change, the date which appears on the proposed change, and the change initiator as identified in the change package.
- 8 Enter the title of the proposed change exactly as it appears in the change package.
- 9 List all documents/end items known to be affected by the proposed change including baseline documents, specifications, Interface Control Documents, plans, procedures, manuals, drawings, etc.
- 10 Identify other Project Elements that have a direct relationship/interface to the proposed change. Identify the CCBD number and CCBD date of the affected element(s).
- 11 Indicate the category of the proposed change as it appears in the change package (e.g., I and II). If the approved category differs from the recommended category, the CCBD must be "Approved with Changes Noted" in block 16.
- 12 Indicate the Program Milestone and/or Event for which the proposed change is planned.
- 13 Enter the location of the change, for example: third floor, building 431.
- 14 Enter the appropriate organization responsible for implementing design, procurement, installation, etc. Enter the date the Mod. Kit and/or MIP is required, approved manpower and funding by activity should be entered.
- 15 The preparer of the CCBD shall sign and date.
- 17 The CCB representative of each organization having a requirement to implement the provisions of the CCBD shall indicate his concurrence or nonconcurrence with the Chairman's decision by placing an "X" in the appropriate box and signing the CCBD.
- 18 The CCB Chairman, after entering his change decision shall sign and date the CCBD.

MIRROR FUSION TEST FACILITY

ENGINEERING SUPPORT REQUEST

1. DATE	2. ESR NO.	REV.	3. LOCATION	4. SHEET ____ OF ____
	5. EFFECTIVITY/EVENT REQD. BY		6. USER NEED DATE	7. CATEGORY
8. FACILITY/SYSTEM/EQUIPMENT	WBS	9. PART	10. PART NO.	11. FIND NO.
12. MANUFACTURER				13. TITLE
14. TYPE OF ACTION				15. DESCRIPTION OF REQUIREMENT/CONDITION/EVENT
16. SCHEDULE IMPACT				17. ACTION REQUESTED
18. JUSTIFICATION				
19. COMMENTS AND ACTION ITEMS				
20. TECHNICAL CONTACT		21. PROJECT MANAGER APPROVAL		22. DESIGN ACCEPTANCE
NAME	ORG.	PHONE	SIGNATURE	DATE
LAWRENCE LIVERMORE LABORATORY				

ENGINEERING SUPPORT REQUEST (ESR)

1. COMPLETION INSTRUCTIONS

Unless otherwise stated, requestor shall complete each block on the form as follows: (Enter "NA" when block is not applicable, leave blank if not known. The items marked with an asterisk (*) must be completed.)

- *1 Enter ESR preparation date.
- *2 Enter the ESR number and ESR revision letter, as required. Obtain ESR number from PP&L.
- 3 Self-explanatory.
- 4 Enter location (i.e., Building 439).
- 5 Enter date and/or event that needs completed action.
- 6 Enter date by which request action is to be completed.
- 7 For proposed changes, enter either Mandatory (Category I) or Highly Desirable (Category II).
 - a. Mandatory Changes - one or more of the following:
 - 1) Hazardous condition exists that could cause fatal or serious injury to personnel or extensive damage or destruction of equipment.
 - 2) A system required to support a critical test is inoperable.
 - 3) A change in operational characteristics develops that, if not accomplished without delay, may seriously delay the program.
 - 4) Conditions exist that require a change to meet program milestones.
 - b. Highly Desirable Changes - all other changes.
- 8 Enter the name of the facility/system/equipment, the request action, and the work breakdown structure number.
- 9 Enter the name of part the request action is against.
- 10 Enter the part number the request action is against.
- 11 Enter the find number the request action is against. Obtain the number, if applicable, from the tag on the part, the GMD parts list, or drawing.
- *12 Enter description title.
- *13 Enter a complete detailed description of the requirement, condition, and/or events. List all attached documents. Any suggested methods of implementation shall be entered here.
- 14 Enter name of manufacturer of part, equipment, etc.
- 15 Enter type of action as follows:

a. New requirement	g. Repair
b. Change requirement	h. Disposition instructions
c. Replace like item	i. Cannibalization
d. Deviation/waiver	j. Studies
e. Budget requirement	k. Other (specify)
f. Field engineering change	
- 16 Identify any potential impact major program or mission milestones.
- *17 Enter descriptive paragraph of action requested.
- *18 Enter detailed justification for request. Describe the impact if request is not implemented.
- 19 To be filled out by design. Enter any pertinent comments and actions required to implement the request.
- *20 Enter the name of the technical contact, the contact's organization and phone number.
- *21 Enter the signature and organization of the person of the originating organization approving the request and date of approval. Any concurrence required by the approving official may be entered in block 19 above the approval block; i.e., R&QA, Safety, etc.
- 22 To be filled out by design.

NOTE: If additional space is required, use Document Continuation Sheet.

MFTF MIRACOR FUSION TEST FACILITY HAZARD ANALYSIS SHEET	1. ☐ DESIGN ☐ OPERATIONAL ☐ INTEGRATED	2. HAZARD	
3. PREPARED BY (Name, Signature, Organization, and Date)		4. SHEET NO.	5. REVISION
6. SYSTEM/SUBSYSTEM TITLE, WBS		7. RELIABILITY/SAFETY REVIEW SYSTEM ENGINEERING (Signature, Date)	
8. HAZARD? YES ☐ PROCEED TO BLOCK 9. NO ☐ JUSTIFY IN BLOCK 10.			
9. HAZARD DESCRIPTION A. DESCRIPTION B. CAUSES C. EFFECTS			
10. RESOLUTION			
11. HAZARD STATUS <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div> ☐ NO HAZARD ☐ ELIMINATED ☐ CONTROLLED ☐ RESIDUAL HAZARD </div> <div style="margin-left: 20px;"> ☐ CRITICAL ☐ CATASTROPHIC </div> </div>			
12. APMP CONCURRENCE DATE		14. APPROVED PROJECT MANAGER, DATE	
13. HAZARDS CONTROL CONCURRENCE, DATE		14. APPROVED PROJECT MANAGER, DATE	

HAZARD ANALYSIS SHEET

- 1 Type hazard analysis.
- 2 Hazard analysis identification number obtained from PP&C.
- 3 Name, signature, and organization of engineer preparing form and the date.
- 4 Sequential number of each Hazard Analysis Sheet for this system/subsystem.
- 5 If Hazard Analysis Sheet is revised, enter revision letter.
- 6 System/subsystem nomenclature and work breakdown structure.
- 7 Name and signature of reliability/safety reviewer and date.
- 8 Hazard identified?
- 9 For an actual hazard identified, enter a:
 - a. Brief description of the nature of the hazard
 - b. Brief statement of cause of hazard
 - c. Statement of possible effects on personnel, equipment, or environment
- 10 If an identified noncompliance with a checklist item constitutes NO HAZARD, enter justification. If an actual hazard was identified, enter resolution. If a hazard is considered an acceptable risk, enter rationale.
- 11 Check the appropriate box to indicate status of resolution and the appropriate level, either critical or catastrophic.
- 12 Concurrence signatures of Associate Project Manager required for controlled and residual hazards only.
- 13 Hazard control concurrence, controlled and residual hazards only.
- 14 Project Manager's approval signature and date.

MFTF

MIRROR FUSION TEST FACILITY

DOCUMENT CONTINUATION SHEET

1. DOCUMENT NO(S).

2.

PAGE _____ OF _____

3. OFFICE

4. DOCUMENT

5. DATE

6.

LAWRENCE LIVERMORE LABORATORY

DOCUMENT CONTINUATION SHEET INSTRUCTIONS

1. GENERAL INSTRUCTIONS

An MFTF Continuation Sheet is provided as a general purpose continuation sheet for the "Change Request," the "Technical Impact and Cost Estimate," the Configuration Control Board Directives," and other MFTF documents as appropriate. The use of this standard form will aid change tracking, help provide documentation clarity, and enable the documentation to be more easily understood.

2. COMPLETE INSTRUCTIONS

Complete each block on the form as follows:

- 1 Enter the same document number(s) appearing on the document being continued. For instance, if a CR form is being continued, enter the CR numbers in this block and if a CCBD is being continued, enter the CCBD number here.
- 2 Number each page as indicated. Use additional continuation sheets as necessary.
- 3 Enter the same office designation appearing on the document being continued.
- 4 Identify the document being continued.
- 5 Enter the same date appearing on the document being continued.
- 6 Identify by block title the block being continued. Insert "(cont)" and underline. Begin the continuation words on the next lower line. Any number of blocks can be continued on a single continuation sheet, but each block should be identified in the same manner.

APPENDIX I

MFTF-B
MIRROR FUSION TEST FACILITY

RELIABILITY, QUALITY ASSURANCE, AND SAFETY PLAN

MFTF-B
RELIABILITY, QUALITY ASSURANCE, AND SAFETY PLAN
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MFTF-B
MIRROR FUSION TEST FACILITY
LAWRENCE LIVERMORE NATIONAL LABORATORY

RELIABILITY, QUALITY ASSURANCE, AND SAFETY PLAN

1. INTRODUCTION

1.1 PURPOSE

This Reliability, Quality Assurance, and Safety (R, QA, and S) Plan defines the R, QA, and S program for the Mirror Fusion Test Facility (MFTF-B) project that fulfills Lawrence Livermore National Laboratory (LLNL) policies and provides for the accomplishment of the functions comprising the program.

1.2 SCOPE AND APPLICABILITY

This plan specifies the R, QA, and S tasks to be considered for implementation during the operations of and the design/construction of modifications to the facilities, systems, and equipment for which this project is responsible. The plan is applicable to all elements of LLNL as specified.

1.3 PROGRAM IMPLEMENTATION

In the implementation of R, QA, and S tasks contained herein, consideration shall be given to the complexity, supplier experience, state of hardware development, unit cost, and usage of the facility, system, or equipment. This plan is implemented through project directives and internal R, QA, and S procedures.

2. PROJECT ORGANIZATIONS AND RESPONSIBILITIES

2.1 ORGANIZATIONS

2.1.1 PROJECT MANAGEMENT.

- a. Project Manager (PM). The PM is responsible for collecting or establishing project/program requirements and policies for the MFTF-B project at LLNL and approving the R, QA, and S efforts and risks to be taken within the project.
- b. Project Planning and Control (PP&C). The PP&C office will monitor and track, propose procedures and policies, and recommend positions and actions concerning R, QA, and S for the project.

2.1.2 FACILITY OPERATIONS.

- a. Associate Project Manager for Operations and Maintenance (APMOM). The APMOM is responsible for facility systems and equipment, QA, and S. By operating and maintaining the equipment baseline properly, existing reliability and quality assurance requirements can be met. Supporting design reviews will assist in improving quality and reliability of new or modified systems. The APMOM is responsible for operational safety.
- b. Operational Safety Leader (OSL). The APMOM will be assisted by an OSL. The OSL shall prepare and maintain an operational safety plan for the concurrence of the LLNL Hazards Control Office and approval by APMOM and the PM. The plan shall be included in this document and will complement as well as supplement the engineering safety work performed under the cognizance of the Associate Program Manager for Engineering (APME). Operations and Maintenance (O&M) safety policies and procedures will be prepared as required for the approval and issuance of by APMOM. Operational Hazard Analyses are prepared per OSL guidance. See figure 1.

90% DESIGN REVIEW

Figure 1. Hazard Analysis Acceptance Flow

2.1.3 ENGINEERING.

- a. APME. The APME, in conjunction with design responsibilities, executes the reliability program and engineering portion of the quality and safety programs for the PM.
- b. Lead Design Engineer. Lead design engineers are responsible for the following R, QA, and S functions:
 - (1) Establishment of the necessary R, QA, and S requirements based on the system or equipment criticality
 - (2) Review of single failure points, design hazards and Critical Items List (CIL), and recommendations on improving system reliability and/or safety
 - (3) Review of problem reports and preparation of recurrence control response [see figure 2(C)]
 - (4) Ensure that all critical components are qualified
 - (5) Establishment of requirements for traceability and limited life hardware where needed
 - (6) Establishment of system criteria and the preparation and use of design hazard analyses
- c. System Engineering. System Engineering performs the following R, QA, and S functions:
 - (1) Assures that project R, QA, and S plans, policies, and procedures are properly implemented and carried out by all elements of engineering
 - (2) Categorizes the MFTF systems and equipment with respect to the fail-safe requirement and supporting the design engineers in establishment of R, QA, and S requirements

(A) GENERAL
REQUESTS FOR INVESTIGATION

(B) WAIVER/DEVIATION

(A) GENERAL
R INVESTIGATIONS AND STUDIES

WAIVER/DEVIATIONS

Figure 2. Engineering Support Requests (No Change to Baseline)

(C) PROBLEM REPORTING & CORRECTION

(C) PROBLEM REPORTING & CORRECTIVE ACTION

Figure 2. Engineering Support Requests (No Change to Design)

NO ACTION

Figure 2. Engineering Support Requests (No Change to Baseline)(Cont)

- (3) Reviews engineering documentation and approves Document Release Authorization (DRA) to ensure that the appropriate provisions are included to cover the following areas:
 - (a) Reliability
 - (b) Quality
 - (c) Systems safety
 - (4) Prepares and maintains Failure Mode and Effects Analysis (FMEA) and CIL
 - (5) Prepares a tracking system for critical Single Failure Points (SFP's) and design hazards
 - (6) Initiates failure analysis requests, prepares failure analysis reports, and maintains problem trend data file [see figure 2(8)]
 - (7) Prepares an integrated CIL based on the individual system level and CIL's prepared by the design engineers and keeps track of changes due to design changes and reanalysis
 - (8) Identifies then coordinates the reviews and acceptance of critical SFP's and design hazards with the responsible operating organization and project management (see figure 3 and figure 1)
 - (9) Reviews procurement documentation to ensure the incorporation of R, QA, and S requirements
 - (10) Reviews contractor's reliability and quality assurance plans for adequacy in meeting R&QA requirements and obtains other concurrences as required
- d. Documentation for Engineering. Documentation maintains a file of all project engineering documents and the status of all actions involving engineering in R, QA, and S.

(A) FAILURE HAZARD TO PERSONNEL OR OTHER EQUIPMENT OR DELAYS OPERATION 8 HOURS OR MORE

(B) FAILURE NO HAZARD TO PERSONNEL OR EQUIPMENT AND DELAY FOR REPAIR LESS THAN 8 HOURS (MIL)

R

LESS THAN 8 HOURS (MINOR)

Figure 3. Single Failure Point Acceptance Flow

2.1.4 PHYSICS. The Associate Project Manager for Physics has little direct responsibility for R, QA, or S. Yet his Experimentation Plan and the Experimentation Criteria are prime drivers requiring high quality and reliability. The participation of the physics experts in design reviews is necessary to achieve the most cost-effective balance of each R, QA, and S with practical reality.

2.1.5 HAZARDS CONTROL. (Does not report to Project Management.)

2.1.5.1 Hazards Control Reviews and Audits. For the director of LLNL, Hazards Control Personnel will visit the MFTF-B work area to assure lab standards and practices are being followed. Scheduled and unscheduled audits of the project will be performed at the discretion of the Hazards Control Department. Representatives of Hazards Control will assist in design reviews change impact assessments, risk acceptance of hazards and single point failures, and operational readiness inspections.

2.1.5.2 Hazards Control Training. The education program offered by the LLNL Hazards Control Department will be utilized to instruct the necessary project personnel as to the hazards involved and the safety precautions to be taken when working with or near the MFTF-B facilities and equipment. Topics that shall be covered, as a minimum, are high voltage, vacuums, magnetism, temperatures, and pressures; microwave and high energy particle radiation; and oxygen-deficient and hydrogen-enriched atmospheres.

2.2 TASK RESPONSIBILITIES

The responsibilities for accomplishing the R, QA, and S functions contained herein are summarized in figure 4. These functions are to be applied selectively in order to achieve the necessary levels of reliability, quality, and safety commensurate with the mission objectives and overall costs. The rationale for not accomplishing specific functions shall be provided by the responsible systems engineer.

R, QA, and S surveys and audits may be performed by any level of project management within their area of responsibility. Scheduled surveys and audits will be formally documented. Unscheduled and random surveys and audits may be documented as minutes of meetings, memos for record, letters, or other informal documentation. An official survey and audit file shall be maintained by each organization performing surveys and audits.

Task Description	Responsibility			
	Prime	Support	Approval	Project File
Determine Critical Systems and Equipment	SE	DE		
Establish R, QA, and S Requirements	DE	SE		
Establish and Assure Component Qualification	DE	SE		SE
Establish Traceability Requirements	DE	SE		SE
Establish Limited Life Hardware Requirements	DE	SE		SE
Conduct Design Reviews	Lead DE	SE	PM	PP&C
Perform Systems Assurance Analysis	SE	DE	PM	PP&C
(1) Develop Failure Modes and Affects Analysis	SE			
(2) Preparation of Integrated CIL	SE			
(3) Preparation of SFP with recommendations and rationale	SE			
(4) Component Qualification Status	DE	SE		
Coordinate Review and Acceptance of SFP's and Design Hazard Analyses	SE	DE	PM	PP&C
Nonconformance Reporting and Correction Action	SE	DE		EDOC
(1) Analysis of Reports				
(2) Input ADP Program				
(3) Repetitive Problem Report (Trend Analysis)				
Failure Analysis	SE	DE		SE
(1) Initiation of Requests	O&M, P, DE, HC, SE			
(2) Approval of Requests	SE			
Waiver/Deviations	O&M, P, SE			
(1) Prepare	Contracting			
(2) Evaluate/Concur	Procurement SE	DE	APME	PP&C

Figure 4. Task Responsibilities

Task Description	Responsibility			
	Prime	Support	Approval	Project File
Procurement Documentation (1) Establish R, QA, & S Requirements (2) Review and Concur in Established Requirements	DE	SE		PP&C
Support Requests (1) Establish Quality Assurance Requirements (2) Review and Concur in Established Requirements	DE	SE		PP&C
Establish Quality Assurance Requirements	DE	SE		PP&C
Perform Onsite Quality Surveillance	Organization Responsible for Fabrication/Installation/Construction Contract	Other Organizations (As Required)		Prime
Establish System Safety Criteria and Constraints	SE	HC O&M		
Perform Surveys and Audits	Any Organizational Element	DE		Any Organ.
Maintain Tracking and Status System for Single Failure Points and Hazards	SE	EDOC		PP&C
Perform Hazards Analysis (1) Design Hazards Analysis	SE	DE Physics O&M HC	PM	PP&C
(2) Operational Hazards Analysis	O&M	Engr. Physics HC	PM	PP&C
(3) Integrated Hazards Analysis	SE	Engr. Physics O&M HC	PM	PP&C

Figure 4. Task Responsibilities (cont)

Task Description	Responsibility			
	Prime	Support	Approval	Project File
R, QA, and S Operating Plan (This document)	Engineering	O&M Physics HC	PM	PP&C
(1) Reliability	Engineering	O&M Physics		
(2) Quality Assurance				
(a) Engineering	Engineering	O&M		
(b) Operating	O&M	Engr.		
(3) Safety				
(a) Engineering	Engineering	O&M Physics HC		
(b) Operating	O&M	Engr. Physics HC	PM	

Figure 4. Task Responsibilities (cont)

Key: SE = System Engineering
DE = Design Engineering
PM = Project Manager
PP&C = Project Planning and Control
EDOC = Engineering Documentation
HC = Hazards Control
O&M = Operations and Maintenance

3. ENGINEERING RELIABILITY AND SAFETY FUNCTIONS

This section describes the reliability engineering functions to be performed.

3.1 DETERMINE CRITICAL SYSTEMS AND EQUIPMENT

- a. Critical systems and equipment are defined as those systems or equipment that through operation or malfunction could cause loss of life, injury to personnel, loss of the facility, or damage to a MFTF-B system.
- b. The Project systems and equipment will be analyzed to determine if they are critical. System Engineering will prepare an initial list of critical systems and equipment. The initial list will be reviewed and approved by the responsible design engineers.

3.2 ESTABLISH R, QA, and S REQUIREMENTS

The design engineers will establish the necessary R, QA, and S requirements for each design based on the hardware complexity, supplier experience, state of hardware development, unit cost, and hardware use.

3.3 SYSTEM ASSURANCE ANALYSIS (SAA)

The Reliability and Safety Analysis is formally documented in a SAA for critical systems (see 3.1b.). An SAA consists of a brief system description, key baseline document references, FMEA, system criticality determination, CIL, SFP (with acceptance rationale), and design hazards analysis (DHA).

SAA's required for noncritical systems will provide a brief system description, system documents reference, criticality rationale, and a design hazard analysis (see 3.3.1).

3.3.1 FMEA AND CIL.

- a. FMEA's and CIL's will be prepared on all critical systems and equipment during the early design phase in order to provide assurance that

unacceptable SFP's are eliminated during the design phase. FMEA's and CIL's will be used to support design reviews as required.

- b. Preliminary FMEA and CIL data will be available for the 30-, 60-, and 90-percent design reviews, as required.
- c. Items appearing on the CIL will be given special attention in establishing hardware specifications and qualification requirements; in manufacturing, inspection, and test planning; and in the formulation of operating and maintenance instructions.

3.3.2 SYSTEM SAFETY GUIDELINES AND CONSTRAINTS. The design engineers shall develop and establish safety guidelines, constraints, and requirements to guide the design of facilities, systems, and equipment. These criteria shall satisfy programmatic guidelines, constraints, and systems safety goals, as well as LLNL safety requirements.

3.3.3 DESIGN HAZARDS ANALYSIS (DHA).

- a. Hazards analysis will be performed during the early design phase in order to provide assurance that hazards are identified and resolved during the design phase where possible.
- b. DHA will be used to support the 30-, 60-, and 90-percent design reviews.
- c. As a general rule, hazard analysis will be performed on systems and equipment containing:
 - (1) Pressurized vessels, tanks, lines, and similar components
 - (2) Hazardous fluids including cryogenics
 - (3) Hydraulic and/or pneumatic components
 - (4) High voltages, radiation sources, and associated hazardous electrical apparatus

(5) Explosives

(6) Toxic, corrosive, and/or harmful materials or fluids

(7) Vacuum oxygen-depleted and oxygen-rich atmospheres, where personnel might enter

3.4 PREPARATION TRACKING SYSTEM FOR CRITICAL SFP'S AND HAZARDS

System Engineering will prepare a tracking system for critical SFP's and design hazards for their facilities, systems, and support equipment.

3.5 COORDINATE REVIEW AND ACCEPTANCE OF SFP'S

System Engineering will coordinate the review and approval of SFP's with the operating organizations and project management as required.

3.6 PROBLEM REPORTING AND CORRECTIVE ACTION SYSTEM (PRACA)

All PRACA reports (Engineering Support Request forms) received by engineering will be processed in accordance with figure 2(c).

3.7 FAILURE ANALYSIS AND PROBLEM ANALYSIS

System Engineering will request and utilize failure analysis reports and will perform problem analysis as needed.

- a. A failure analysis is defined as a systematic physical investigation of hardware carried out by specially trained laboratory personnel.
- b. A problem analysis is defined as a study carried out by a design organization after a failure analysis has been performed by the appropriate engineering shop. The failure analysis will form the basis of the problem analysis, but the problem analysis will be more comprehensive.

3.8 PROCUREMENT DOCUMENTATION

- a. The design engineer is responsible for the preparation of the procurement documentation for initial technical procurements.
- b. System Engineering will assure that the appropriate reliability requirements are included in all procurement packages.
- c. System Engineering will review all engineering procurement requests to determine the adequacy of the specified reliability requirements. Concurrence will be evidenced by signature.

3.9 COMPONENT QUALIFICATION

Components qualified for the intended use shall be selected insofar as practical. Qualification can be by:

- a. Actual testing of the component in reliability, functional, or life tests
- b. Use of Government/Industry Data Exchange Program (GIDEP) to obtain reliability, qualification test, and usage information on parts, material, and components
- c. Satisfactory previous use data at LLNL or other reliable source
- d. Where data on similar design, same materials, or same manufacturer are available, this information shall be considered.

3.10 LIMITED LIFE HARDWARE

- a. Items that are subject to operating time or cycle wearout will be identified by the design engineers along with required changeout schedules as part of the design documentation.
- b. Age control requirements will be specified in the design documentation for those items that are subject to variations or degradation with age.

3.11 DESIGN REVIEWS

- a. Reliability personnel from System Engineering will participate in design reviews to assure that the appropriate reliability requirements are implemented.
- b. Design engineers will include the FMEA and qualification testing status as part of the design review package as applicable.

4. ENGINEERING QUALITY ASSURANCE FUNCTIONS

This section describes the quality assurance functions to be performed by engineering.

4.1 QUALITY ASSURANCE REQUIREMENTS

- a. The design engineer shall establish the quality assurance requirements necessary for procurement, fabrication, inspection, testing, and pre-launch checkout as applicable in specifications, drawings, and procedures. The following quality assurance requirements will be considered as a minimum:
 - (1) Traceability requirements
 - (2) Identification of mandatory characteristics and mandatory inspection points required to verify a mandatory characteristic
 - (3) Inspection and test criteria
 - (4) Performance and/or tolerance limits
 - (5) Applicable specifications for contamination control
 - (6) Applicable process specifications, standards, and procedures

(7) Limited life items

(8) Acceptance/rejection criteria

- b. System Engineering will review the design documentation to assure that the quality assurance requirements are adequate. The DRA will be signed by System Engineering prior to design release.

4.2 PROCUREMENT DOCUMENTATION

- a. The design engineer will assure that the appropriate quality and/or inspection requirements are included in all procurement packages.
- b. System Engineering will review all procurement packages to determine the adequacy of the quality provisions and obtain other engineering concurrences as required. Concurrence will be evidenced by signature.
- c. System Engineering will review contractor's R&QA plans for adequacy in meeting the R&QA requirements and obtain other concurrences as required.

4.3 SUPPORT REQUESTS

- a. Design engineers will request inspection, as required, when preparing a request for support. When inspection is required, each characteristic recommended for inspection will be listed on the support request. If inspection is not requested, the organization providing support will provide routine inspection in accordance with their quality assurance plans.
- b. All support requests (except requests for administrative support) will be forwarded to the responsible R&QA element for review. The responsible R&QA element will determine if the quality requirements are adequate and signed.

4.4 QUALITY SURVEILLANCE

Quality surveillance is defined as the technical direction and monitoring of a contractor's quality assurance and inspection function or the quality assurance and inspection functions delegated to another agency to assure compliance with the contractual quality requirements. Engineering is responsible for the quality surveillance on all engineering contracts for construction/fabrication/installation of facilities, systems, and equipment. For fabrication/installation work being performed by the operations and maintenance (O&M) organization, the O&M organization provides the quality surveillance functions.

- a. The engineering organization responsible for the management of a construction/fabrication/installation contract is also responsible for quality surveillance of the contractor.
- b. The onsite quality surveillance functions may be accomplished as follows, depending on the available manpower and the skills required:
 - (1) MFTF personnel
 - (2) Other LLNL organizations
 - (3) Support contractors
 - (4) Architect/Engineer (A/E) contract for Title II services

In all of the above cases, engineering will monitor the surveillance activities for conformance to requirements.

- c. Offsite quality surveillance need will be included in the contract planning and execution.
- d. The general construction/fabrication/installation quality surveillance functions to be accomplished are as follows:
 - (1) Review and approval of the contractor's quality assurance plans and procedures and monitor implementation of the quality assurance program

- (2) Perform inspection of mandatory inspection points and witness contractor tests
- (3) Review contractor's quality control inspection and testing records and reports
- (4) Review shop drawings for quality assurance provisions
- (5) Monitor the contractor's review of procurement documents and control over his subcontractors
- (6) Review and monitor the contractor's receiving inspection activities
- (7) Monitor the contractor's calibration procedures, methods, and schedules
- (8) Monitor the contractor's failure and corrective action system to ensure prompt and effective action
- (9) Review the contractor's change control system and ensure that only authorized changes are incorporated
- (10) Perform scheduled and unscheduled audits and surveys of contractors' and other agencies' quality activities

5. OPERATING QUALITY ASSURANCE FUNCTIONS

(To be completed by the APMOM)

6. OPERATING SAFETY FUNCTION

(To be completed by the OSL for the APMOM)

6.1 OPERATIONAL HAZARDS ANALYSIS

(To be completed by the OSL)

APPENDIX II

INTEGRATED LOGISTICS PLAN

MTFT-8
INTEGRATED LOGISTICS SUPPORT PLAN
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 - 2.2.3 System Maintainability Analysis
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SECTION I

INTRODUCTION

1.1 PURPOSE

This plan identifies the requirements, responsibilities, ground rules, and implementation guidelines for the Mirror Fusion Test Facility (MFTF-B) project integrated logistics support (ILS) activities during the operational phase of the plasma fusion experimentation activities.

1.2 OBJECTIVES

The primary requirement of integrated logistics is to ensure maximum online availability of the MFTF-B systems and equipment in support of experimental operations.

The objectives of this plan include:

- a. Implementation and managing the integrated logistics functions necessary for proper operation of the facility as illustrated in figure 1-1
- b. Identification and analysis of all line replaceable units (LRU's) and shop replaceable units (SRU's) for scheduled or unscheduled maintenance activities
- c. Establishing the management controls and organization necessary to assure that all operational support activities are implemented effectively within the budgetary and experiment schedule constraints
- d. Assuring that standard and special system/component maintenance requirements are identified and integrated into the facility design analysis and documentation

☒ - INCLUDES NORMAL LLNL OPERATIONS SUPPORT
WHERE AVAILABLE

FIGURE 1 - 1 INTEGRATED LOGISTICS SUPPORT FUNCTIONS

- e. Defining the management policy and interfaces required between the MFTF-B Project, the MFTF-B contractor(s), the Lawrence Livermore National Laboratory (LLNL), the equipment vendors, and the consumable suppliers
- f. Assuring that Operations and Maintenance (O&M) documentation contracted for or prepared in-house is adequate, clearly defined, and consistent with the available operational support resources and capabilities
- g. Integrating of the requirements for LRU/SRU offline maintenance, calibration, repair, tooling, transportation, and storage with the existing and planned LLNL capabilities
- h. Defining the maintainability analysis and spares analysis requirements for the hardware and consumables necessary to support the experiments
- i. Eliminating all unnecessary duplication of equipment, facilities, and manpower and minimize all operational paperwork

1.3 POLICY

MFTF-B ILS policy is to:

- a. Support the experiment schedule to the maximum extent
- b. Plan and conduct hardware adjustments/replacements and preventative maintenance concurrent with operational shifts where possible
- c. Establish a simple but effective system for management, control, surveillance, and reporting of integrated logistics activities
- d. Utilize to maximum benefit the information and experience gained during similar LLNL research projects and other applicable Government projects

1.4 APPLICABILITY AND SCOPE

This plan is applicable to all MFTF-B systems, components, support equipment, and facilities.

It is applicable to all organizations having any integrated logistics responsibility in support of the MFTF-B at LLNL or at other locations such as vendor or contractor manufacturing/repair facilities.

1.5 DEFINITIONS

Following are definitions applicable to this plan:

- a. Maintenance. Actions required to retain an item in or restore it to a specified condition commensurate with design or test requirements
- b. Item. Any level of hardware assembly (such as system, element, subsystem, equipment, component, or part)
- c. Scheduled Maintenance. Any repetitive maintenance action deemed necessary to ensure functional success of equipment, including periodic servicing and replacement of time/cycle components
- d. Unscheduled Maintenance. Any maintenance activity required as a result of random failures of equipment, including restoration to a serviceable condition of a failed subsystem, end item, replacement package, or unit, component, or part
- e. Online Maintenance. Consists of scheduled and unscheduled actions, such as: inspection, cleaning, lubrication, servicing, calibration, adjustment, removal, and replacement of malfunctioned parts and assemblies (LRU's); in-place modification; in-place repair; and verification of systems, subsystems, and associated components. It is performed at the installed location of fixed items.

- f. Offline Maintenance. Consists of scheduled and unscheduled actions, such as: repairing and verifying of LRU's removed during online maintenance; replacement or repairing of SRU's; cleaning modification, calibration, alignment, adjustment, refurbishment, and manufacture of parts; and assembly of items. It is performed in fixed facilities (shops and laboratories) onsite at LLNL, at Government or commercial fixed facilities located offsite, or by dispatch of specialists with parts, materials, tools, and equipment from these facilities to the location of an item that requires this level of work.
- g. LRU. Any item capable of being removed and replaced as an integral unit from a higher indenture level system or assembly at the normal online operating location of the item. Items requiring more than two levels of access or extensive access time are normally not classified as LRU's.
- h. SRU. Any item capable of being removed and replaced as an integral unit from a free-standing assembly or subassembly in a maintenance/manufacturing shop or laboratory. Normally associated with items removed from LRU's in offline shops and labs.
- i. Source, Maintenance, and Recoverability (SMR) Code. A SMR code that indicates the most efficient and practical source or method of supply for selected repair parts; the maintenance facility assigned the installation or manufacture of the repair part; and recoverability aspects of the repair part.

SECTION II

ILS DEVELOPMENT PHASE

2.1 ILS SYSTEM

The MFTF-B Integrated Logistics Support System will be structured to provide maximum utilization of the test facilities for experiment runs with minimum maintenance downtime and resource allocation.

The development of the ILS system to support MFTF-B requirements will encompass the analyses and phased implementation of the following principal functions:

- a. Logistics engineering analysis
- b. Maintenance operations (online and offline)
- c. Operations, maintenance, and training documentation
- d. Spares provisioning
- e. Supply support operations
- f. Information management and work control
- g. Policy, requirements, and resources integration

An overview of the ILS system is illustrated in figure 2-1.

2.2 LOGISTICS ENGINEERING ANALYSIS

The key element in successful integrated logistics system planning is the accurate identification and analysis of the system hardware and maintenance resource requirements in a time frame that will permit feedback into system design, life/cycle costing, and program budget projections.

■ - INCLUDES NORMAL LLNL OPERATIONS SUPPORT WHERE AVAILABLE

FIGURE 2-1. INTEGRATED LOGISTICS SUPPORT SYSTEM OVERVIEW

The MFTF-B logistics engineering analysis will proceed as follows:

- a. System and equipment categorization and LRU identification
- b. Critical LRU maintainability analysis
- c. System maintainability analysis

2.2.1 SYSTEM CATEGORIZATION. For ILS purposes, the MFTF-B facility will be categorized and analyzed in the system approach shown in figure 2-2.

It must be noted that the clean separation of systems depicted herein is for logistics analysis purposes only and does not reflect the exact operational interfaces.

Group 1 and 2 systems are under the direct responsibility of the MFTF-B Project.

Group 3 systems have a shared responsibility between the MFTF-B Project and LLNL Facility Support.

Identification and classification of the hardware items for logistics engineering review shall correlate with the systems groups shown in figures 2-3 and 2-4.

Similarities of component types within different systems will be included in the analysis.

2.2.2 CRITICAL LRU MAINTAINABILITY ANALYSIS. A maintainability analysis will be performed on every LRU located within the operationally closed areas and on every critical or high value LRU (\$500 or more) external to the vault area.

The analysis will document the information currently available from the system/equipment manufacturers and from MFTF operating personnel on a simple checklist format as shown in figure 2-5.

ILS MAJOR SYSTEM GROUPS

FIGURE 2-2. ILS MAJOR SYSTEM GROUPS

GROUP 1 - MECHANICAL, FLUID & STRUCTURAL
ILS SYSTEM / SUB-SYSTEM DEFINITION

FIGURE 2-3. GROUP 1 SYSTEM/SUB-SYSTEMS

GROUP 2 - ELECTRICAL & ELECTRONIC
 ILS SYSTEM / SUB-SYSTEM DEFINITION

FIGURE 2-4. GROUP 2 SYSTEMS/SUB-SYSTEMS

MIRROR FUSION TEST FACILITY

LRU MAINTAINABILITY ANALYSIS CHECKLIST

ORIGINATOR _____ DATE _____

LRU NAME _____ LRU PART NO. _____

SYSTEM NAME _____ SYSTEM DESIGNATOR/WBS NO. _____

LRU NEXT HIGHER ASSY DWG NO(S). _____ WBS NO. _____

LRU PRICE \$ _____ DELIVERY TIME _____ TOTAL QTY IN SYSTEM _____

OBTAINABLE FROM: SYSTEM CONTRACTOR ☐ CONTRACTOR NAME _____

OEM ☐ OEM NAME _____ OEM P/N _____

MTBF _____ HRS PREDICTED ☐ MTTR _____ HRS PREDICTED ☐

ACTUAL ☐ ACTUAL ☐

NORMAL FAILURE MODES _____ LRU REPAIRABLE: YES ☐ NO ☐

REPAIR PARTS REQUIRED: YES ☐ NO ☐ REPAIR PARTS P/N _____ PRICE \$ _____

SOFT GOODS REQUIRED: YES ☐ NO ☐ SOFT GOODS P/N _____ PRICE \$ _____

LRU LOCATION: INTERNAL TO VAULT AREA ☐ EXTERNAL TO VAULT AREA ☐ REPLACEABLE WITH SYSTEM POWER UP: YES ☐ NO ☐

LRU CRITICALITY: MANDATORY ☐ NONMANDATORY ☐ CONTROL COMPONENT ☐ INSTRUMENTATION COMPONENT ☐

LRU SERVICING REQUIREMENTS: LUBRICATION ☐ FREQ _____ CLEANING ☐ FREQ _____

CALIBRATION ☐ FREQ _____ REFURBISH ☐ FREQ _____

ADJUSTMENT ☐ FREQ _____ OPERATE ☐ FREQ _____

LRU AGE/TIME/CYCLE/SHELF REQUIREMENTS: _____

ACCESS TO LRU REQUIRED: YES ☐ NO ☐ DIRECT ACCESS ☐ 2ND LEVEL ☐ 3RD LEVEL ☐ TIME REQUIRED _____

SAFETY CONSIDERATIONS: MAGNETIC FIELD ☐ RADIATION ☐ VOLTAGE ☐ PRESSURE ☐

TEMPERATURE ☐ WEIGHT/SIZE ☐ OXYGEN LEVEL ☐

OTHER ☐

LRU REMOVAL: TIME REQUIRED _____ REMARKS _____

LRU INSTALLATION: TIME REQUIRED _____ REMARKS _____

TOOLS/FIXTURES REQUIRED: STANDARD TOOLS ☐ SPECIAL TOOLS ☐ SPECIAL TOOLS/FIXTURES P/N _____

TORQUING REQUIRED: YES ☐ NO ☐ SHIELDING REQUIRED: YES ☐ NO ☐ MISC. _____

LRU ADJUSTMENT AFTER INSTALLATION: YES ☐ NO ☐ TIME REQUIRED _____ LRU RETEST AFTER INSTALLATION: YES ☐ NO ☐ TIME REQUIRED _____

TEST EQUIPMENT REQUIRED: STANDARD TEST EQUIPMENT ☐ SPECIAL TEST EQUIPMENT ☐ SPECIAL TEST EQUIPMENT P/N _____

LAWRENCE LIVERMORE LABORATORY

Each LRU analysis will address in particular the following considerations:

- a. LRU access and removal/installation time
- b. LRU servicing, lubrication, and time/cycle requirements
- c. Repair capability and recommended repair parts, materials, and soft goods
- d. Test/calibration equipment and tooling not currently available at LLNL

2.2.3 SYSTEM MAINTAINABILITY ANALYSIS. Integration of the individual LRU analyses with the system maintainability goals will establish the minimum online and offline maintenance requirements in support of the experiment operations. The system analysis will be documented as follows:

- a. Preliminary online maintenance matrix chart(s)
- b. Preliminary offline repair assignments and schedules
- c. Addition of repair item costs to the spares budget projection
- d. Addition of test equipment and tooling costs to the capital equipment budget protection
- e. MFTF-B manpower projections to support online and offline maintenance operations

2.3 MAINTENANCE PLANNING AND CONSTRAINTS

2.3.1 MAINTENANCE CONCEPTS. The MFTF-B operational experiment schedules require that online and offline maintenance activities be managed and integrated in a joint effort directed at maximum compliance with experiment support.

Maintenance planning will meet the primary goals outlined in the maintenance concepts shown in figures 2-6 and 2-7.

Figure 2-6. Online Maintenance Concepts

Figure 2-7. Offline Maintenance Concepts

The System Maintainability Analysis will provide the prime data source for integrated maintenance planning.

2.3.2 GENERAL CONSTRAINTS. The MFTF-B maintenance plan will take into account:

- a. Existing onsite maintenance capability. Use of existing and/or modified resources will be emphasized.
- b. Limited manpower/equipment resources and spares
- c. LRU and SRU changes due to experiment results or reconfigurations
- d. Average turnaround time for repairable LRU's to be recycled will be 15 days for MFTF-B project repair, 30 days for assigned LLNL lab repair, and 90 days (including shipping) for offsite repair.
- e. Incremental maintenance funding and equipment acquisition during installation and test phase to insure full capability by the operational date

2.3.3 ONLINE MAINTENANCE. Online maintenance planning will cover three basic areas of operations:

- a. Preventive/corrective maintenance
- b. LRU replacement
- c. Equipment reconfiguration/installation

2.3.3.1 Preventive/Corrective Maintenance. Preventive/corrective maintenance for MFTF-B systems will consist of all scheduled or unscheduled activities required to maintain operational equipment in ready condition for experiment support, including in-place calibrations, adjustments, or alignments.

2.3.3.2 LRU Replacement. LRU replacement will include replacement for (1) preventive/corrective maintenance reason such as lab calibrations, filter replacements, time/cycle/age changeout or (2) hard failure or suspect failure.

2.3.3.3 Equipment Reconfiguration/Installation. Equipment reconfiguration/installation will consist of those activities associated with the reconfiguration of the experiment system(s) or the installation of new or modified equipment to support new experiment requirements.

2.3.3.4 Online Experiment Support Analysis. The minimum online maintenance requirements defined in the system maintainability analysis will be integrated with the total experiment support schedules and will include evaluation of:

- a. Personnel requirements and safety restrictions
- b. Environment/cleanliness requirements
- c. Special support (e.g., cranes, forklifts, etc.)
- d. Verification, alignment, and retest times

2.3.3.5 Online Matrix Chart. The preliminary online maintenance matrix will be finalized by including estimates for failed LRU replacement activities, estimates for equipment reconfiguration activities, and the results of the above online experiment support analysis.

2.3.3.6 Online Scheduling. The online maintenance matrix will be utilized for management visibility and maintenance scheduling control.

The matrix will be a dynamic control vehicle and will require inputs from each of the affected system team lead technicians on a continuing basis to reflect actual operating experience. The matrix will be formally revised monthly during the first 4 months of system operation and quarterly (as required) thereafter.

2.3.3.7 New/Modified Design Impact. Impact on online maintenance operations will be evaluated during the analysis of any requested new design effort.

2.3.4 OFFLINE MAINTENANCE. Offline maintenance planning will cover two basic areas of operations:

- a. LRU/SRI maintenance flow
- b. Shop/Lab (S/L) process control

2.3.4.1 LRU/SRU Maintenance Flow. Removal of an LRU from operation and induction into the offline cycle initiates a maintenance flow, completed upon return of a repaired/refurbished LRU to inventory. LRU flow will be controlled by the system team responsible for the particular LRU. Status and tracking of the LRU flow will be maintained by the MFTF-B Supply and Distribution Center (S&DC) for system team and management visibility.

2.3.4.1.1 Scheduled Offline Maintenance Flow. Basic flow necessary to perform offline maintenance for an LRU/SRU removed for scheduled maintenance is shown in figure 2-8. An LRU removed during online maintenance is routed per system team leader direction. The LRU may be routed directly to a prime S/L for repair or refurbishment or to the MFTF-B S&DC for shipping to an offsite agency. The team leader will utilize the LLNL transportation services as required for hardware handling and delivery. In all cases, the S&DC shall be notified of the LRU status and schedule. The work order (see figure 2-9) accompanying the LRU will be used by the S/L work control for planning, scheduling, and production control information.

The LRU initially will be scheduled for maintenance or service to the lowest part level required. An inspection will be conducted to determine the extent of wear and tear for time/cycle components. Any parts, components, or SRU's requiring maintenance or service will be removed from the LRU in accordance with applicable maintenance instructions and documentation. If, during testing, a problem or anomaly is discovered, a problem report will be written and dispositioned and a copy attached to the work order [see Reliability, Quality Assurance, and Safety Plan, appendix I, figure 2(c)].

Upon completion of testing, required maintenance or service will be identified and documented. This will include any work required on SRU's or other removed parts. Parts or SRU's that require cleaning or other service exceeding the capability of the prime S/L will be sent to a designated S/L accompanied by necessary routing and disposition instructions. Once support work is completed, SRU's either can be returned via S&DC to stock or sent to the proper S/L for reassembly into serviceable LRU's.

Figure 2-8. Scheduled Removal Line Replaceable Unit Maintenance Flow

MFTF-B
O&M ...
WORK ORDER

		DATE _____	
PART NO. _____	TITLE _____	WORK ORDER NO. _____	
SYSTEM _____	WBS NO. _____	REQUESTOR _____	
JOB _____	CONTACT _____		
DUE DATE _____	EST. HRS. _____	DRAWING/PROCEDURE NO. _____	
HARDWARE FAILURE - ACTUAL ☐ SUSPECTED ☐			
JOB DESCRIPTION: & ROUTING INSTRUCTIONS:			

RETURN TO REQUESTOR ☐			
RETURN TO S&DC ☐		AUTHORIZED BY: _____	
DO NOT WRITE BELOW LINE, SHOP USE			

ASSIGNED TO _____		JOB NO. _____	
ESTIMATE _____	Start _____	How, s _____	Comp _____
DATE COMP _____	QA _____	DATE _____	
NOTES _____			

Accepted LRU's/SRU's are returned to the requestor or turned in to the S&DC for receipt, accountability, and routing to the appropriate storage area for that item. Entries of completion and inspection will be made on the work order and forwarded with the LRU.

As shown in figure 2-8, a removed LRU may be designated to be sent offsite. LRU's in this category will be transported to the S&DC for packaging and shipping. If a problem, failure, or other anomaly is discovered during testing at an offsite location, a problem report will be written and forwarded to MFTF. Once the LRU is repaired and shipped back to central supply, it can be routed either to a designated S/L for validation or returned directly to storage, depending on acceptance requirements.

Similarly, LRU's or SRU's in storage periodically can be sent to a designated S/L for reverification per shelf and storage life requirements and then returned to storage. Finally, if a removed LRU is coded as nonrepairable, it will be surplused or scrapped after turn-in to the S&DC. Any SRU's removed from the LRU during the maintenance cycle that are coded as nonrepairable, likewise will be surplused or scrapped.

2.3.4.1.2 *Unscheduled Offline Maintenance Flow.* Basic functions necessary to perform offline maintenance for an unscheduled LRU removal are shown in figure 2-10. When a malfunction or anomaly is isolated to an LRU, online maintenance will remove and replace and generate the appropriate problem report on the MFTF-B O&M work order.

With prior approval from Engineering, the LRU can be sent directly to Failure Analysis, to offsite through S&DC, or to its prime S/L for test and separation. It would depend upon the nature of the fault and the system team leader's routing instructions. The S/L responsible for the analysis can amend or require specific routing of the LRU or its SRU's when necessary for the determination and explanation of the cause of malfunction or anomaly.

After the LRU/SRU has undergone necessary evaluation and analysis to close out the problem report to the satisfaction of the system team leader initiating the

Figure 2-10. Unscheduled Removal Line Replaceable Unit Flow

work order, the LRU/SRU will be routed to the prime S/L designated for normal item maintenance. Upon completion of repairs, the item(s) will be returned to stock. If an LRU/SRU has been condemned during the evaluation process, it will be surplussed or scrapped.

2.3.4.2 S/L Process Control. The nature of the experimental equipment and the high usage demand of the facility indicate that a significant number of LRU's will be processed through the repair/refurbishment cycle.

The flow of LRU's through the existing LLNL shops and labs will be managed by the existing process controls within those facilities.

The flow of LRU's through the MFTF-B shops requires that internal MFTF-B shop process controls be established to maintain high product quality and to insure that all work functions are considered in project support scheduling.

The process controls will cover the normal sequential work activity that must occur within the shops. Typical work activity shop action items are shown in figure 2-11. The sequence may be altered to provide the correct path for the given requirements of any LRU.

At each action item, the shop manager will insure compliance with the O&M Manual procedural requirements and the MFTF-B documentation requirements for the given LRU.

It must be noted that differing paths through the system will occur when:

- a. An LRU is sent successively to several different supporting shops.
- b. Different SRU's removed from one LRU are sent to different supporting shops.
- c. An LRU/SRU is recycled within an S/L.

Figure 2-11. Typical Shop Work Activity Flow

Preplanning of these paths is necessary to support the anticipated mix of LRU types. Periodic updating of the paths and time factors will occur as experience is accumulated.

2.4 OPERATIONS, MAINTENANCE, AND TRAINING DOCUMENTATION REQUIREMENTS

Safe and efficient operation of the MFTF-B experiment facility will require clear and concise O&M documentation and necessary certification training (where required).

The specific requirements will be determined after completion of the following development steps:

- a. Define the minimum types of documentation required for adequate O&M support for each system and LRU item. Analyze each system against the following checklist:
 - (1) End-to-end schematics
 - (2) Indentured drawing list or drawing tree
 - (3) LRU parts list and illustrated parts breakdown (IPB)
 - (4) O&M requirements and specifications (OMRS)
 - (5) O&M procedures
 - (6) Installation drawings/instructions
 - (7) Safety information
- b. Assure that all procured systems and equipment have contracted requirements for O&M manuals and/or installation drawings/operating procedures.
- c. Verify or establish schedules for O&M documentation preparation on systems or equipment manufactured in-house at LLNL.
- d. Schedule and prepare total integrated system schematics including instrumentation, diagnostics, and control for the major mechanical and electrical systems.

- e. Schedule and prepare the *minimum* OMRS that must be met by all online, operating experiment systems. See figure 2-12 for sample format.
- f. Determine those systems and equipment that will require formal procedures for operations and maintenance tasks.

NOTE

Each OMRS requirement must be verified at least once by a software program or a hardcopy procedure.

- g. Schedule and prepare (as required) procedures or maintenance charts for the following repetitive tasks:

- (1) Installation/removal
- (2) Inspection/verification
- (3) Test/calibration
- (4) Servicing/adjustment/alignment
- (5) Cleaning/repair

NOTE

Manufacturer's or vendor's data will be utilized to the maximum extent possible.

- h. Identify the training and certification record requirements for O&M personnel. Identify any unique system/equipment safety requirements.

NOTE

On-the-job (OJT) training is preferred to classroom or audiovisual techniques.

- i. Schedule and prepare documentation and/or training equipment as required for any system item that requires formal training techniques.
- j. Determine the documentation records required for both real time technical support and management/quality/history purposes.

MFTF-B OPERATION AND MAINTENANCE REQUIREMENTS AND SPECIFICATIONS

SYSTEM		SYSTEM DESIGNATOR / WDS NO.		OMRS DOCUMENT NO.	REVISION
SUBSYSTEM / ITEM		ITEM PART NO.		LOCATION / BLDG. NO.	
REQUIREMENT NO.	REQUIREMENT DESCRIPTION	MEASUREMENT OR COMMAND NO.	SPECIFICATION	INTERVAL/CONSTRAINTS/REMARKS	

FIGURE 2-12.

Identify documentation record requirements and data storage and retrieval requirements in the following categories:

- (1) Inspection - receiving, installation, or S/L
- (2) Servicing/maintenance
- (3) Test/calibration
- (4) Rework/reidentification
- (5) Fault isolation/failure analysis
- (6) Safety records [MFTF-B, LLNL, and Occupational Safety and Health Administration (OSHA)]
- (7) Provisioning and S&DC records

2.5 SPARES PROVISIONING AND SUPPLY OPERATIONS REQUIREMENTS

2.5.1 SPARES PROVISIONING METHODOLOGY. Spares provisioning to support MFTF-B operations will require utilization of the standard, basic provisioning methodology:

- a. Hardware identification/costing
- b. Budget authorization/funding commitment
- c. Spares procurement activities

However, implementation of the above standard processes prior to the experiment operational phase must of necessity rely on assumptions and projections in the many areas of new design.

2.5.1.1 Spares Level Philosophy. A minimum/maximum spares level philosophy will be established by the Associate Program Manager for Engineering (APME) and concurred with by the Associate Program Manager for Operations and Maintenance (APMOM).

The spares level philosophy will stress minimum emphasis on complete LRU assembly stocking and maximum emphasis on LRU/SRU repair parts stocking. Cost factors and repair time vs procurement time factors will be an integral part of the philosophy.

Stocking of consumables to support more than a 6-month demand will have to be justified on the basis of long term price and deliverability factors.

2.5.1.2 Spares Provisioning Phasing. Spares provisioning to support MFTF-B will be accomplished in two phases:

- a. Initial operational spares provisioning
- b. Sustaining annual spares provisioning

The initial operational spares will consist primarily of the required complement of complete LRU assemblies necessary to support real time replacements during the experiment run periods.

Procurement action for the initial spares should take place no later than the third quarter of fiscal year (FY) 84.

The sustaining annual spares will consist primarily of the required complement of LRU/SRU repair parts necessary to sustain the onsite LRU assemblies.

Procurement action for the annual spares shall take place no later than the second quarter of FY 85 and each subsequent year thereafter.

2.5.1.3 Hardware Identification and Costing. Hardware identification and costing will accumulate all available data and data projections from the following sources:

- a. Critical LRU maintainability analysis
- b. Equipment mean time between failure (MTBF) data/estimates
- c. Spare parts lists
- d. LLNL experience factors
- e. Rome Air Development Command (RADC) standards for new equipment
- f. Projected consumables usage rates

NOTE

Extensive preliminary estimates will have to be utilized during the preoperational phase due to the lack of specific information regarding hardware identification/costs. For example, the deliverable spare parts list for the cryogenic and external vacuum system is not due until June 30, 1984.

2.5.1.4 Spare Costs Trade Studies. A spares cost analysis will be prepared to document the trade studies performed prior to final spares procurement recommendations. The analysis report shall include, as a minimum, the information outlined in figure 2-13.

NOTE

If repair parts are recommended in lieu of complete LRU assemblies for LRU items with cost ratios less than 1.0, written justification will be required.

2.5.1.5 Existing LLNL Piece Part Provisioning. Evaluation of the existing LLNL standard stock supply of piece parts and attaching hardware will be a prime factor in any repair parts procurement recommendation.

2.5.1.6 Provisioning Conferences. A provisioning conference will be held for each group 1 and group 2 system shown in figure 2-2, no later than the second quarter of FY 84. The agenda items will include:

- a. Total system costs per fiscal year
- b. Long lead time items list
- c. High value item analysis
- d. Make or buy decisions
- e. Repair onsite versus offsite
- f. Schedules for spares/repair parts/bulk items/consumables

2.5.1.7 Provisioning Recommendation Authorization. The APMOM will approve the provisioning conference reports and submit them to the APME and the Project Manager for concurrence.

M113-B SPARES COST ANALYSIS											
SPARES ASSY. P/N	TITLE	SYSTEM	TOTAL USAGE QTY.	RECOMMENDED ASSY. SPARES LEVEL		ASSY. PURCHASE COST	PURCHASE TIME	ASSY. REPAIR PARTS COST	ASSY. REPAIR LABOR COSTS	REPAIR TIME	COST RATIO: ASSY. PURCHASE COST ASSY. REPAIR COST
				MIN.	MAX.						

Figure 2-13.

2.5.1.8 Spares Procurement Activities. Existing LLNL S&DC practices, policies, and forms (e.g., LL4969, LL4869, etc.) will be utilized to obtain the spares and material required to support the MFTF-B operations. Where required, MFTF-B will procure items directly via purchase order, supply contract, or time and material agreement. Hardware procurement via telecon will require APMOM authorization.

NOTE

To assure validity, the following paragraphs can only be prepared as the ILS development phase is being implemented. Feedback and flexibility are necessary for optimization prior to the ILS (not MFTF-B) being fully operational.

2.6 ILS Information Management and Work Control Requirements

2.7 Management Policy and Organization

III. ILS OPERATIONAL PHASE

3.1 Experiment, Quality and Safety Integration

3.2 Operations, Maintenance and Training Documentation Control

3.3 Maintenance Operations and Trend Analysis

3.3.1 Online

3.3.2 Offline

3.4 Supply Support and Budgets

3.5 Information and Work Control System