~~SECRET~~ SPECIAL HANDLING

ELECTROMAGNETIC COMPATIBILITY CONTROL PLAN COMPOSITE SYSTEM

SAFSL EXHIBIT 30035

FOR THE

MANNED ORBITING LABORATORY PROGRAM

6 JUNE 1968

~~SECRET~~ SPECIAL HANDLING

SAFSL EXHIBIT 30035

The undersigned has reviewed the document and understands the contents to the extent necessary to scope subsequent proposals.

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Section 1

INTRODUCTION

1.1 SCOPE

The McDonnell-Douglas Corporation (MDC) and the Martin-Marietta Corporation (MMC) shall implement this control plan for the MOL composite system. Henceforth, MDC in their role of implementing the OV composite Electromagnetic Compatibility (EMC) program will be referred to as the OV EMC Integrator in this document. Similarly, MMC shall be referred to as the FV EMC Integrator.

This plan delineates the methods that shall be used by the EMC Integrator to ensure the electromagnetic compatibility of the combined system segments in a composite MOL System. All system segments must first have been proven to be electromagnetically compatible as individual entities. The following EMC Control Plans that apply to each MOL system segment are unconnected, but are supporting documents to this composite system plan:

SAFSL 12006 Gemini B Segment Electromagnetic Compatibility Control Plan

SAFSL 21005 Laboratory Vehicle Electromagnetic Compatibility Control Plan

SAFSL 24005 General Electric Company Management Plans for Electromagnetic Interference Control

SSD-CR-65-334 Electromagnetic Compatibility Control Plan, Titan IIIM System.

F-012094RH MOL/DORIAN Program EMC Control Plan

However, system degment design or procedural deficiencies which could jeopardize the electromagnetic compatibility of the areas covered by this plan are directly within the control of this plan.

This plan is concerned with the following:

a. The system segment EMC Design Control Plans and their relationship to the composite system.

b. The EMC verification of the flight vehicle and its associated Aerospace Ground Equipment (AGE).

c. The interface of ambient conducted and radiated electromagnetic environment with the Flight Vehicle.

d. EMC analysis of the MOL composite system.

All deliverable data and/or documentation specified in this exhibit shall be in accordance with the respective Contractor's CDRL (DD 1423 or equivalent) as detailed by Forms 9.

Section 2

APPLICABLE DOCUMENTS

P 2.1 GOVERNMENT

The following documents are specifications governing Electromagnetic Interference and Compatibility for the composite MOL System to extent specified herein.

SAFSL Exhibit 30005	Electromagnetic Compatibility Requirements for Manned Spacecraft, General Specifications for (6 June 1968)
MIL-B-5087B (ASG)	Bonding, Electrical, and Lightning Projection for Aerospace Systems
AFWTRM 127-1	Air Force Western Test Range Safety Manual (25 February 1966)
SAFSL Exhibit 30006	General Specifications for Wiring Harness in Manned Spacecraft (6 June 1968)
IFS-MOL-100001	Interface Control Exhibit
SAFSL Exhibit 20023	MOL VAFB Launch Operations Requirements (6 June 1968)
SAFSL Exhibit 30060	Manned Orbiting Laboratories (MOL) Explosive Ordnance System Requirements (6 June 1968)

P 2.2 CONTRACTOR

Each associate contractor or agency has prepared additional documents which modify, expand, and clarify the intent or direction of the above Government documents, as necessary, to be consistent with their specific MOL System segment and contract direction. These associate contractor/agency documents support this composite control plan at the system segment level, but are not part of this plan. The only valid requirements in these documents are those consistent with SAFSL Exhibit 30005 plus deviations granted to the specific contractor. In the event there are inconsistencies between the various documents for the different system segments (possibly due to granting different deviations), the EMC Control Board will resolve these problems and initiate appropriate action through the MOL SPO. The following subsections list the specific MOL System segment, the responsible associate contractor or agency, and supporting documents.

2.2.1 Gemini B Vehicle System Segment

McDonnell Aircraft Corp.

SAFSL Exhibit 12006	- Gemini B Segment Electromagnetic Compatibility Control
Data Item 14T(U)T-205	- Production Spacecraft Test Plan

2.2.2 Laboratory Vehicle System Segment

Douglas Aircraft Company

SAFSL Exhibit 21005	- Laboratory Vehicle Electromagnetic Compatibility Control Plan
SAFSL Exhibit 21008	- Ground Test Plan

2.2.3 Mission Payload System Segment

General Electric Company

SAFSL Exhibit 24005	- General Electric Company Management Plans for Electromagnetic Interference Control
MOL SPO approved	- EMC Test Plan
MOL SPO approved	- Ground Test Plan

2.2.4 Titan IIIM System Segment

Titan III-M SPO

SSD-CR-65-334	- Electromagnetic Compatibility Control Plan, Titan IIIM System
SSD-CR-65-275	- System Test Plan, Titan IIIM System Volume VII, Electromagnetic Compatibility (EMC) Test Plan

2.2.5 Photographic System Segment

F-012094RH	MOL/DORIAN - Program EMC Control Plan
MOL SPO approved	Final EMC Test Plan for the MOL/DORIAN System.

SECTION 3

RESPONSIBILITIES

P 3.1 EMC CONTROL BOARD

The EMC Control Board has been established to direct the development of the MOL System for electromagnetic compatibility. The charter of the EMC Control Board is given in Appendix I of this document.

T 3.2. MOL INTEGRATION TESTING

The OV EMC Integrator shall publish and maintain the OV composite system test plan and shall direct the overall composite testing. The FV EMC Integrator shall publish and maintain the FV composite system plan and shall direct the overall FV composite testing. Each of the associate contractors for the system segments shall provide support (personnel and equipment) to perform the tests and record the data for their own system segment. The details of the support shall be specified in segment EMC test plans. The OV EMC Integrator, with the assistance of the associate contractor, shall assemble the data and prepare the EMC Test Report for the OV composite system.

T 3.3 DOCUMENT REVIEW

The OV EMC Integrator shall review all associate contractor EMC Control Plans and EMC Test Plans, system segment level contract end item (CEI) specifications, or equivalent facility contract end item (FCEI) specifications, or equivalent, interface control specifications (IFS), and interface control drawings (ICD) that relate to electrical and electronic compatibility. If the documentation indicates an actual or impending electromagnetic incompatibility, the OV EMC Integrator working through the appropriate interface control working group (ICWG), shall request appropriate changes through the EMC Control Board. If an ICWG does not exist, the OV EMC Integrator shall request that the MOL SPO convene a sub-group meeting of the EMC Control Board, attended by the affected associate contractors or agencies, to review a problem and recommend a solution. The FV EMC Integrator with the assistance of the associate contractors shall assemble the data and prepare the EMC test report for the FV composite system.

3.4 CONTRACTOR RESPONSIBILITY

T 3.4.1 Associate Contractor Responsibility

The design and demonstration of the electromagnetic compatibility of the various MOL system segments is the basic responsibility of the system segment associate contractors and will be described in the documents listed in Subsection 2.2. The associate contractors and agencies shall provide the EMC Integrator with EMC Control Plan, EMC Test Plan, technical analyses, and data on its system segment and its interface characteristics and with other system segments in sufficient detail so that the composite system can be analyzed. If the requests for analysis, tests, data, etc., are outside the scope of the agency's responsibility or associate contractor's contract, resolution shall be obtained through the EMC Control Board by action of the appropriate contracting office. Each associate contractor or agency shall designate EMC point of contact for this support of the EMC Integrator.

P 3.4.2 Subcontractor Responsibility

Subcontractor EMC activities are a part of the agency or associate contractor's sphere of responsibility, and all contact with subcontractors will be through the associate contractor or agency unless otherwise directed by the associate contractor/agency.

T 3.4.3 Segment Integration Requirements

In some areas, associate contractors and agencies are also integrators, i.e. the integration of the T-IIIM booster vehicle, the integration of the mission payload system segment and laboratory module into the Laboratory Vehicle system segment, and the integration of the Laboratory Vehicle with the Gemini B to form the Orbiting Vehicle. Where associate contractors and agencies are integrators, they are responsible for ensuring that the electromagnetic interface has been correctly identified, compatibility requirements have been fully specified, and practical and adequate quality assurance methods have been established for their task; they are also responsible for identifying their electromagnetic compatibility interface with other units within the MOL composite system through interface control documentation; i.e., interface specifications (IFS), and interface control drawings (ICD).

T 3.5 VAFB EMC TESTING

EMC testing at VAFB shall be conducted in accordance with the provisions specified in SAFSL Exhibit 20023, VAFB Launch Operations Requirements.

The 6595th Aerospace Test Wing is the operating arm of the SO at VAFB. All EMC testing at the launch site shall be performed under the direction of the 6595th Aerospace Test Wing.

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RESPONSIBILITIES

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The OV EMC Integrator shall publish and maintain the OV composite system test plan and shall direct the overall composite testing. The FV EMC integrator shall publish and maintain the FV composite system plan and shall direct the overall FV composite testing. Each of the associate contractos for the system segments shall provide support (personnel and equipment) to perform the tests and record the data for their own system segment. The details of the support shall be specified in segment EMC test plans. The OV EMC Integrator, with the assistance of the associate contractor, shall assemble the data and prepare the EMC Test Report for the OV composite system.

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The OV EMC Integrator shall review all associate contractor EMC Control Plans and EMC Test Plans, system segment level contract end item (CEI) specifications, or equivalent facility contract end item (FCEI) specifications, or equivalent, interface control specifications (IFS), and interface control drawings (ICD) that relate to electrical and electronic compatibility. If the documentation indicates an actual or impending electromagnetic incompatibility, the OV EMC Integrator working through the appropriate interface control working group, (ICWG), shall request appropriate changes through the EMC Control Board. If an ICWG does not exist, the OV EMC Integrator shall request that the MOL SPO convene a sub-group meeting of the EMC Control Board, attended by the affected associate contractors or agencies, to review a problem and recommend a solution. The FV EMC Integrator with the assistance of the associate contractors shall assemble the data and prepare the EMC Test Report for the FV composite system.

T 3.4 CONTRACTOR RESPONSIBILITY

3.4.1 Associate Contractor Responsibility

The design and demonstration of the electromagnetic compatibility of the various MOL system segments is the basic responsibility of the system segment associate contractors and will be described in the documents listed in Subsection 2.2. The associate contractors and agencies shall provide the EMC Integrator with EMC Control Plan, EMC Test Plan, technical analyses, and data on its system segment and its interface characteristics with other system segments

in sufficient detail so that the composite system can be analyzed. If the requests for analysis, tests, data, etc., are outside the scope of the agency's responsibility or associate contractor's contract, resolution shall be obtained through the EMC Control Board by action of the appropriate contracting office. Each associate contractor or agency shall designate EMC point of contact for this support of the EMC Integrator.

P 3.4.2 Subcontractor Responsibility

Subcontractor EMC activities are a part of the agency or associate contractor's sphere of responsibility, and all contact with subcontractors will be through the associate contractor or agency unless otherwise directed by the associate contractor/agency.

Section 4

EMC CONTROL PROGRAM

P The Composite Systems EMC Control Program is implemented to ensure adequacy of design for EMC and to verify this compatibility by demonstrating an Electromagnetic Interference Safety Margin (EMISM) in accordance with SAFSL Exhibit 30005 requirements.

P 4.1 IMPLEMENTATION OF EMC REQUIREMENTS

Composite Systems EMC relies on adequate implementation of EMC requirements at the system segment level, control of the System Segment's electromagnetic interfaces (conducted and radiated), and incorporation of additional corrective design action based on the composite system external electromagnetic environment.

P 4.1.1 System Segment

The contractual EMC requirments invoked on each Associate Contractor are implemented as described in the respective EMC Control Plans. This will assure that each System Segment will be compatible with itself and reasonable assurance that compatibility can be achieved at the Composite System Level.

P 4.1.2 System Segment Interfaces

Program cost considerations presently allow the use of commercial, off-the-shelf or existing hardware and/or modified versions thereof. This precludes 100% compliance with the EMC requirements; therefore, System Segment Interfaces will require special attention to assure compatibility under these circumstances.

EMC requirements will be implemented through IFS's and ICD's by incorporating specific requirements in all System Segment Interface documents. Resolution of conflicts in interface requirements will be accomplished per the procedures specified in IFS-MOL-100001 and/or through the EMC Control Board.

T 4.1.3 Electromagnetic Environment

The OV EMC Integrator shall evaluate the Composite System external electromagnetic environment as specified in Paragraph 4.2.2 and affected Associate Contractors shall be informed of potential problems. Where necessary, further analysis shall be conducted by the affected contractor or jointly by affected contractors and corrective action shall be taken. Contractual procedures shall be utilized for followup action to modify existing requirements or to add new requirements. Where System Segment Interfaces are affected, the procedures specified in MOL-IFS-100001 will be followed. If the problem cannot be resolved between the contractors, it shall be presented to the EMC Control Board for resolution.

4.2 EMC CONTROL METHODS

T 4.2.1 Conducted Signal Control

The conducted compatibility of interfacing system segments is ensured when the system segments are individually compatible and when the conducted interface does not change this compatibility. Because the interface involves two or more contractors, the possibility of invalidating the basic compatibility of the individual system segments exists. The interfacing contractors shall mutually explore, identify, and take applicable action to eliminate all areas of potential incompatibility to ensure the probability of achieving successful integration.

The following control methods shall be used for conducted interference to increase the probability of a compatible integration.

-AVE 4.2.1.1 Interface Circuit Isolation

a. Direct conducting paths between sensitive interfacing circuits shall be avoided wherever practicable.

b. Power circuits shall originate and return to the same side of the interface.

c. Power, instrumentation, and control signals shall not share common conductors; currents of two or more classes shall not flow in the same conductor.

d. Common conductors shall not be used for two or more power circuits, two or more instrumentation circuits, or two or more control circuits, unless the compatibility of the shared circuits can be established before the system segments are integrated.

e. Wire shield continuity and shield grounding requirements must consider the complete circuit as an entity; the interface shall preserve this consideration.

f. The isolation of wires into categories for the purpose of creating wire bundles or harnesses shall be compatible on both sides of the interface.

-AVE 4.2.1.2 Interface Electrical Bonding

The structural interface shall be electrically bonded to the requirements of MIL-B-5087, Class R bonding (rf potentials); flat bonding straps are permitted.

-AVE 4.2.1.3 Interfacing Circuit Compatibility

For interconnecting circuitry, the following test and analysis requirements shall apply and shall be accomplished at a systems segment level prior to acceptance at this level:

a. Where the interfacing circuits are classified as susceptible and

b. Receivers:

(1) Suprious response characteristics for input levels up to and including one millivolt.

(2) Oscillator emission spectrum characteristics involving a determination of power versus frequency from 14 KHz to 10 GHz as the receiver is operated.

Requirements

Equipment of the composite system segment, which transmits or receives radiated RF energy shall have its spectrum signature measured. Each associate contractor or agency is responsible for the acquisition, preliminary analysis, and compatibility of the spectrum signature of the equipment in its system segment. Data pertaining to the individual equipments and the results of preliminary system segment spectrum compatibility analysis shall be transmitted to OV EMC Integrator for composite system specturm signal analysis. Schedules for submittal of associate contractor or agency data shall be established by the OV EMC Integrator with concurrence of the associate contractors and agencies. Schedule for submittal of the composite system spectrum data shall be established by the OV EMC Integrator and the MOL SPO. Any disagreements will be submitted to the EMC Control Board for resolution.

Use of Nonoperational Antennas

Wherever technically practicable, the antenna system or dummy antenna used during spectrum signature measurements shall have the same characteristics as the operational antenna system to realistically present the fundamental and off-frequency impedance characteristics. The off-frequency antenna characteristics are of great importance since they usually differ greatly from the primary frequency characteristics. The load impedance, in turn, can greatly affect the spurious behavior of some electronic equipment. Where test antennas differ from the system antenna, a variation will be submitted with the test plan for approval by the EMC Control Board.

-AVE 4.2.3 Electro-Explosive Devices and Firing Circuits

For EMC, all electro-explosive devices (EED) and firing circuits shall meet the applicable requirements of SAFSL Exhibit 30005, SAFSL Exhibit 30060, and AFWTRM 127-1.

The electromagnetic compatibility of the firing circuits for the EED within each system segment shall have been ascertained on each system segment prior to MOL Composite System integration. Where EED firing circuits pass through the interface between system segments, they shall be controlled by the ICD and IFS.

the susceptibility limits of the interconnected equipment are not known or are not measured as a specification requirement, the unknown data shall be obtained for the frequency limits of SAFSL Exhibit 30005 or the limits of susceptibility. Malfunction threshold data shall exist and the EMISM shall be as specified in SAFSL Exhibit 30005.

b. Where one side of an interfacing circuit is classified as susceptible and the other side is classified as a generator of interference and both sides of the interface are controlled by different specification limits, the interfacing contractors shall take applicable action to achieve compatibility.

c. For the conditions of (b), where neither side or only one side of the interface has available test data, tests or analyses shall be conducted to determine interference characteristics, after which the criteria of (b) shall apply.

d. Where both sides of the interface are classified as interference generators, the interface circuits must not produce a level of interference which would degrade the EMISM of any critical point.

e. Where both sides of the interface may be classified as interference generators and neither side, or only one side, of the interface has data available, tests shall be conducted to determine the interference characteristics. The criteria of (d) then shall apply.

The above criteria must be used with discretion. Wherever detailed analysis of a circuit or subsystem can show that the level of interference existing on interfacing wire will not affect the operation of the circuit, subsystem, or adjacent interface circuits, tests may not be necessary. All circuits and subsystems, where analyses are to replace tests, must be identified in the individual EMC test plans and require MOL SPO approval.

The requirements of this paragraph shall be met in the following manner:

All segment interfacing circuits shall be examined for EMI susceptibility and those identified as susceptible shall have the maximum allowable EMI limits specified in the appropriate Interface Document. The definition of maximum allowable EMI limit is that amount of EMI which both ends of the interfacing circuit can tolerate without performance degradation of the equipments or systems involved. This maximum allowable EMI shall be considered separately but may be within or outside signal tolerance agreements depending on the selected method of documentation.

P 4.2.2 Radiated Signal Control

The interface between Flight Vehicle subsystems that is used for transmitting or receiving radiation, and between these subsystems and nearby AGE and

range communication and tracking systems, can have a profound influence on their proper operation. For this reason, the fundamental operating frequencies and the spurious signal response or generation of radiation systems must be carefully controlled by judicious frequency management, strict conservation of spectrum bandwidths, control of all generated signals, and harmonic sideband control.

4.2.2.1 Frequency Management

The primary frequencies of all vehicle and launch related transmitting and receiving equipment shall be coordinated with the OV EMC Integrator. Frequency allocations shall be requested from the MOL SPO by the associate contractor or agency.

Frequencies of Existing Equipment

Compatibility of these predetermined frequencies shall be analyzed by the EMC Integrator and changes recommended where necessary.

New Frequency Requirements

Where specific frequencies remain to be assigned, the associate contractor or agency shall coordinate the request with the OV EMC Integrator. The OV EMC Integrator shall determine the impact of this frequency request on the Composite MOL System. The associate contractor or agency shall work closely with the OV EMC Integrator to select the frequency on the basis of optimum utilization of the spectrum, maximum effectiveness for the mission, and minimum interference to other subsystems, equipment, and services. The frequency request shall be made by the associate contractor or agency with the concurrence of the OV EMC Integrator to the MOL SPO.

4.2.2.2 Spectrum Signature

Definition

Spectrum signature is defined to be the following characteristics of radiating transmitter and receiving systems where a system includes the RF unit (transmitter or receiver) and its transmission components (cable/waveguide and circulator), with antenna or dummy load.

a. Transmitters:

(1) Emission spectrum characteristics involving a determination of power versus frequency from 14 KHz to 10 GHz as the transmitter is operated (key down).

(2) Intermodulation products where two or more transmitters operate into a single transmission system.

Section 5

QUALITY ASSURANCE

P Quality assurance provisions for composite system electromagnetic compatibility tests shall be as specified here and within the system segment electromagnetic compatibility test plans of the associate contractors or agency.

P 5.1 INTERFACE QUALITY ASSURANCE

The methods and criteria used to demonstrate interface compatibility shall be determined during the design pahse and become a part of interface documentation.

T 5.1.1 Responsibilities

If, during the course of integation testing, problems develop across interface areas, the EMC Integrators, in cooperation with affected associate contractors and agencies shall determine the gross cause of the problem and determine the associate contractor(s) or agency(s) responsible for the solution. Recommendation will be made by the EMC Integrators to the MOL SPO for implementation of a solution.

T 5.1.2 Test Measurements

Wherever practical, measurements which must be made to determine compatibility at the segment interface shall be made without physically or electrically disturbing the integrity of the interface. For example, the power quality delivered across an interface should be measured at the power bus rather than by inserting a breakout connector at the interface. Likewise, the effects of radiated interference or susceptibility shall be measured at critical test points within a subsystem rather than attempting a measurement of the interference at a physical interface.

T 5.2 EMC TEST PLANS

The detailed electromagnetic compatibility test plans for each applicable flight shall be in accordance with electromagnetic compatibility test plan for composite and segment EMC tests and shall be submitted in accordance with CDRL. The EMC test plans shall be submitted to the MOL SPO for approval prior to testing. Implementation of the various system segments and their interfaces to effect a compatible MOL integrated system.

T 5.2.1 Composite System Tests

Development and qualification testing on individual system segments shall be covered in the EMC Control Plan of the particular associate contractor. When mating segments are not available, associate contractors shall use electrical substitutes wherever possible to test their interface with other system segments. Associate contractors' control plans, test plans and test results shall be analyzed by the OV EMC Integrator to ascertain and define potential integration

problem areas. The MOL SPO shall be apprised of any segment deficiencies and problem areas which may affect integration. Composite systems tests covered by this plan shall consist of the integration testing of the various system segments as they functionally flow together into the Flight Vehicle.

T 5.2.1.1 Laboratory Vehicle Integration Tests

The first integration is the integration of the Mission Payload system segment with the Laboratory Module system segment to make the Laboratory Vehicle system segment. This integration is scheduled for accomplishment at the Douglas facility in Huntington Beach. EMC tests shall be made by the OV Integrator and supported by the applicable associate contractors on the Laboratory Vehicle during Production System Integration Area tests. A flight configuration of the Laboratory Module joined to a complete mission module shall be used for the conducting of limited EMC qualification tests during simulated prelaunch, launch, and on-orbit operations. The limitation is the result of the simulation of the conducted EM interfaces and the deficiencies of the radiated EM environment. Compatibility shall be determined from measurements of EMISM of critical test points. Satisfactory demonstration of EMISM's and freedom from out-of-specification power bus transients are the criteria for test success.

T 5.2.1.2 Gemini B/Laboratory Vehicle Interface Tests

The Gemini B, Laboratory Vehicle and Integrated T-IIIM will be mechanically mated at the launch pad. Following Gemini B checkout, the Gemini B and Laboratory Vehicle system segments will then be electrically mated to form the Orbiting Vehicle. After the functional mating of the two system segments, interface tests shall be run to ensure (1) the proper flow of information and power across the interface, and (2) electromagnetic compatibility of interfacing systems with one another. Any special EMC tests required by the Gemini B/Laboratory Vehicle interface specification shall be accomplished at this time by the OV Integrator supported by the applicable associate contractors. Satisfactory demonstration of compliance with the electromagnetic compatibility requirements will be considered to have been met if the operation of any system segment does not degrade the measured performance of any subsystem in any other system segment below the specified limits. The OV EMC Integrator shall apprise the MOL SPO of any deficiencies or potential problem areas learned through data acquired during this test phase.

T 5.2.1.3 Orbiting Vehicle Tests

After integration of the Gemini B and Laboratory Vehicle into an Orbiting Vehicle, a simulated mission, including prelaunch, launch, injection and on-orbit operations will be run, during which time the electromagnetic compatibility of the electrical and electronic subsystems on the Orbiting Vehicle shall be checkout concurrently with required operational AGE and ground facilities. Satisfactory demonstration of compliance with the electromagnetic compatibility requirements will be considered to have been met if the operation of any system segment does not degrade the measured performance of any subsystem in any other system segment below the specified limits.

Verification of EMISMs will be made by the DU EMC Integrator supported by the applicable Associate Contractors on the Orbiting Vehicle during the qualification testing of the MOL System noted in 5.2.2. OGE shall measure system performance. The OV EMC Integrator shall analyze test results, evolve solutions to problem areas in coordination with the associate contractors, and recommend action to the MOL SPO.

T 5.2.1.4 Orbiting Vehicle/TIIIM Interface Tests

The fully tested Orbiting Vehicle will be functionally mated to an integrated TIIIM Launch Vehicle. Interface tests shall be run to ensure the proper flow of information across this interface and that the interfacing systems are electromagnetically compatible with one another. Any special EMC tests required by the OV/TIIIM interface specification shall be accomplished at this time by the FV EMC Integrator supported by the applicable Associate Contractors. Satisfactory demonstration of compliance with the electromagnetic compatibility requirement will be considered to have been met if the operation of any system segment does not degrade the measured performance of any subsystem in any other system segment below the specified limits. The EMC Integrator shall apprise the MOL SPO of any deficiencies or potential problem areas discovered from data acquired during this test phase. Solutions to problem areas shall be evolved with affected contractors and action recommended to the MOL SPO.

T 5.2.1.5 Flight Vehicle Tests

After integration of the OV and the TIIIM to form the Flight Vehicle simulated prelaunch, launch, ascent and on-orbit tests will be run, during which time the electromagnetic compatibility of the electronic subsystems of the Flight Vehicle shall be checked along with required AGE, ground facilities and portions of the SCF by the FV EMC Integrator, supported by applicable Associate Contractors. Satisfactory demonstration of compliance with the electromagnetic compatibility requirements will be considered to have been met if the operation of any system segment does not degrade the measured performance of any subsystem in any other system segment within the MOL Composite System, below acceptable limits, including EMC specification deviations granted to each contractor. Verification of EMISMs shall be made only on the flight vehicle during the qualification testing of the MOL System as noted in 5.2.2. OGE shall be used to measure system performance. The FV EMC Integrator shall analyze test results, evolve solutions to problem areas in coordination with affected contractors, and recommend corrective action to the MOL SPO.

T 5.2.2 EMC Qualification

EMC qualification tests shall be performed on the following vehicles:

a. Gemini B Qualification Flight
b. First complete Manned Orbiting Vehicle Flight
c. First complete Unmanned Mission Orbiting Vehicle Flight

Qualification testing shall be accomplished by measurement of the accepted critical test points of each system segment to ascertain that the EMISM at these points has not been degraded below the acceptable level during the integration of the system segments into a composite system in the launch environment.

T 5.2.3 ACCEPTANCE TEST

Each system segment shall conduct an EMC test as a part of the segment level acceptance testing and prior to any integrated testing for each flight article. Electromagnetic interference safety margins (EMISM) on critical test points shall be measured.

T 5.3 EED VALIDATION

For EMC, the validation of all EED and firing circuits shall be inaccordance with the applicable requirements of SAFSL Exhibit 30005, SAFSL Exhibit 30060, and AFWTRM.127-1.

T 5.4 TEST REPORTS

Each associate contractor shall submit a test report for their system segment in accordance with the CDRL. The EMC Integrators shall submit the EMC test report for the composite system in accordance with the CDRL.

Section 6

EMC ANALYSIS

One of the major EMC roles of the EMC Integrator is to anticipate EMI problems before they happen. If in the early design stages of the MOL development, potential sources of EMI are identified, recommendations can be made to avoid their occurrence; a better system will be achieved.

EMC analysis is a powerful tool for obtaining advanced information on the Composite MOL System and the EMC Integrator shall use this analysis to its full advantage. An EMC analysis using the preliminary MOL parameters shall be started immediately after the Phase II go ahead. The purpose of performing the analysis at this early stage is to:

a. Develop the techniques for making the EMC analyses.

b. Identify potential sources of EMI as soon as possible.

As the MOL vehicle development progresses, more precise system parameters will become available. Also, there will probably be some system changes from time to time. These new data shall be used to update the analysis and to determine their impact on the Composite MOL System. Whenever potential sources of electromagnetic imcompatibility are uncovered from the analyses, the MOL SPO shall be informed of this situation and corrective recommendations shall be made by the EMC Integrator.

The following is an outline of procedures that shall be used by the EMC Integrator in performing the analysis:

1. a. Requests for RF transmitting and receiving frequencies.

   b. Transmitting chain frequencies (oscillator, multiplier frequencies, etc.).

   c. Receiver local oscillator frequencies.

   d. Primary frequencies generated in the segment other than RF frequencies (power frequencies, chopper frequencies, etc.)

   e. CEI specifications or equivalent.

   f. Facility IFS's

   g. EMC control plans

   h. AVE grounding diagrams

   i. Critical test point lists and rationale data

   j. Description of critical test point measuring equipment

k. EED types and susceptibility

l. Results of segment tests where electrical interface substitutes are used

m. Analysis on interface circuits

n. Spectrum signatures

o EMC test plans and EMC test reports

2. A complete tabulation of all the frequencies of all the equipment shall be maintained up to date for the life of the contract. In conjunction with this tabulation, information shall be kept on harmonics and intermodulation frequencies. This list shall be referred to when coordinating frequency assignment requests.

The following applies to the FV EMC Integrator in performing his analysis:

1. A survey (calculated) shall be made of the EMC environment of the launch site. This survey will be kept up to date. The EMC Control Board shall be kept informed on the EMC environment of the launch site and its effect on the MOL vehicle.

2. From the data received from the associate contractors, the EMC environment of the MOL vehicle shall be computed. This computation shall be updated whenever changes in the system parameters are reported. The EMC Control Board shall be kept informed on the status of the EMC environment of the MOL vehicle. The EMC Integrator shall also inform the EMC Control Board of optential EMI problems that have been determined from the analyses and make recommendations for their correction.

APPENDIX A

CHARTER FOR THE MOL ELECTROMAGNETIC COMPATIBILITY CONTROL BOARD

1. Introduction - The purpose of this document is to define objectives and responsibilities of the MOL Electromagnetic Compatibility (EMC) Control Board and its membership.

2. Function - The EMC Control Board will meet regularly to direct the development of the MOL system for electromagnetic compatibility.

3. Authority - The Board will exercise authority through the MOL SPO. The MOL SPO vests with its GSE/TD Contractor, Aerospace, specific authority necessary to pursue an EMC program which will accomplish, through timely events, the objectives delineated in the document, SSD Exhibit 64-4, Electromagnetic Compatibility Requirements for Manned Spacecraft.

4. Responsibility - The EMC Control Board is responsible for directing the implementation of programs to insure EMC interface considerations are incorporated in the MOL system design, sufficient and timely tests are programmed to verify interface EMC, and contractual documents are prepared to establish the EMC interface requirements. The Board will report to the MOL SPO/Aerospace all findings concerning interface data resulting from evaluation of system designs, proposed tests, and test data. The Board will advise the MOL SPO/Aerospace what action is necessary to resolve EM incompatibilities through design alteration and further testing. In the event action items from the Board cannot be readily accomplished within itself, the Board will inform the MOL SPO/Aerospace and recommend implementation action.

5. Representation - The MOL SPO will direct the Board. Membership will include the MOL SPO, AFSCF, 6595th ATW, Aerospace, T-III SPO, Douglas Aircraft Company, The Martin Company, GE and McDonnell. Additional representation may be requested for particular requirements. When problems arise pertaining to only one or two segments of the MOL system, special arrangements may be made by the Chairman to call sub-group meetings.

6. General - Meetings will be held as agreed to by the MOL SPO and Aerospace. Sufficient latitude will be given the Board to investiage problem aspects of the MOL system to assure that the MOL segments are fully compatible and the specified EMC objectives are achieved.

/s/ B. P. Leonard
B. P. Leonard
Vice-President, General Manager
MOL Systems Engineering Office

/s/ R. A. Berg
Russell A. Berg
Brigadier General, USAF
Deputy Director, MOL

APPENDIX B

Titan IIIM System Segment Deviations

1. Whever SAFSL 30005 is referenced, replace by the applicable EMC control plan for the Titan III system segments.

APPENDIX C

General Electric Company Deviations

1. The following paragraphs are not applicable to the General Electric Company because the General Electric Company segment does not contain equipment pertaining to these paragraphs. In the event changes are made to the General Electric Company segment to include equipment which pertains to these paragraphs, they then shall apply.

4.2.2	Radiated Signal Control
4.2.2.1	Frequency Management
4.2.2.2	Spectrum Signature

2. Paragraphs 5.2.1.1, 5.2.1.2, 5.2.1.3, 5.2.2:
For VAFB testing, the number of critical points for General Electric Co. shall be equal to or greater than six (6) but shall not exceed twelve (12).

APPENDIX D

Eastman Kodak Company Deviations

1. The following paragraphs are not applicable to Eastman Kodak Company because the Eastman Kodak Company segment does not contain equipment pertaining to these paragraphs. In the event changes are made to the Eastman Kodak Company segment to include equipment which pertain to these paragraphs, they then shall apply.

4.2.2	Radiated Signal Control
4.2.2.1	Frequency Management
4.2.2.2	Spectrum Signature
4.2.3	Electro-Explosive Devices and Firing Circuits
5.3	EED Validation

2. Paragraph 5.1.2:

   Breakout cables may be useful for EMISM testing on the Eastman Kodak Company segment.