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## HEXAGON RETRIEVAL MISSION

**TITLE:** Program Planning (1.0)

**REQUIREMENT:** Program plan ensures all essential activities are identified, scheduled and accomplished.

**TASK DESCRIPTION:**

- Develop master program plan
  - Plan 1, interim (Nov 82 - Mar 83)
  - Plan 2, program (Mar 83 - end of contract)
  - Define interaction between activities and associate contractors
  - Program schedules (tier 1 thru 3)
- Develop draft CDRL (contract CDRL's at ATP)

**OUTPUT:** Program plans for SPO review and approval.

**SCHEDULE:**

| Item | Date |
|---|---|
| Plan No. 1 draft to SPO for review | 15 Nov 82 |
| Plan No. 1 SPO approval | 19 Nov 82 |
| Plan No. 2 draft to SPO for review | 5 Jan 83 |
| Plan No. 2 SPO approval | 5 Feb 83 |

**OPR:**

1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC,* PE, MDAC, CSC

*LEAD

## HEXAGON RETRIEVAL MISSION

**TITLE:** System Engineering (2.0)

**REQUIREMENT:** System level requirements for retrieval/reuse must be developed (across associate lines) and allocated.

**TASK DESCRIPTION:** Develop system level requirements and allocate down to subsystem requirements, effort will include:

2.1 Scenario definition
2.2 Requirements definition
2.3 Develop refurbishment plan

**OUTPUT:** System specification - Nov 82
System requirements review - Dec 82

**OPR:** 1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

GON RETRIEVAL MISSION

TITLE: Retrieval Scenario (2.1)

REQUIREMENT: Scenario required to bound design options, provide basis for requirements flow-down

TASKS: Develop total retrieval mission scenario

- Define key tasks/operations
- Define approaches to tasks
- Trade-off approaches as appropriate

OUTPUT: Reports (scenario and trades documentation).

SCHEDULE:

| Item | Date |
|---|---|
| Task ATP | 03 Nov 82 |
| Preliminary Draft Report | 21 Nov 82 |
| SPO Complete Review | 01 Dec 82 |
| Final Draft Report | 07 Dec 82 |
| SPO Approval | 15 Dec 82 |

OPR: 1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

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## HEXAGON RETRIEVAL MISSION

TITLE: Requirements Definition (2.2)

REQUIREMENT: SPO approved design/operational requirements are needed to guide the development.

TASK DESCRIPTION:
- LMSC (in coordination with SPO) develop system level requirements.
- LMSC coordinate and flow down requirements to subsystems (i.e., SBAC, P/L, RV, CMND, Sys, ASE, etc.) based on mission scenarios.
- Associates document their subsystem requirement (contractor format, i.e., SRL's).
- Associates identify requirements design and cost drivers.

OUTPUT/SCHEDULE:

| Item | Date |
|---|---|
| System Requirement Draft | 10 Nov 82 |
| System Requirement Final | 26 Nov 82 |
| System Requirement Review | 15 Dec 82 |

OPR: 1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC*, PE, MDAC, GE

HEXAGON RETRIEVAL MISSION

TITLE: Refurbishment Plan (2.3)

REQUIREMENT: Refurbishment plan is needed to identify modifications required to lower cost and/or risk of refurbishment.

TASK DESCRIPTION:
- Conduct trade studies on P/L refurb on West Coast and propulsion refurb at SV level using WTR.
- Develop baseline of refurbish plans, schedules and hardware effected.
- Draft refurb plan Feb 83

OPR:
1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC,* PE, GE, MDAC

## HEXAGON RETRIEVAL MISSION

**TITLE:** Spacecraft Modifications (3.0)

**REQUIREMENT:** Develop SV mods required for STS retrieval and relaunch compatibility.

**TASK DESCRIPTION:** Accomplish the following sub tasks:

3.1 Trunnion and keel preliminary design
3.2 Solar array management
3.3 Grapple design
3.4 Antenna modifications
3.5 Electrical control and power management
3.6 Propulsion modifications

**OUTPUT:** Preliminary Design Review Feb 83.

**OPR:** 1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

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## HEXAGON RETRIEVAL MISSION

TITLE: Trunnion and Keel Preliminary Design (3.1)

REQUIREMENT: Trunnions and keels which interface with standard STS latches are required to secure SV to the ASE in the Shuttle.

TASK DESCRIPTION
- Develop designs for SV mod
  - For retrieval only
  - For launch and retrieval
- Trade of designs (cost, schedule weight, risk, mission impacts).
- Develop preliminary designs and fab schedules.
- Conduct demo tests on design concept if required.

OUTPUT: Reports on: Trade studies
Preliminary Design
Demo test results

SCHEDULE: Trade study results - Dec 83
Demo test complete - Jan 83
Preliminary design - Feb 83

OPR: [redacted] (b)(3) 10 USC ⊥ 424

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## HEXAGON RETRIEVAL MISSION

**TITLE:** Solar Array Management (3.2)

**REQUIREMENT:** The Hexagon solar arrays must be jettisoned or stowed prior to berthing the Hexagon in the Orbiter.

**TASK DESCRIPTION:**

- Review the technical options for stowing/jettisoning the solar arrays
- Develop preliminary designs for a minimum of two approaches - automatic with manual backup and manual.
- Perform trajectory analysis of separated array

**OUTPUT:**

| | |
|---|---|
| Jettison demonstration | Dec 83 |
| Water tank EVA demo | Start Nov 82, complete TBD |
| Trade Study results | Jan 83 |

**SCHEDULE:**

**OPR:**

1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

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## HEXAGON RETRIEVAL MISSION

**TITLE:** Grapple Design (3.3)

**REQUIREMENT:** Modify the SV to accommodate retrieval and deployment with the standard STS RMS and grapple interface, SV deboost capability must be retained.

**TASK DESCRIPTION:**

- Develop preliminary grappple designs and SV installation locations.
- Identify structural modifications required to transfer berthing loads
- Trade-off grapple designs and SV installation locations.
- Analysize RMS/grapple interface dynamics and berthing implications and NASA interface support.

**OUTPUT:**

- Trade study results.
- Berthing/dynamic analysis results.
- Mockup, simulation and demo test requirements.
- Show deboost requirements are satisfied in the event of a grapple release failure.

**SCHEDULE:** TBD

**OPR:**

1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

## HEXAGON RETRIEVAL MISSION

TITLE: Antenna Modifications (3.4)

REQUIREMENT: All SV antenna must fit inside the STS cargo envelope for retireval/relaunch.

TASK DESCRIPTION:
- Analyze all SV antenna for interference with the STS cargo envelope (assess berthing, storage and deployment).
- Develop antenna modifications and conduct trade studies on the design options and impacts to existing hardware.

OUTPUT/SCHEDULE:
- Analysis and trade study report - Jan 83
- Design base line at PDR

OPR:
1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

## HEXAGON RETRIEVAL MISSION

TITLE: Electrical Control/Power Management (3.5)

REQUIREMENT: The SV must be electrically safed for STS retrieval, berthing, landing and relaunch.

TASK DESCRIPTION:
- Evaluate power management methods and develop design options to meet the retrieval/reflight requirements.
- Both automatic power switching and EVA activated switches should be considered in the design trades in addition to impacts to existing hardware and impacts to existing hardware as well as command software..

OUTPUT/SCHEDULE:
- Design trade study result - Jan 83.
- Preliminary design at PDR - Feb 83.

OPR: 1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

## HEXAGON RETRIEVAL MISSION

**TITLE:** Propulsion Modifcations (3.6)

**REQUIREMENT:** Ensure SV meets new mission requirements and is safe for STS retrieval/reflight.

**TASK DESCRIPTION:**

- Develop preliminary design that meets the STS safety requirements and conduct trade studies to include effect such as pressure drop, in rush and structural design of OA engine support. Conduct demo test if appropriate.
- Support request for NASA propulsion waiver in parallel to design effort.

**OUTPUT/SCHEDULE:**

- Preliminary design and trade study reports - Jan 83.
- Demonstration test reports - TBD.

**OPR:**

1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

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## HEXAGON RETRIEVAL MISSION

| | |
|---|---|
| TITLE: | Airborne Support Equipment (4.0) |
| REQUIREMENT: | ASE (cradles, AFD) must be built to interface/support the SV retrieval and reflight on STS. |
| TASK DESCRIPTION: | - Develop design options for cradles with launch and retrieval capability conduct trade-off studies on the design options.<br>- Develop AFD and STS/SV umbillical design. |
| OUTPUT/SCHEDULE: | - Trade study report including detailed cradle design option(s) - Jan 83.<br>- Baseline design for PDR - Feb 83. |
| OPR: | 1. [redacted] (b)(3) 10 USC ⊥ 424<br>2. LMSC |

## HEXAGON RETRIEVAL MISSION

| | |
|---|---|
| TITLE: | System Analysis (5.0) |
| REQUIREMENT: | System analysis must be conducted to support requirements flowdown and design option evaluation. |
| TASK DESCRIPTION: | As a minimum the following analysis will be accomplished:<br><br>5.1 Structures analysis<br>5.2 RMS operations analysis |
| OUTPUT: | Task 5.1 and 5.2 schedule for major outputs - Dec-Nov 82. |
| OPR: | See 5.1, 5.2 |

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## HEXAGON RETRIEVAL MISSION

**TITLE:** Loads Analysis (5.1)

**REQUIREMENT:**

**TASK DESCRIPTION:**

- The first load cycle and structural SV design impact assessment (all associates) will be accomplished for STS liftoff/landing using latest STS dynamic math models/forcing functions.
- Each associate will assess the structural impacts on their portion of the SV and LMSC will provide a system assessment.

**OUTPUT/SCHEDULE:**

- Load cycle report - _____.
- Structural design impacts report (all associates) - Dec 82.
- Preliminary fracture mechanics evaluation - Feb 83.

**OPR:**

1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

## HEXAGON RETRIEVAL MISSION

TITLE: RMS Risk Analysis (5.2)

REQUIREMENT: The Hexagon vehicle must be grappled and berthed using the RMS. There is, however, uncertainty associated with the RMS.

TASK DESCRIPTION:
- Review all existing RMS studies and data.
- Identify risk areas, quantify where possible.
- Define effort required to reduce risk-relate to risk reduction for other NRO programs.

OUTPUT/SCHEDULE: Report: Reclaim to false concerns, endorsement of valid risks, plan to reduce risks - 15 Dec 82.

OPR: 1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

HEXAGON RETRIEVAL MISSION

| | |
|---|---|
| TITLE: | Reentry Vehicle Modifications (7.0) |
| REQUIREMENT: | To evaluate the applicability of cross parachute system for system use. To develop loads models and conduct structural analysis to support LMSC and identify required design changes. |
| TASK DESCRIPTION: | - Conduct evaluation drop test program on cross parachute system.<br>- Develop finite element model for RV<br>- Conduct structural analysis for loads determination and satisfaction of STS structural requirements. |
| OUTPUT: | - Parachute test report/briefing<br>- Finite element model<br>- Loads data |
| SCHEDULE: | Test report - Mar 83 |
| OPR: | 1. [redacted] (b)(3) 10 USC ⊥ 424<br>2. MDAC |

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HEXAGON RETRIEVAL MISSION

TITLE: Command Subsystem Module (9.0)

REQUIREMENT: The command Subsystem must be able to support mission requirements with sufficient and properly allocated commands. Further, the command subsystem must meet all safety requirements.

- Support IFWG's, and safety meetings.
- Perform necessary analysis to determine what modifications, if any, must be performed on the command subsystem.

OUTPUT: Reports, as required, on necessary command subsystem modifications.

SCHEDULE: TBD

OPR: 1. [redacted] (b)(3) 10 USC 424
2. GE

## HEXAGON RETRIEVAL MISSION

**TITLE:** STS Integration (10.1)

**REQUIREMENT:** Mission must be integrated onto STS.

**TASK DESCRIPTION:** Develop the STS integration plan (tasks vs. time)

**SCHEDULE:**

| Item | Date |
|---|---|
| Final draft to SPO | 19 Nov 82 |
| SPO approval | 23 Nov 82 |

**OPR:** 1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

## HEXAGON RETRIEVAL MISSION

**TITLE:** Launch Site Integration (10.2)

**REQUIREMENT:** Mission must be integrated with launch site.

**TASK DESCRIPTION:** Develop a launch site integration planning schedule for both WTR and ETR.

**OUTPUT:** A WTR and an ETR LSI planning schedule

**SCHEDULE:**

| Item | Date |
|---|---|
| Final draft to SPO | 19 Nov 83 |
| SPO approval | 23 Nov 83 |

**OPR:** 1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

## HEXAGON RETRIEVAL MISSION

**TITLE:** STS Safety (10.3)

**REQUIREMENT:** STS safety requirements

**TASK DESCRIPTION:**
- Develop draft safety milestones/incorporate in program plan.
- Monitor engineering and design efforts for safety impacts/inputs.
- Develop draft hazard list
- Prepare draft waivers as appropriate

**OUTPUT/SCHEDULE:** Draft hazard list TBD.

Draft Waivers TBD

**OPR:**
1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

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## HEXAGON RETRIEVAL MISSION

TITLE: Flight Operations (11.0)

REQUIREMENT: Develop an operations concept and a conceptual flight plan for on-orbit portion of the HEXAGON retrieval mission.

TASK DESCRIPTION: Accomplish the following sub tasks

10.1 Develop preliminary ops concept
10.2 Develop summary on-orbit timeline
10.3 Develop RMS operations plan
10.4 Develop EVA concepts

SCHEDULE: TBD

OPR: 1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

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## HEXAGON RETRIEVAL MISSION

| | |
|---|---|
| TITLE: | Preliminary Ops Concept Development (11.1) |
| REQUIREMENT: | The roles and interfaces between AFSCF/MCC-2 and JSC/MC4-H must be defined early to ensure timely requirement implementation. |
| TASK DESCRIPTION: | - Determine roles/responsibilities of each MCC<br>- Determine MCC-2 and modifications required to support the flight.<br>- Determine MCC-2/MCC-H interface requirements.<br>- Determine AF/NASA training requirements. |
| OUTPUT: | Operations concept document that embodies for the following requirements documents: AFSCF ORD, PIP, PIP Annex 3, 5, and 7. |
| OPR: | 1. [redacted] (b)(3) 10 USC ⊥ 424<br>2. LMSC/VOA |

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## HEXAGON RETRIEVAL MISSION

**TITLE:** Summary On-orbit Timeline Development (11.2)

**REQUIREMENT:** Perform the orbit case studies. Add initial look at consumables analysis to create a conceptual flight plan including an on-orbit timeline.

**TASK DESCRIPTION:** Perform a joint NASA/AF orbit case study analysis including looks [redacted] visibilities, SV commanding scenarios, Orbiter rendezvous timelines, Orbiter consumables analysis, SV consumables analysis, and rendezvous terminal phase visibilities and relative motions.

**OUTPUT:**
- Approved initial AFSCF case study
- Draft NASA conceptual flight plan
- Draft Annex 2 inputs

**OPR:**
1. [redacted] (b)(1) (b)(3) 10 USC ⊥ 424
2. LMSC/VOA (b)(3) 10 USC ⊥ 424

## HEXAGON RETRIEVAL MISSION

**TITLE:** RMS Operations Study (11.3)

**REQUIREMENT:** To determine that the NASA RMS/Orbiter system has the capability to berth the HEXAGON vehicle.

**TASK DESCRIPTION:** Analyze the NASA developed RMS operations procedures and capabilities to identify RMS failure modes that would cause mission failure and possible work arounds. (Most of this work has already been done.) Develop a study plan whose outputs would be a determination of what RMS preprogrammed maneuvers could be used, Oribter and spacecraft relative attitudes at berthing, spacecraft stability requirements and verification of ASE berthing hardware. The plan would include a berthing demonstration, possibly using a balloon mockup.

**OUTPUT:**

- RMS failure mode an impact analysis
- RMS berthing demonstration plan
- RMS operations plan (draft)

**OPR:**

1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

## HEXAGON RETRIEVAL MISSION

**TITLE:** EVA Concepts Development (11.4)

**REQUIREMENT:** Determine that planned SV modifications are adequate for flight.

**TASK DESCRIPTION:** Develop a plan to evaluate the current EVA work stations planned for the retrieval. Perform as many individual task analyses as possible within the time allowed.

**OUTPUT:**

- Individual work station evaluation results
- Test plan to evaluate the entire EVA activitiy to verify design
- Draft Annex 11 inputs

**OPR:**

1. [redacted] (b)(3) 10 USC ⊥ 424
2. LMSC

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## HEXAGON RETRIEVAL MISSION

| | |
|---|---|
| TITLE: | Refurbishment History/Experience (12.0) |
| REQUIREMENT: | Document contractor history of refurbishment to support viability of refurbishing satellite. |
| TASK DESCRIPTION: | - Document HEXAGON program successes on RV/TU |
| | - Document P269 results from refurb standpoint |
| | - Identify cost savings for RV/TU based on reuse |
| OUTPUT: | Executive level briefing/report (annotated charts) |
| SCHEDULE: | Strawman briefing (outline, content, approach) 5 Nov |
| | Internal briefing 3 Dec |
| | Report/briefing available for Washington 17 Dec |
| OPR: | 1. [redacted] (b)(3) 10 USC ⊥ 424<br>2. MDAC, PE, LMSC |

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HEXAGON RETRIEVAL MISSION

TITLE: Payload STS Compatibility (6.1)

REQUIREMENT: Develop design concepts to make the P/L compatible for both retrieval and reflight.

TASK DESCRIPTION:
- Develop preliminary designs for (a) film path seal and repressurization, (b) take-up and film supply caging.
- Conduct loads analysis on P/L section to evaluate current design margins/modifcations required to structurally withstand launch/retrieval.
- Support refurbishment plan (1.5).

OUTPUT/SCHEDULE: Loads analysis assessment - Dec. 82

OPR: 1. [redacted] (b)(3) 10 USC ⊥ 424
2. PE

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## HEXAGON RETRIEVAL MISSION

**TITLE:** Payload Modifications (6.2)

**REQUIREMENT:** Develop plans and validate concepts pertaining to payload enhancement.

**TASK DESCRIPTION:**

- Develop refurbishment plan
  - Description of key activities and tasks to accommodate payload enhancement during 1986.
- Demonstrate CID lens concept
- Grid generator
- 29° stereo angle layout

**OUTPUT/SCHEDULE:** CID demo - 1 Dec 82

**OPR:**
1. [redacted] (b)(3) 10 USC ⊥ 424
2. PE