REQUEST FOR PROPOSAL (RFP)

Generation 4: Number 3
RFP No. N66617C

Statement of Work (Gen4#3-03.2)

ASSOCIATION OF UNIVERSITIES FOR RESEARCH IN ASTRONOMY, INC. (AURA)
Operating the
Gemini Observatory
Hilo, Hawaii and Cerro Pachón, Chile

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Exhibit A: Statement of Work
to
AURA Contract No. N66617C

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1 Definitions

In this document, the following capitalized (shown here also in boldface) terms shall have the following meanings:

Gen 4#3 Associated Hardware: This term refers to the project deliverable hardware items that are not part of the Gen4#3 Instrument but are necessary for the successful operation and maintenance of the instrument. These items include any necessary non-commonly available hardware and tools used for alignment, assembly, calibration, handling, installation, maintenance, service, testing, and transportation (including shipping containers). Gen 4#3 Associated Hardware also includes a set of agreed Gen 4#3 Instrument spares.

Gen 4#3 Associated Software: This term refers to the project deliverable software items that are not part of the Gen 4#3 Instrument but are necessary for the successful operation and maintenance of the instrument. These items include any software required for alignment, calibration, maintenance, service, simulation, and testing.

Gen 4#3 Change Control: This term refers to the formal project process used to ensure that changes to a design element, document, or component are introduced in a controlled and coordinated manner. Once under Gen 4#3 Change Control, Contractor cannot make additional changes without review from a change control committee including the Technical Representative or a designate. A change control process shall be defined by the Project Manager and Technical Representative at the start of the project.

Gen 4#3 Completion Date: This term refers to the date by which all the Work is completed, all deliverables have been accepted, and the contract is considered complete. The Gen 4#3 Completion Date is the date provided in Article 2 of the Contract (Gen4#3-03.1)

Gen 4#3 Contract Price: This term refers to the total Contract amount as provided in Article 3 of the Contract (Gen4#3-03.1)

Gen 4#3 Contract Deliverables: This term refers to the complete set of final contract deliverables that are to be delivered to AURA by Contractor. The Gen 4#3 Contract Deliverables consist of:

- Gen 4#3 Instrument
- Gen 4#3 Data Reduction Products
- Gen 4#3 Associated Hardware
- Gen 4#3 Associated Software
- Gen 4#3 Deliverable Documentation Set

Gen 4#3 Data Reduction Products: This term refers to data simulation tools, quick look tool, nighttime data quality assessment science, science quality data reduction software, unit tests and regression tests, and data reduction software documentation required upon completion of the Contract.

Data reduction software should be aimed at maximize the scientific productivity of the Gen 4#3 Instrument. The data processing functions shall be a collection of building-block tasks associated with the Gen 4#3 Instrument and be integrated into the Gemini data handling and data processing software systems.

Gen 4#3 Delivery Location: This term refers to where the Gen 4#3 Contract Deliverables shall be delivered upon acceptance. The current Gen 4#3 Delivery Location is:

Gemini Observatory,
Cerro Pachón,
Chile.

The Gen 4#3 Delivery Location shall be confirmed at the start of the Critical Design Stage.

Gen 4#3 Deliverable Documentation Set: This term refers to the complete set of documents associated with the Contract.

Further details on the Gen 4#3 Documentation Set are contained in Appendix A.

Gen 4#3 Instrument: This term refers to the scientific astronomical instrument that is the subject of this contract. This includes all operational software (such as the instrument control system and detector control system) running on the instrument hardware.

Gen 4#3 Key Performance Metrics: This term refers to a number of identified metrics that Contractor shall track against during the lifetime of the project. The values tracked for each metric shall include the requirement, the current best estimate (obtained by design, analysis, or measurement), and the current margin.

Gen 4#3 Requirements: This term refers to the set of contractual requirements stated in Section 4.

AURA Contracts Officer: See Article 10 of the Contract (Gen4#3-03.1)

Technical Representative: See Article 12 of the Contract (Gen4#3-03.1)

Program Manager: See Article 13 of the Contract (Gen4#3-03.1)

2 Gen 4#3 Guiding Principles

(a) Gemini has created a set of Gen 4#3 Guiding Principles, outlined below, that are intended to guide the decision making process if adverse issues related to capabilities, schedule, and cost are encountered in performing the Gen 4#3 project. These Gen 4#3 Guiding Principles are based on the Gemini Instrument Feasibility Studies (GIFS), resolutions from the Gemini Board, recommendations of the Gemini Science and Technology Advisory Committee, and guidance from the Gen 4#3 Steering Committee. Gemini and Contractor shall make decisions in accordance with these principles throughout the lifetime of the project.

(b) Core capabilities. The Gen 4#3 Instrument shall provide a set of core capabilities. Gemini's priority when considering the impact of adjusting requirements, schedule, or cost, is to ensure that the core capabilities are provided. These core capabilities are outlined in the table below.

Parameter	**Value**
Spectrographic	
Wavelength Range	0.4 to 1.6μm
Simultaneous Coverage	Yes
Continuous Coverage	Yes
Resolving Power (λ/Δλ)	≥ 4000
Spatial Sampling	≤ 0.2" at V, ≤ 0.15" at H
Imaging	
Natural Seeing FOV	≥ 170" x 90"
Spatial Sampling	≤ 0.2" at V, ≤ 0.15" at H
Performance	
Throughput	Maximize
Target Acquisition time	Minimize
Reliability	Maximize
Limiting Magnitude	Maximize
Night time calibration time	Minimize

Table 1 *Core capabilities and core efficiency performance parameters*

(c) Schedule. Delivering the Gen 4#3 Instrument with the core capabilities by the Gen 4#3 Completion Date is Gemini's next priority when considering choices between capability, requirements, schedule, or cost. After ensuring core capabilities, maintaining schedule is the next driving factor.

(d) Cost. Contractor delivering the Gen 4#3 Instrument with the core capabilities by the Gen 4#3 Completion Date for the Contract Price is Gemini's following priority. After ensuring core capabilities and schedule, meeting budget is the highest importance – higher than achieving any additional capability beyond the core set identified above.

(e) Additional capabilities. Contractor's final priority is to deliver the Gen 4#3 Instrument with the core and additional capabilities by the Gen 4#3 Completion Date for the Contract Price. However, achieving the additional capabilities is not considered as important as meeting the core capabilities, meeting them on schedule, and meeting them on budget.

3 Schedule, Budget, and Performance-based Telescope Time

3.1 Schedule

(a) Contractor shall manage the Work so that it is successfully completed by the Gen 4#3 Completion Date.

(b) Contractor shall maintain a baseline schedule and include schedule contingency beyond the baseline of a reasonable amount (at least 15% beyond the critical path). The schedule, including contingency, shall not exceed the Gen 4#3 Completion Date.

(c) The schedule cannot be re-baselined more often than at the beginning of each stage without the approval of the Technical Representative.

(d) Contractor shall follow the Gen 4#3 Guiding Principles when making decisions related to schedule.

(e) Contractor shall routinely monitor the progress of the schedule based on the Work performed to date and the remaining Work to be completed, and shall promptly inform the Technical Representative if at any time there is reason to believe an end-of-stage completion date or Gen 4#3 Completion Date will be exceeded (relevant dates are contained in Article 4 of the Contract).

(f) Contractor shall monitor the deliverables schedule for each of the subcontractors. If Contractor believes there will be a delay in deliverables that will impact the critical path, Contractor must notify the Technical Representative promptly.

(g) Telescope time shall be awarded for meeting an end-of-stage completion date as indicated in Article 4 of the Contract.

(h) If Contractor does not meet an end-of-stage completion date, Gemini may award all, none or part of the allocated telescope time at the Director's discretion.

(i) Any telescope time awarded through meeting schedule shall be governed by the clauses in Section 12.

3.2 Budget

(a) Contractor shall manage the Work so that it is successfully completed for a total cost to AURA that is equal to or less than the Gen 4#3 Contract Price.

(b) Contractor shall maintain a baseline budget and include an unallocated risk mitigation budget item beyond the baseline of at least 15% per stage of the project.

(c) Contractor shall follow the Gen 4#3 Guiding Principles when earmarking or allocating internal risk mitigation funds.

(d) Contractor shall routinely monitor amounts expended in performing the Work and the remaining Work to be completed, and shall promptly inform the Technical Representative if at any time there is reason to believe that the total project costs may exceed the total project budget.

(e) Telescope time shall be awarded for meeting a cumulative stage budget at the accepted completion of each stage as described in Article 4 of the Contract.

(f) If Contractor does not meet the cumulative stage budget, Gemini may award all, none, or part of the allocated telescope time at the Director's discretion.

(g) Any telescope time awarded through meeting budget shall be governed by the clauses in Section 12.

4 Requirements

(a) The Gen 4#3 Instrument is a wide-band medium resolution spectrograph and imager. It is expected to contribute to new understandings in the age of time-domain astronomy. Technically, this kind of science demands rapid acquisition, fast readout/high duty cycle, broad and preferably simultaneous wavelength coverage, and R~4000.

Key requirements:

Requirement	Value
Spectrographic	
Wavelength Range	
Simultaneous Coverage	Yes
Continuous Coverage	Yes
Resolving Power (λ/Δλ)	
Spatial Sampling	
Imaging	
Natural Seeing FOV	
Spatial Sampling	
Performance	
Throughput	
Target Acquisition time	
Reliability	
Limiting Magnitude	
Night time calibration time	

Table 2 *Key requirements table*

The key requirements shall be provided by the proposer and shall equal or better those provided in Table 1 (see Section 2). Additional key requirements based on additional capabilities shall be extracted from the selected proposal and placed into the Table 2.

(b) The Gen 4#3 instrument must also comply with the *Gemini Observatory Facility Instrument Common Requirements and Standards Specification* document, which references the appropriate set of interface control documents (ICDs).

(c) The requirements provided in paragraph (a), together with the requirements provided in the latest revision of the Requirements Document approved by the Technical Representative, shall constitute the functional and performance requirements that the Gen 4#3 Instrument must meet (the Gen 4#3 Requirements).

5 Project Structure, Staffing, Deliverables, and Communication

5.1 Project Structure

The Gen 4#3 project shall be divided into 3 phases and 6 stages as shown in Figure 1 below.

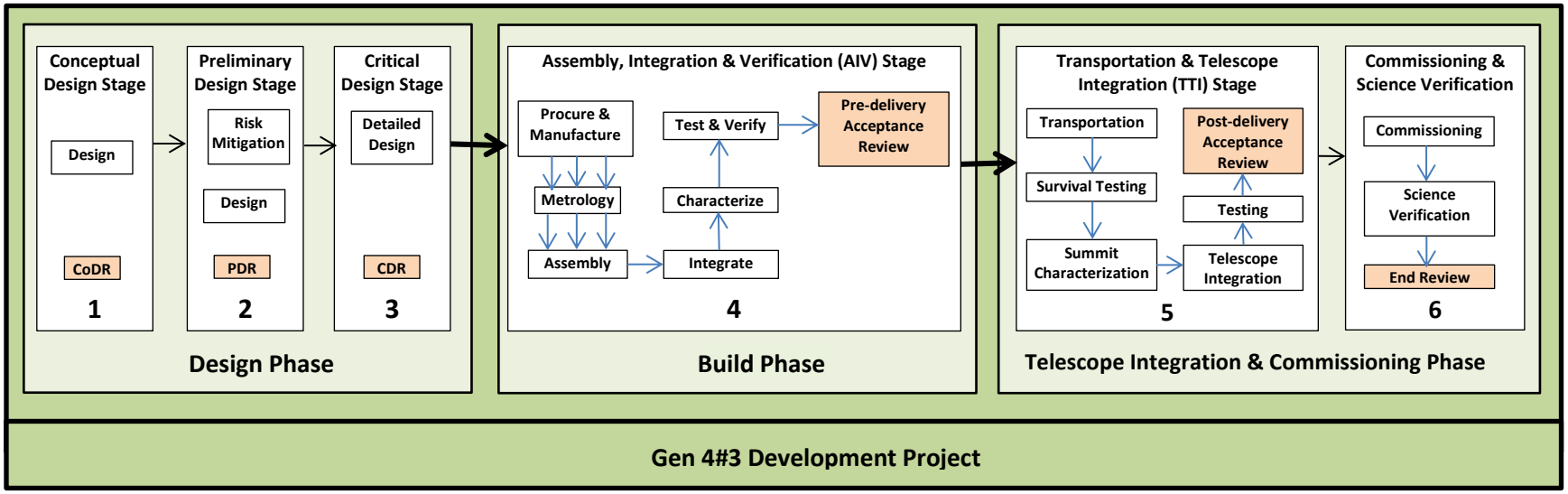

Figure 1 *The identified Gen 4#3 project phases and stages.*

Each stage shall begin with a kickoff meeting (see Section 5.4.1) and conclude with an end-of-stage review (see Section 5.4.4 and Appendix A).

5.1.1 Design Phase

The Design Phase of the project is the phase in which Contractor develops the design of the Gen 4#3 Contract Deliverables. It is divided into three stages:

- Conceptual Design Stage: See Section 6 for its statement of work
- Preliminary Design Stage: See Section 7 for its statement of work
- Critical Design Stage: See Section 8 for its statement of work

The successful completion of the Critical Design Review (CDR) shall mark the closure of the project's Design Phase. Once completed, the entire design of the Gen 4#3 Contract Deliverables shall be under Gen 4#3 Change Control and can only be changed with the approval of a project change control process that includes approval by the Technical Representative.

5.1.2 Build Phase

The Build Phase of the project is the phase in which Contractor manufactures, procures, creates, measures, assembles, integrates, characterizes, optimizes, tests, and verifies the Gen 4#3 Contract Deliverables. This phase consists of a single standalone stage:

- Assembly, Integration, and Verification (AIV) Stage: See Section 9 for its statement of work

The successful completion of the AIV Stage shall mark the closure of the project's Build Phase. Once the phase is completed, all hardware associated with the Gen 4#3 Instrument and Gen 4#3 Associated Hardware should be in their final state and placed under Gen 4#3 Change Control. Any changes, such as remanufacturing or reassembly, shall require approval by the Technical Representative.

5.1.3 Telescope Integration and Commissioning Phase

The Telescope Integration and Commissioning Phase of the project is the phase in which Contractor transports, tests, integrates, and commissions the Gen 4#3 Contract Deliverables. This phase has been divided into two stages:

- Transportation and Telescope Integration Stage: See Section 10 for its statement of work
- Commissioning and Science Verification Stage: See Section 11 for its statement of work

The successful completion of the Commissioning and Science Verification Stage shall mark the closure of the project, the formal acceptance of the Gen 4#3 Contractor Deliverables by Gemini, and the instrument's handover to regular operations.

5.2 Project Staffing

Contractor shall staff a full-time project manager for the project.

5.3 Deliverables

In addition to the Gen 4#3 Contractor Deliverables, a set of intermediate deliverables are required by AURA in each stage. They include:

- Kickoff Meetings: Presentation report (See Section 5.4.1)
- Gen 4#3 Weekly Status Meeting: Verbal report (See Section 5.4.2)
- Gen 4#3 Monthly Progress Reports: Written report (See Section 5.3.1)
- Gen 4#3 Quarterly Reviews: Presentation report (See Section 5.4.3)
- End-of-Stage Reviews: Review documentation (See Section 5.4.4 and Appendix A)

The Gen 4#3 Contractor Deliverables are reviewed and formally accepted at the end of the contract. Each of these deliverables has the following specific details:

- **Gen 4#3 Associated Hardware:** All items shall be transported to the Gen 4#3 Delivery Location during the Transportation & Telescope Integration Stage.
- **Gen 4#3 Associated Software:** Versions of the Gen 4#3 Associated Software shall be made available to Gemini during the Build Phase and Telescope Integration & Commissioning Phase. Some items may change (under Gen 4#3 Change Control) during the Commissioning & Science Verification Stage.
- **Gen 4#3 Data Reduction Products:** Versions of the Gen 4#3 Data Reduction Products shall be made available to Gemini during the Build Phase and Telescope Integration & Commissioning Phase. Some items may change (under Gen 4#3 Change Control) during the Commissioning & Science Verification Stage.
- **Gen 4#3 Instrument:** The Gen 4#3 Instrument shall be transported to the Gen 4#3 Delivery Location during the Transportation & Telescope Integration Stage.
- **Gen 4#3 Deliverable Documentation Set:** A subset of documents shall be reviewed at the end-of-project review as detailed in Appendix A.

See Section 1 and Appendix A for a definition of the deliverables.

5.3.1 Monthly Progress Reports

By the 15th day of each month, Contractor shall submit a written progress report to the Technical Representative describing the technical, schedule, and financial progress of the Work as of the end of the previous calendar month. Each monthly report must include the entire project and incorporate the Work performed by subcontractors. The report can be supplemented with additional information provided by subcontractors. Each report shall include:

(a) Information regarding the technical status of the Work overall, and in each engineering discipline;

(b) An updated schedule to consist of the most current project plan to completion. Contractor shall compare the current schedule to the last approved baseline schedule. Contractor shall maintain the schedule in Microsoft Project, or equivalent, and present it with a Gantt chart and with a column showing percent complete for each listed task. Contractor shall report the current expected project completion date, including its associated margin and uncertainty;

(c) A table of the major milestones, and cross-institute deliverables, with the original, previous, and current dates by which they will be attained. Contractor shall explain any significant changes from the previous date and include all the explanations from previous lists;

(d) Problem areas related to the Work, including potential for delays, risk mitigation plans, and the status of identified risks;

(e) The following earned value metrics: Budgeted Cost of Work Scheduled (BCWS), Budgeted Cost of Work Performed (BCWP), Actual Cost of Work Performed (ACWP), Schedule Performance Index (SPI=BCWP/BCWS), and Cost Performance Index (CPI=BCWP/ACWP). Contractor shall report a time series of these metrics showing at least the most recent 12 months. Descriptions related to the schedule performance, cost performance, and work performed against the critical path shall be included;

(f) Gen 4#3 Key Performance Metrics including the requirement, current best estimate, and the current margin. Contractor shall retain and present the entire log of previous monthly values for comparison;

(g) A table of financial data, in a format to be agreed with the Technical Representative, including direct labor dollars, capital dollars, and total dollars, for the following categories: planned value for the report month, actual value for the report month, planned minus actual value for the report month, cumulative to date planned value, cumulative to date actual value, and cumulative to date planned minus actuals value. On the same page Contractor shall provide an estimated cost at completion, total dollar value of invoices, and payments received to date; and

(h) High-level action items for Gemini and Contractor (both open and closed), and associated status. Contractor shall be responsible for recording and tracking the high-level action items.

These reports shall be reviewed at the next weekly telecon between the Technical Representative, Program Manager, and any key personnel needed to discuss the current status of the project.

5.4 Meetings and Reviews

5.4.1 Kickoff Meetings

(a) Contractor shall host a kickoff meeting with AURA personnel, key Contractor personnel, and key subcontractor personnel within 15 days of the beginning of each stage.

(b) The kickoff meetings associated with the following stages shall be held at the following locations:

Phase/Stage	Location
Conceptual Design Stage (Contract kickoff)	Contractor's location
Preliminary Design Stage	Contractor's location
Critical Design Stage	Contractor's location
Assembly, Integration and Verification Stage	Contractor's location
Transportation & Telescope Integration Stage	Contractor's location
Commissioning and Science Verification Stage	SBF, La Serena, Chile

(c) At each kickoff meeting, Contractor and the subcontractors shall present any changes to the Project Plan (including the schedule, budget, and risks) requested as a result of the previous end-of-stage review. The meeting shall focus on the upcoming stage's scope of work, plan, and deliverables, including cross-institutional deliverables.

(d) Any documentation presented at the kickoff meeting by Contractor shall be provided to Gemini, and any documentation presented by Gemini shall be provided to Contractor.

5.4.2 Weekly Meetings

During the course of the Work, Contractor shall hold weekly meetings with the Technical Representative and other AURA personnel as needed, to discuss the progress of the Work. These meetings may be held by telephone or videoconference.

5.4.3 Quarterly Project Reviews

(a) Every three months, on a date agreed to by the Program Manager and the Technical Representative, Contractor shall host a one-day quarterly progress review. The location of the meeting shall be rotated among major institutes involved in the project, including Contractor, Gemini, and major subcontractors. The Technical Representative, other needed AURA personnel or representatives, the Program Manager, and other key members of Contractor's team (including subcontractors) shall attend. At every second review, Gemini and Contractor executive management shall meet to align their expectations and understanding of the project.

(b) A quarterly progress review will not be scheduled within one month of an end-of-stage review. Quarterly reviews shall resume three months after the next stage's kickoff meeting.

(c) Standing agenda items for both Gemini and Contractor at the quarterly reviews shall include: project management, system engineering management, science, quality, and work package status. In addition to reviewing cost, schedule, and scope, the review should also include any current technical or project issues that could benefit from direct discussion, possibly with additional visiting Gemini staff.

5.4.4 End-of-Stage Reviews

(a) All stages identified in Section 5 shall include a formal end-of-stage review. The stage review acts as a project health check to demonstrate that the project is on-schedule, on-budget, on-track to meet requirements, and ready to proceed to the next stage. If the Conceptual Design (CoD) stage is being competed, then the clauses in Section 6.1 apply for the CoD Review.

(b) The required state of the Gen4#3 Contract Deliverables at the end of each stage can be found in the Statement of Work section associated with each document. See table in Section (f) below.

(c) The review evaluation criteria shall be based on the Statement of Work for that stage and the required status of the Gen 4#3 Contract Deliverables at the end of that stage.

(d) Once the Technical Representative and Contractor are confident that Contractor and Gemini shall have all end-of-stage deliverables ready by a certain date, the Technical Representative shall determine the date of the review.

(e) Contractor and AURA shall schedule two days for each end-of-stage review.

(f) The location for the reviews is as follows:

Stage Review	SOW	Location of Review
Conceptual Design	Section 6	Gemini North Base Facility, Hilo, US
Preliminary Design	Section 7	Gemini North Base Facility, Hilo, US
Critical Design	Section 8	Gemini South Base Facility, La Serena, Chile
Pre-delivery Acceptance	Section 9	Contractor's Integration & Test Location
Post-delivery Acceptance	Section 10	Gemini South Base Facility La Serena, Chile
Commissioning & Science Verification	Section 11	Gemini South Base Facility La Serena, Chile

(g) The Gemini Associate Director for Development shall select an external review committee chair and shall select the review committee members with the advice of the review committee chair, if so requested. Gen 4#3 Steering Committee and NSF personnel may elect to attend the review. The Technical Representative will be responsible for making the logistical arrangements.

(h) Each end-of-stage review shall not relieve Contractor of any responsibility for the successful completion of the Work outlined in the Gen 4#3 Requirements. Similarly, no part of the review, including comments made during the review, can waive any of the Gen 4#3 Requirements or relieve Contractor of any contractual obligations.

(i) Contractor shall deliver the end-of-stage documentation to AURA for distribution to the review committee at least two weeks before the end-of-stage review.

(j) Gemini shall be responsible for all travel expenses and arrangements for Gemini staff and the review committee.

(k) Within 10 working days after the review, the review committee shall produce and deliver an End-of-Stage Review Report to the Gemini Associate Director for Development.

(l) Within 10 working days after receiving a report (the "Committee Report"), the Gemini Associate Director for Development shall deliver to the Technical Representative and the Program Manager a report (the "Project Executive Report") containing a list of recommendations and proposed actions for the project. The Gemini Associate Director for Development shall decide whether the Gen 4#3 project can proceed to the next stage or whether to require additional work (including, possibly, an additional review) to correct identified shortcomings.

5.5 Project Communication

(a) Primary Contacts and Communications: The primary contacts for this Work are the Technical Representative (for AURA) and the Program Manager (for Contractor). Although regular informal communications between AURA, Contractor personnel, and subcontractor personnel are encouraged to explore possible ideas and gather information, other than issues addressed in Section (c) below, all communications that might be construed as direction or permission to modify any aspect of the Gen 4#3 Requirements or design, including interfaces, must be made by means of written communications between the Technical Representative and the Program Manager. Both parties will explain this requirement to all staff involved in this work, and shall ensure that all design/requirement modifications go through the primary contacts.

(b) Technical Representative's role: Contractor acknowledges that the Technical Representative is the only person with authority to provide technical direction with regard to the Work, and that no other person, committee, or board has any authority to direct or influence any aspect of the Work. In the event that Contractor receives direction or a suggestion from any other source that Contractor feels has merit, it shall communicate the direction/suggestions to the Technical Representative with its recommendations, and the Technical Representative shall make a decision in consultation with the Program Manager.

(c) Sections 5.4 a and b notwithstanding, the Statement of Work may be modified only by change order and/or contract amendment , as described in Article 5 of the main contract. The Technical Representative does not have authority to modify anything in this Statement of Work. This Statement of Work may be modified only by means of a written document signed by the AURA Contracts Officer and accepted by Contractor. Verbal agreements or direction from anyone other than the AURA Contracts Manager to modify or add work or requirements are void; if anyone at AURA gives Contractor any direction that shall result in a change to the Contract Price, Completion Date, Gen 4#3 Requirements, or Statement of Work, or that may give rise to schedule delays, Contractor shall not implement the direction but shall instead promptly contact the AURA Contracts Officer and request guidance on how to proceed.

(d) When the contract requires that something be documented "in writing," there is no requirement that the writing be in hard copy format unless a hard copy is specified explicitly; email and electronic documents satisfy this requirement.

6 Conceptual Design Stage: Statement of Work

(a) This section describes the Work to be performed by Contractor during the Conceptual Design Stage of the project.

(b) The stage shall begin with a kickoff meeting and conclude with an end-of-stage review as stated in Section 5.4.

(c) Contractor shall prepare a conceptual design for the Gen 4#3 Instrument and perform all analyses and trade studies reasonably required to demonstrate that these design concepts meet all of the Gen 4#3 Requirements.

(d) Contractor shall create the Conceptual Design Documentation Set as described in Appendix A.

(e) Contractor shall build its science team to be inclusive of professional scientists across the partnership.

(f) If the Conceptual Design Stage is not competed, the stage shall conclude with an end-of-stage review as described in Section 5.4.4.

(g) If the Conceptual Design Stage is competed, Contractor shall present the results of the conceptual design study to the review committee at the Conceptual Design Review as provided in Section 6.1 below.

6.1 Competed Conceptual Design Stage Review and Selection Process

(a) Gemini shall provide Contractor with a set of selection criteria at or shortly after the Conceptual Design Stage Kickoff meeting.

(b) Gemini shall select the review committee chair and review committee members and send Contractor a list of their names by no later than eight weeks before the conceptual design review. Contractor shall have 10 days to notify the Technical Representative of any conflicts of interest it has to any review committee member.

(c) Gemini may fund one or more teams in addition to Contractor to perform competing conceptual design studies. All teams will have the same amount of time to complete their studies. Gemini shall conduct the Conceptual Design Review (CoDR) after all teams have finished their scheduled work and submitted their Conceptual Design Review documentation.

(d) Contractor shall deliver the conceptual design stage documents to Gemini at least three weeks before the CoDR.

(e) Contractors shall not be allowed to see the competing teams' CoDR documentation. This material shall only be available to the review committee and Gemini.

(f) The CoDR shall be held at the Gemini Base Facility, Hilo, and last one day.

(g) Gemini shall be responsible for all travel expenses of review committee members.

(h) The review committee shall use the selection criteria provided pursuant to item (c) above to evaluate the Conceptual Design Documents.

(i) The results of CoDR process shall not relieve Contractor of any responsibility for the successful completion of the Work in conformity with the Gen 4#3 Requirements. Similarly, the committee report, including comments made during the review, cannot waive any of the Gen 4#3 Requirements or relieve Contractor of any obligations under this Contract.

(j) Within 15 working days of the CoDR, the review committee chair shall submit a written committee report to Gemini giving the committee's recommendations on how to proceed with the project.

(k) After receiving the committee recommendations, Gemini may meet with Contractor, either in person or via videoconference, to discuss and seek clarifications regarding the CoD Documentation before making a final selection.

(l) Gemini shall make a final selection based on the review committee recommendations and any clarifications provided during follow-up meetings with Contractor. In consultation with its governance, AURA shall make the final decision on how Gemini will proceed.

(m) AURA reserves the right to cancel this Gen 4#3 Instrument after the Conceptual Design Stage at its sole discretion.

7 Preliminary Design Stage: Statement of Work

(a) This section of the Statement of Work describes the Work conducted by Contractor during the Preliminary Design Stage of the project.

(b) The stage shall begin with a kickoff meeting and conclude with an end-of-stage review as stated in Section 5.4.

(c) Contractor shall expand on the information contained within the Conceptual Design Documentation Set to create the Preliminary Design Documentation Set as described in Appendix A.

(d) Contractor shall prepare a Preliminary Design for the Gen 4#3 Instrument, Gen 4#3 Associated Hardware, and Gen 4#3 Associated Software that is a continuation of the design presented in the Conceptual Design Study Documentation listed in Appendix A. Contractor shall complete the following tasks for the design to be considered a preliminary design:

1) All design trades options shall be resolved and the detectors and controllers have been selected and justified.
2) All major design risks shall be eliminated or reduced to an acceptable level.
3) All telescope interfaces shall be verified.
4) Procurement methods for all mechanisms (purchased commercially, subcontracted, produced in-house, etc.) shall be resolved.
5) All system budgets (performance, error, mass, power, etc.) and tolerances shall be established and documented.
6) Preliminary performance analysis of the opto-mechanical design shall be performed including, but not necessarily limited to:
    1. Sensitivity analysis;
    2. Ghosting;
    3. Scattered Light;
    4. Instrument throughput vs. wavelength calculated at 100nm intervals across the entire wavelength; and
    5. Performance degradation consistent with the flexure, vibration, and tolerance analyses of the instrument design.
7) Instrument vibration analysis, including both vibrations generated by the instrument and those received from the telescope/environment, shall be performed with particular attention paid to vibration effects on instrument stability and the vibrations transmitted to the Instrument Support Structure from the instrument.
8) The software design shall be detailed as follows:
    a) An overview of the software architecture for the chosen solution. All the major software components shall be described. The associated hardware and physical layout of the software components shall be included.
    b) Information shall be included on items to be controlled, sequencing issues, and FITS data formats the instrument will write. The initial dictionary of status items and configuration items shall be produced.
    c) The software design shall be described to the level of detail required to explain how the system will operate under typical required situations using a uniform methodology.
    d) A demonstration of how instrument status, sequence commands, and events flow in the system shall be included.

e) A set of user scenarios (or use cases) demonstrating how the software will enable the science objectives of the instrument.
f) Plans for or progress on the Engineering User Interface that shall be used for acceptance testing. This shall include an overall description of the design and required software tools.
g) Detector controller software/firmware preliminary design.
h) A preliminary set of internal system interface documents. All interfaces between internal hardware or software subsystems shall be defined and documented, including any software systems from third-party vendors.
i) A description of required development platforms and tools shall be included, highlighting what needs to be acquired. Development plans that show collaborative development and testing as outlined in the "Guidelines for Designing Gemini Instrument Software" document shall be described.
j) A summary of data processing choices shall be documented. An initial list and design description of data processing pipeline recipes tied to the major instrument observing modes shall be included. Essential calibrations data and procedures associated with those recipes shall be identified. Relevant software components and algorithms shall be identified and show how pipeline integration will occur. Execution times and processing requirements for data processing shall be estimated, and data processing-related risks shall be identified.
k) Identify software milestones and releases and schedule points for Gemini collaborative testing at each milestone (at least once every four months).
l) A description of the computing hardware, networking, and any extra hardware needed to interface the computing system to the instrument shall be provided. This information shall be final or near final at this stage.

8 Critical Design Stage: Statement of Work

(a) This section of the Statement of Work describes the Work to be performed by Contractor during the Critical Design Stage of the project.

(b) The stage shall begin with a kickoff meeting and conclude with an end-of-stage review as stated in Section 5.4. The end-of-stage review shall include a dedicated safety review.

(c) Contractor shall expand on the information contained within the Preliminary Design Documentation Set to create the Critical Design Documentation Set as described in Appendix A.

(d) Contractor shall create a budget to completion for the Gen 4#3 Instrument based on obtained quotations.

(e) Contractor shall prepare a Critical Design for the Gen 4#3 Instrument, Gen 4#3 Associated Hardware, and Gen 4#3 Associated Software that is a continuation of the design presented in the Preliminary Design Study Documentation. The Critical Design shall be considered complete when (1) all of the tasks listed below are complete and (2) the instrument design is complete and demonstrated to meet all the Gen 4#3 Requirements. In preparing the critical design, Contractor shall prepare at least:

1) A complete set of 3D models of the instrument including all its subassemblies;
2) A complete set of 2D manufacturing drawings;
3) A complete set of quotations for all component procurements;
4) Assembly drawings of all mechanisms with analyses to show they meet the Requirements (including the opto-mechanical tolerances);
5) Complete designs of any necessary cooling systems, including strap designs, length, gauge, number of strands, etc.;
6) Complete electronics design with all mechanisms enumerated, sources established (commercial, custom, etc.), and needed modifications detailed;
7) Full designs and schematics, suitable for conversion to manufacturing drawings, for all custom electronic components;
8) Final layout of electronics cabinets, including cable layout;
9) A "Finite Element Analysis (FEA)" of the instrument's flexure (including cabling, electronics cabinets, etc.) at a range of orientations to a level of detail appropriate for the instrument;
10) A "Failure Mode and Effects Analysis" (FMEA) identifying the instrument's potential failure modes and their consequences, to a level of detail appropriate for the instrument;
11) A final, appropriate baffle design;
12) A final, appropriate stray light and ghost analysis in all operational modes, demonstrating the necessary performance can be met;
13) Alignment tolerances and procedures for all optical elements;
14) Detailed layout of electronics cabinets including location and mounting of each component along with power consumption and mass estimates for each component and the fully populated cabinet.
15) The planned cable layout, illustrating for each cable its major function, power and signals, types of connectors on each end, type of cable wire used (number of conductors, wire gauge, insulating material, and shielding), length, and routing.
16) Software materials progressed since the Preliminary Design Stage to include, at a minimum, the following:

a) The software documentation shall completely explain the design of the software system and demonstrate proper operation of the instrument in the Gemini control system.
b) The information shall include the detailed design of the software. All the major software components shall be described at the level needed to code. The document shall be at a stage such that any senior software engineer can understand how the software system works.
c) Final information shall be included on components of the instrument controlled by software, list of sequencing issues, and FITS data formats the instrument will write.
d) A final dictionary of status items and configuration items.
e) A thorough demonstration of how instrument status, sequence commands, and events flow in the system using diagrams.
f) A set of user scenarios (or use cases) demonstrating how the software will enable common modes of operation in the ConOps.
g) Final design of the Engineering User Interface that will be used for acceptance testing.
h) Detector controller software/firmware final design.
i) A build set of Internal System Interface Documents. All interfaces between internal and external hardware or software subsystems shall be finalized and documented.
j) The final data processing design shall be documented including the final list of data processing pipeline recipes and calibrations tied to the major instrument observing modes. All choices, algorithms, products, and data formats shall be well documented. A description of common observing modes and how the associated processing integrates with the Gemini pipeline software shall be provided. Final performance estimates and hardware requirements and/or assumptions will be included as well as any remaining significant issues or risks identified.
k) All software milestones and releases shall be identified, and schedule points for Gemini collaborative testing at each milestone shall be identified. Software release milestones shall be no less frequent than approximately once every four months.
l) The final design of the computing hardware, networking, and any extra hardware needed to interface the computing system to the instrument shall be provided.

9 Assembly, Integration, and Verification [AIV] Stage: Statement of Work

(a) This section of the statement of work describes the Work conducted by Contractor during the Assembly, Integration, and Verification (AIV) Stage of the project.

(b) The stage shall begin with a kickoff meeting and conclude with an end-of-stage review as stated in Section 5.4.

(c) Contractor shall create the AIV Documentation Set as described in Appendix A.

(d) Contractor shall successfully manufacture, build, and assemble subsystems and integrate, align, and characterize the Gen 4#3 Instrument such that the Gen 4#3 Instrument shall meet all the Gen 4#3 Requirements. Contractor shall perform the integration of the Gen 4#3 Instrument in conformance with the procedures in the approved final Assembly, Integration and Verification Plan, see Section A.19.

(e) Contractor shall begin system acceptance testing once the Gen 4#3 Instrument is fully assembled and characterized. Contractor shall test integrated system performance as described in the final version of the Acceptance Test Plan, see Section A.11. Contractor shall verify that the completed Gen 4#3 Instrument meets all of the Gen 4#3 Requirements. Where possible, Contractor shall verify by test and include the following:

(1) Tests of system performance using calibration source(s) or a telescope simulator at the input focal plane.
(2) Tests of integrated system performance in a simulated science observation sequence, including imagers, spectrographs, and data reduction products.
(3) Tests of the assembled Gen 4#3 Instrument in an appropriate environment to verify operation at typical telescope temperatures and temperature changes.
(4) Tests of the assembled Instrument on a variable gravity vector test stand to verify expected structural flexure limits are not exceeded.
(5) Characterize the vibration signature of the assembled instrument.

(f) Contractor shall promptly notify the Technical Representative of any testing results that indicate that a particular requirement shall not be met.

(g) Contractor shall create the Pre-Delivery Acceptance Test Report, (pre-ATR; see Section A.22), documenting the results of all of the tests described in the Acceptance Test Plan (ATP; see Section A.11), completing the performance matrix, and any revised changes to the ATP which were made during the integration and testing procedures.

(f) Contractor, assisted by AURA when possible, shall apply and obtain any International Traffic in Arms Regulations (ITAR) license(s) and/or other export control license(s) required before transporting the deliverables.

(g) Contractor, assisted by AURA when possible, shall obtain transportation and insurance quotations to transport the Gen 4#3 Contract Deliverables from Contractor's facility to the Gen 4#3 Delivery Location.

1. Contractor shall transport the Gen 4#3 Contract Deliverables with the least risk and least disassembly/reassembly practical.
2. Contractor shall use airfreight when transporting across and between continents.

10 Transportation and Telescope Integration [TTI] Stage: Statement of Work

(a) This section of the statement of work describes the Work conducted by Contractor during the Transportation and Telescope Integration (TTI) Stage of the project.

(b) The stage shall begin with a kickoff meeting and conclude with an end-of-stage review as stated in Section 5.4.

(c) Contractor shall create the TTI Documentation Set as described in Appendix A.

(d) Once AURA approves shipment, Contractor shall package the instrument in a manner that shall protect it from harm during transit in accordance with the specifications contained in ICD-G0013 (Gemini Environmental Requirements), and shall then ship the instrument to the Gen 4#3 Delivery Location.

(e) All packing materials must comply with the International Standard for Phytosanitary Measures (ISPM) Publication No. 15, Guidelines for Regulating Wood Packaging Material in International Trade.

(f) Contractor shall pack the Gen 4#3 Contract Deliverables into transportation containers and include an appropriate and usable number of:

1. Shock sensors internal to the transportation containers,
2. Shock sensors external to the transportation containers, and
3. Tilt sensors external to the transportation containers.

(g) Contractor shall insure the instrument against loss or damage during shipment for the full replacement cost of the instrument, with AURA and Contractor both named as loss beneficiaries.

(h) Before the instrument leaves Contractor's facility, Contractor shall fax a copy of the bill of lading, waybill, and insurance documentation, to the AURA Contracts Manager and send the originals by courier service to the Gen 4#3 Delivery Location. To the extent the bill of lading and waybill do not specify the following information, Contractor shall include it on a separate sheet included with the bill of lading and waybill:

- Weight and dimensions of each package;
- Lifting method to be used with each package, i.e. slings, forklift, or other;
- Estimated date of arrival;
- Employee of Contractor to contact with questions about the shipment.

(i) Before the instrument or any documentation leaves Contractor’s facility, Contractor shall ensure that all licenses and documentation for export have been obtained for full compliance with the ITAR, as well as all other United States and other applicable region’s laws and regulations controlling the transfer of technology to other nations.

(j) Contractor personnel shall direct AURA-supplied technical personnel in unpacking the instrument and any necessary assembly/configuration according to the Transportation and Telescope Integration Plan (TTIP; see Section A.18).

(k) Before beginning telescope integration, Contractor shall perform basic fitness tests to verify the Gen 4#3 Instrument survived transportation to the Gen 4#3 Delivery Location. Contractor shall compare test

results against those obtained in the pre-ATR. Contractor shall perform a subset of acceptance tests before telescope integration. These tests may include additional flexure testing on the instrument test rig. Contractor shall remedy any discovered issues.

(l) Contractor shall perform all the telescope integration tasks, inspections and post-delivery tests described in the TTIP, following the procedures in the ATP, with assistance from AURA. Unless otherwise specified, Contractor shall provide all personnel and equipment necessary to perform the post-delivery tests and inspections.

(m) At the conclusion of the initial round of post-delivery testing, AURA shall review the results of all of the post-delivery tests and inspections specified in the TTIP and ATP. AURA shall then provide Contractor with a written list of all instrument deficiencies that must be corrected. Contractor shall correct all the noted deficiencies and submit new test and inspection results showing that the deficiencies have been corrected.

(n) Once AURA is satisfied that the TTIP has been completed and the Instrument meets all of the Gen 4#3 Requirements after delivery, and that all other Gen 4#3 Contract Deliverables, including documentation, meet all contract requirements, it shall give Contractor written notice that the instrument has successfully passed all of the tests and inspections described in the Acceptance Test Plan, and appears to meet all the Gen 4#3 Requirements. AURA shall then set a date for the end-of-stage review.

11 Commissioning and Science Verification [CSV] Stage: Statement of Work

(a) This section of the statement of work describes the Work conducted by Contractor during the Commissioning and Science Verification (C&SV) Stage of the project.

(b) The stage shall begin with a kickoff meeting and conclude with an end-of-stage review as stated in Section 5.4.

(c) Contractor shall create the C&SV Documentation Set as described in Appendix A.

(d) Contractor and AURA shall perform the tasks included in the Commissioning and Science Verification Plan (CVSP; see Section A.23).

(e) The commissioning and science verification team shall include members selected by Contractor, the Technical Representative, and other appropriate members of the Gemini staff.

11.1 Science Data during Commissioning and Science Verification Stage

(a) All science data collected with the Gen 4#3 Instrument during this stage shall be exclusively available to the members of the commissioning and science verification team during the proprietary period (see below). Contractor members of the verification and commissioning team shall promptly lead and/or approve any publication(s) of verification and commissioning science data.

(c) The proprietary time for science data taken during this stage shall be determined by the Gemini Director.

(d) Gemini may decide to incorporate all science data collected during this stage into the Gemini Science Archive.

(e) Prior to entering the public domain, no science data from the stage may be released through publications, press releases, Web pages, etc., without the express consent of AURA.

(f) Scientific publications by the Gen4#3 Instrument team using data taken during this stage shall include the Technical Representative, the Gemini Instrument Scientist and other contributing members of Gemini as co-authors. They shall also include the following acknowledgment or its successor:

> *"Based on observations obtained at the Gemini Observatory, which is operated by the Association of Universities for Research in Astronomy, Inc., under a cooperative agreement with the NSF on behalf of the Gemini partnership: the National Science Foundation (United States), the National Research Council (Canada), CONICYT (Chile), Ministerio de Ciencia, Tecnología e Innovación Productiva (Argentina), and Ministério da Ciência, Tecnologia e Inovação (Brazil)."*

See www.gemini.edu for the latest version.

12 Performance Related Telescope Time (TT)

(a) The Gemini Board has agreed to provide Contractor with Telescope Time (TT) to use the Gen 4#3 Instrument by meeting budget and schedule as described in Article 4 of the contract.

(b) Telescope Time shall be awarded as classical time.

(c) All provided TT must be used for observations using the Gen 4#3 Instrument and not for observations using other instruments. Telescope Time granted pursuant to this agreement shall nominally be split evenly during each semester the Gen 4#3 Instrument is operational over a maximum period of 3 years. For example, if Contractor is awarded 12 nights of TT, the time can be used as quickly as 4 nights for the next 3 semesters, or as slowly as 2 nights for the next 6 semesters. The requested distribution is at the Gemini Director's discretion.

(d) Telescope Time shall be scheduled starting at the same time as the first public access to observing time using the Gen 4#3 Instrument (i.e. regular PI proposals).

(e) The exact dates of the nights allocated for TT shall be determined by the Gemini Director in his/her sole discretion. If a night is not usable because of weather or technical problems, a replacement night shall not be allocated.

(f) Targets to be observed during TT shall be submitted to Gemini using the same mechanism as used for public access proposals, and by the same deadlines. The TT observing team may specify whether targets are to be confidential or public. Confidential targets shall not be protected from duplicate observations by other teams. Gemini does not allow duplicate observations of public targets.

Appendix A: Gen4#3 Documentation Set

This appendix contains a description and scope for each deliverable document. Table 1 lists each document and shows the project stages in which each document must be submitted to Gemini for the end-of-stage review assessment. The letter *D* signifies a *draft* version of the document while *cc* means the document goes under change control at the start of that stage.

Phase	Doc No.	Deliverable	Section	Stage					
				CoDR	PDR	CDR	AIV	TTI	CSVR
Design	XXXX-01	Project Management Plan (PMP)	A.1	✓ CC	✓	✓	✓	✓	
	XXXX-02	System Engineering Management Plan (SEMP)	A.2	✓ CC	✓	✓	✓	✓	
	XXXX-03	Safety Management Plan (SMP)	A.3	✓ CC	✓	✓	✓	✓	
	XXXX-04	Science Cases	A.4	✓ CC	✓	✓	✓	✓	✓
	XXXX-05	Concept of Operations Document (ConOps)	A.5	✓ CC	✓	✓	✓	✓	✓
	XXXX-06	Requirements Document (RD)[1]	A.6	✓	✓	✓	✓	✓	✓
	XXXX-07	Conceptual Design Document (CoDD)	A.7	✓					
	XXXX-08	CoD End Stage Report	A.8	✓					
	XXXX-09	Preliminary Design Stage Plan	A.9	✓					
	XXXX-10	Preliminary Design Document (PDD)	A.7		✓				
	XXXX-11	Instrument Interface Control Documents (ICD)	A.10		✓ D	✓ CC	✓	✓	✓
	XXXX-12	Acceptance Test Plan (ATP)	A.11		✓ D	✓ CC			
	XXXX-13	PD End Stage Report	A.8		✓				
	XXXX-14	Critical Design Stage Plan	A.9		✓				
	XXXX-15	Critical Design Document (CDD)	A.7			✓			
	XXXX-16	Service and Maintenance Manual (S&MM)	A.12			✓ D	✓**cc**	✓	✓
	XXXX-17	User Manual (UM)	A.13			✓ D	✓**cc**	✓	✓
	XXXX-18	Technical Manual (TM)	A.14			✓ D	✓**cc**	✓	✓
	XXXX-19	Software Maintenance Manual (SMM)	A.15			✓ D	✓**cc**	✓	✓
	XXXX-20	Data Reduction Software Programmer Manual (DRPM)	A.16			✓ D	✓**cc**	✓	✓
	XXXX-21	Data Reduction Software User's Manual (DRUM)	A.17			✓ D	✓**cc**	✓	✓
	XXXX-22	Transportation & Telescope Integration Plan (TTIP)	A.18			✓ D	✓**cc**		
	XXXX-23	Assembly, Integration and Verification Plan	A.19			✓			
	XXXX-24	CD End Stage Report	A.8			✓			
	XXXX-25	AIV Stage Plan	A.9			✓			
Build	XXXX-26	As-built records	A.20				✓**cc**	✓	✓
	XXXX-27	Recommended Spares List	A.21				✓ **cc**	✓	✓
	XXXX-28	Pre-Delivery Acceptance Test Report (pre-ATR)	A.22				✓		
	XXXX-29	Commissioning & Science Verification Plan (CSVP)	A.23				✓ D	✓**cc**	
	XXXX-30	Science Campaign Proposal	A.24				✓		
	XXXX-31	AIV End Stage Report	A.8				✓		
	XXXX-32	TTI Stage Plan	A.9				✓		
Telescope Integration & Comm.	XXXX-33	Transportation & Telescope Integration Report (TTIR)	A.25					✓	
	XXXX-34	Post-Delivery Acceptance Test Report (post-ATR)	A.26					✓	
	XXXX-35	TTI End Stage Report	A.8					✓	
	XXXX-36	C&SV Stage Plan	A.9					✓	
	XXXX-37	Commissioning and Science Verification Report (CSVR)	A.27						✓
	XXXX-38	Gen 4#3 End Project Report	A.28						✓

[1] see document description for change control D = draft, CC = change control

Table A.1 Matrix listing end of stage document deliverables.

Contractor shall specify the *XXXX* prefix.

Each document should contain a title page containing at least: the document title, document number, author, author's institute, contract number, version number, release date, page number, and total number of pages.

Each page of each document should contain at least the document title, document number, version number, release date, page number, and total number of pages.

Each deliverable document contained within Appendix A should be delivered in source file (e.g. *.docx, .mpp, .xlsx,* etc.) and in *.pdf*.

Some documents shall either comprise of or be accompanied and supported by, electronic materials of an alternative file format. For example: wiring diagrams, 3d models, OpticStudio (formerly known as ZEMAX) files, Microsoft Project files, etc.

Each deliverable specifies what accompanying/supporting documents are required.

Each document should be written with brevity and only include content which will assist readers in dealing effectively with the information.

A.1 Project Management Plan [PMP] (XXXX-01)

A.1.1 **Purpose**

The purpose of the Project Management Plan [PMP] is to communicate Contractor's project management approach, methodology, practices, processes, and tools they shall apply through the lifetime of the project. The PMP shall also communicate the specifics related to the creation, monitoring, and control of management elements including budget, schedule, risk, work elements, resources, and communication.

A.1.2 **Description**

The PMP shall expand on relevant material contained within the proposal to describe how the management team shall manage the project from start to end.

The PMP shall include a description of the project management team's approach and methodology, including any incorporated institutional practices and standards. It should also describe any project management support and training available to the management team by the host institute such as a project management office and any active mentoring arrangements. It shall include details of any other support needed to successfully manage the project such as accounting, contracts, and finance. It shall include details of the project approach to ensure all deliverables, including documentation, are developed meeting requirements and delivered on time.

The PMP shall include a section that describes project management processes and tools covering organizational project resource allocation processes, budget creation and monitoring tools, schedule tracking and monitoring tools, the process for assigning risk mitigation budget, and schedule contingencies. The section should include what information is provided by each institute to the project and how it is processed by the project and reported to Gemini.

The PMP shall include an organizational structure and a description of how the management team fits into its institutional organizational chart. It shall include project organizational chart(s) displaying the project relationship between institutions and individuals including external stakeholders. It shall describe the roles, responsibilities, and relevant experience of the project's key personnel, including the levels of effort for each. It shall list backup options available for key team personnel.

The PMP shall include a communication plan for the project including details of internal and external meeting and reporting. It shall explain how communication and reporting shall be managed and monitored. It shall describe how Gemini staff will be able to access Contractor documentation during the project.

The PMP shall describe the Work Breakdown Structure (WBS) in enough detail to facilitate reliable costing and tracking throughout the lifetime of the project. Each WBS element shall include the duration, cost, and workforce required. The section should describe how any portions of the work will be subcontracted. The WBS, itself, shall be attached as an appendix.

The PMP shall include a project budget, demonstrating how it is derived from the work packages listed in the WBS. It shall provide enough detail from the WBS along with the corresponding labor hours and charge rates for each task, such that an independent cost analysis may be performed at any point in time. It shall include three-point cost estimates to obtain overall cost margins. This budget section shall describe how costs will be managed, tracked, and controlled during the lifetime of the project. It shall

describe how Contractor intends to use the risk mitigation budget, along with schedule and scope contingency to actively control budget. An appendix shall contain the details of the budget (the “Cost Breakdown”).

The Cost Breakdown shall contain a list of the expected procurements, describing all major and/or significant components and materials that will need to be purchased. This list shall include the description of the component/material, the estimated quantity, the estimated price with a margin of error, a description of the source of pricing information, the estimated date the procurement will need to be initiated, the estimated vendor's lead time, and the date the item is needed.

The PMP shall describe how the schedule was created. It shall include stage delivery dates with a margin of error and provide an explanation on the schedule structure, schedule reserve and critical path. It shall include a description of the development and delivery schedule for the instrument (through all stages). It shall demonstrate how the schedule adequately accommodates known risks and likely variations in the plan. It shall clearly identify decision points, especially those related to up-scope and descope options. This section shall describe how the schedule shall be managed, tracked, and controlled during the lifetime of the project. A project Gantt chart shall be attached as an appendix and shall clearly identify all stages of the project, each major work package, dependencies, milestones, long lead items, schedule reserve and shall clearly display the critical path.

The PMP shall describe how risks are identified, categorized, assigned, assessed (for probability and impact), and managed. It shall describe the overall risk management and mitigation approach. It shall describe the major risks identified at the start of the project and include a narrative description of the research, analysis, or demonstrations that would need to be done to establish the viability of any key or high-risk components. A risk register shall be attached as an appendix. It shall include key risks to schedule, cost, performance, personnel, or any other aspect that would prevent the project from being successful.

Contractor’s facilities and subcontractors’ facilities must be described. These descriptions will be used during the lifetime of the project. The PMP shall also describe how Contractor shall manage facility resource loading and what backups exist for needed facilities.

A.1.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Project Management Approach, Methodology, and Support
- Project Management Processes and Tools
- Project Structure, Roles, and Responsibilities
- Project Communication, Reporting, and Monitoring
- Project Work Breakdown Structure
- Project Budget, Cost Management and Control
- Project Schedule, Schedule Management and Control
- Project Risk Management, Register, and Mitigation Plans
- Facilities

A.1.4 **Change Control**

This document shall be created during the Conceptual Design Stage and reviewed at the Conceptual Design Review. It shall then be placed under change control and kept up-to-date and resubmitted at every stage review except the Commissioning and Science Verification Review.

A.2 System Engineering Management Plan [SEMP] (XXXX-02)

A.2.1 **Purpose**

The purpose of the System Engineering Management Plan (SEMP) is to communicate the Contractor's system engineering approach, methodology, practices, processes and tools it shall apply to the project during its duration.

A.2.2 **Description**

The SEMP shall expand on the material contained within the proposal to describe how the management team shall employ systems engineering to manage the technical aspects of the project from start to end.

The SEMP shall include a description of the management team's general approach and methodology to technical management and system engineering, including any incorporated institutional practices and standards. It shall also include the system engineering support, training, and mentoring available to the team by their host institute.

The SEMP shall include a section describing how systems engineering roles and responsibilities are organized within the team. It should also include the system engineering communications methods used within the project.

The SEMP shall include sections that describe the project's systems engineering approach for requirements management, interface management, budget management, information and configuration management, quality management, and verification management. Each section shall describe the process(es) employed, any tools used, the process owners, location and structure of information, and how change control is supported. These sections should also include what technical information each institute is to provide to the project and how it is processed and reported to Gemini.

The SEMP shall include a requirement management section describing how requirements (science and technical) were structured and created, how they will be flowed down, and how they will be managed, cross referencing the Requirements Document as appropriate.

The SEMP shall include an interface management section on interface definition. It shall describe how project interfaces were created, the current architecture, and how the interfaces shall be maintained and verified.

The SEMP shall include a performance management section describing the performance, error and tolerance budgets including how they were constructed, how contingency was determined, and how they will be maintained throughout the projects. The Performance/Error Budgets shall be attached as an appendix.

The SEMP shall contain an information and configuration management section detailing the configuration management process used for this project including how documents will be numbered, stored, and accessed by partners.

The SEMP shall include a quality management section describing the activities and techniques used to realize quality. These include optimization of science and operational performance through the use of various analysis and trade studies during design, measurement or inspection of completed parts, issue tracking and resolution, and internal and external reviews.

The SEMP shall include a verification management section describing the verification methods that will be used, including details such as planned modeling and simulation, and test events.

The SEMP shall include sections that describe the project's systems engineering activities that occur during each stage of the project.

A.2.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- System Engineering Approach and Methodology
- System Engineering Processes
    - Requirements management
    - Interfaces management
    - Budgets management
    - Information and configuration management
    - Quality management
    - Verification management
- Project Stages and Systems Engineering Activities

A.2.4 **Change Control**

This document shall be created during the Conceptual Design Stage and reviewed at the Conceptual Design Review. It shall then be placed under change control and resubmitted at every stage review thereafter with the exception of the Commissioning and Science Verification Review.

A.3 Safety Management Plan [SMP] (XXXX-03)

A.3.1 **Purpose**

The purpose of the Safety Management Plan (SMP) is to communicate the project's approach to keeping personnel and the instrument safe during the project.

A.3.2 **Description**

The SMP shall summarize the aspects of the project that could represent a hazard to personnel, the environment or the instrument. It shall detail safety policy and applicable safety documents, safety requirements for the design process, instrument-specific operational safety issues, areas of risk to the instrument, troubleshooting cautions, and transportation.

The SMP shall be a comprehensive summary with appropriate references to the definitive procedures. It shall identify and mitigate risks associated with all the identified hazards to personnel, the instrument and the facility.

The SMP shall include safety procedures applying to the entire lifespan of Gen 4#3 Instrument, including construction, integration, commissioning, and operations.

The SMP shall describe any training and certification required for all personnel to perform critical tasks or procedures.

A.3.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Institutional Safety Policies and Procedures
- Applying Safety to the Project
- Specific Safety considerations
    - During the Design Phase
    - During the Build Phase
    - During the Telescope Integration and Commissioning Phase

A.3.4 **Change Control**

This document shall be created during the Conceptual Design Stage and reviewed at the Conceptual Design Review. It shall be placed under change control and resubmitted at every stage review thereafter.

A.4 Science Cases (XXXX-04)

A.4.1 **Purpose**

The purpose of the Science Cases document is to communicate the science cases for the instrument.

A.4.2 **Description**

The document describes the science cases for the instrument and motivates the scientifically required operations modes and scenarios that are developed in the ConOps. It provides a narrative explaining how the instrument design satisfies the science requirements that result from the presented science cases. The science requirements themselves are derived from these science cases, but are included in the Requirements Document.

A.4.3 **Composition (Shall include, but be not limited to, the following sections)**

- Science Cases
- Science Requirements
- Competition
- Science Cases Linked to Instrument Parameters
- Motivations for Operating Modes

A.4.4 **Change Control**

This document shall be created during the Conceptual Design Stage and reviewed at the Conceptual Design Review. It shall then be placed under change control and resubmitted at every stage review thereafter.

A.5 Concept of Operations Document [ConOps] (XXXX-05)

A.5.1 **Purpose**

The purpose of the Concept of Operations Document (ConOps) is to communicate the instrument's operating modes and key operating scenarios.

A.5.2 **Description**

The ConOps presents the concept of operations. It describes each of the instrument's operating modes and key operating scenarios. It contains specific example science observations created from the science cases, which then lead to a detailed description of the required operating and instrument modes necessary to complete them. Some instrument and operational requirements in the Requirements Document are then based on the needs derived here. The operating scenarios shall be described in sufficient detail for a technically and scientifically skilled, but non-expert, audience to understand. Operating scenarios shall be presented to be comprehensible to a person familiar with telescope operations in general, but not Gemini, specifically. Besides being used to derive some of the operations related requirements in the RD, this section of the ConOps shall later form the basis for the instrument User's Manual.

A.5.3 **Composition (Shall include, but be not limited to, the following sections)**

- Instrument Overview
- Instrument Operating Modes
- Daytime Calibrations
- Nighttime Observations
- Data Processing, Reduction, and Pipeline

A.5.4 **Change Control**

This document shall be created during the Conceptual Design Stage and reviewed at the Conceptual Design Review. It shall then be placed under change control and resubmitted at every stage review thereafter.

A.6 Requirements Document [RD] (XXXX-06)

A.6.1 **Purpose**

The purpose of the Requirements Document (RD) is to communicate the requirements associated with the Gen 4#3 Contract Deliverables, mostly the Gen 4#3 Instrument.

A.6.2 **Description**

The RD shall contain all the requirements pertaining to the deliverables, mostly for the instrument and supporting hardware and software. It shall contain all science, instrument, system, subsystem, and component requirements. Each requirement shall follow the structure communicated in the SEMP and should be either derived from the primary sources (for example: science cases, Gemini requirements, interface control documents) or flow down from other requirements that are in turn derived from the above three primary sources.

Appendix A of the Gemini Instrument Common Requirements document describes a set of recommended data fields and the following fields are required for each requirement:

- A unique identifying number to make it easy to reference
- A running, consecutive version number and corresponding date.
- The source(s) used to derive it including a brief description of how the requirement was derived from its source along with any assumptions made in the derivation.

Each requirement must be captured such that it is objectively verifiable at some stage in the project. Each requirement must identify the intended method(s) and project stage(s) of verification.

A.6.3 **Composition (Shall include, but be not limited to, the following sections)**

See Appendix A of the Gemini Instrument Common Requirements document.

A.6.4 **Change Control**

The RD Science and System level requirements go under change control at the end of the Preliminary Design Stage. The remainder of the requirements go under change control at the end of the Critical Design Stage.

A.7 Design Document [DD](XXXX-07, XXXX-10 & XXXX-14)

This section covers the:

- Conceptual Design Document [CoDD]
- Preliminary Design Document [PDD]
- Critical Design Document [CDD]

A.7.1 **Purpose**

The purpose of the Design Document (DD) is to communicates the current design of the Gen 4#3 Instrument, the Gen 4#3 Associated Hardware, and the Gen 4#3 Associated Software.

A.7.2 **Description**

The DD shall expand on the design material contained within the proposal or the design document submit at the end of the previous stage to provide the current design of the Gen 4#3 Instrument, Gen 4#3 Associated Hardware, and Gen 4#3 Associated Software.

The DD shall begin with an executive summary followed by an introduction before providing a technical overview describing the high level design. Throughout the document relevant material contained in other deliverable documents should be adequately cross-referenced.

The DD shall include a technical overview section and include, at least, the following items:

- A description of the instrument's subassemblies.
- A summary of performed trades.
- Results of analyses and any trade studies performed during the stage. .
- Performance results of any instrument simulations.
- Flexure analysis taking into account both optical and mechanical effects.
- Opto-mechanical error budgets constraining or resulting from the baseline design. Details should be given for particularly difficult or challenging tolerances.
- A summary of existing component designs (hardware or software) to be used in the instrument as a means of reducing risk and/or development time.
- A summary of the technical high-risk items included in a risk register table.
- Remaining up-scope and descope options against the baseline.
- A description providing a comprehensive overview of the entire design of the instrument.
- A description of priorities in balancing science vs. performance trades.
- Science cases cross-referenced to instrument requirements. A summary of the flow down of the science cases cross-referenced to the instrument requirements, as listed in the Requirements Document. The ConOps develops this flow down in more detail, but a general overview and summary of the key science drivers and requirements is desired here.
- A compliance summary matrix comparing the requirements and the current design.

The structure of the remainder of the document should be such that it is easy to follow and links well with information provided in other documents. Whether arranged by work package or by discipline, the conceptual design document shall include the following items:

Optical design items:

- A depiction of the general layout of the optical components.

- A description of optical mounting schemes, including the general approach used to mount and align all optical components.
- A description of key risks associated with the optical design, e.g. long-term stability of optical alignment, manufacturability, coating reliability, expected lifetimes, etc.
- A summary of expected throughput.
- A summary of all optical elements contained in the instrument and coatings that will be used.
- A description of the throughput budgets.
- Detailed surface specifications (material, purity, surface curves, dimensions, scratch/dig, coatings, etc.) for each optical element so that replacements may be obtained if necessary.

Mechanical design items:

- An overview of the instrument's mechanical design.
- An overview of the instrument's subassemblies schematics in the mechanical layout.
- Designs (3D models / drawings) for all subassemblies.
- A description of the design elements that are common to multiple assemblies.
- Outline of instrument integration procedure to verify that there are no significant integration and testing challenges.
- Analysis showing there are no significant instrument handling or space envelope issues with the design as conceived.

Electrical design items:

- An overview of the instrument's electronic systems.
- Estimate of the number of separate control systems the electronics design must support.
- Description of approach to controlling stepper motors and actuators.
- A general layout and wiring scheme for major electronic components.
- A summary of the use of commercial vs. custom boards.
- A description of the detector and controller.

Software design items:

- An overview of the software architecture.
- Description of all major software components.
- Description of the instrument's status and commands.
- Description of development platform and tools.
- Description of processing design choices.

Data reduction software design items:

- An overview of the data processing choices and system design choices
- The data reduction architecture
- A list and description of data reduction recipes.
- A list of software tools needed to create, build and run the data reduction software
- Designs for each identify data reduction module.

Other items to be included:

- A current design description of the Gen 4#3 Associated Hardware and Software.

A.7.3 **Composition (Shall include, but be not limited to, the following sections)**

- Executive Summary
- Introduction
- Technical Overview
- Design details (structured to provide the best read and flow for the current stage)

A.7.4 **Change Control**

Once submitted, discussed, reviewed, and fully accepted (expected on successful completion of the stage review), the document shall be archived.

A.8 End Stage Report(s) [XXXX-08, XXXX-13, XXXX-24, XXXX-31, XXXX-35]

NOTE: This description covers all the End Stage Reports, one required for each stage, except the last.

A.8.1 **Purpose**

The purpose of the End Stage Report is to review the progress of the project to date including how the stage performed against the original project and stage plan baseline. It shall discuss the major successes and challenges of the stage, suggest future actions based on lessons learned, and include requests related to deviations associated with the next stage.

A.8.2 **Description**

The End Stage Report shall comment on the validity of the project's driving science cases considering the advances in astronomy during the stage, including the status of synergistic facilities and surveys. If the driving science cases are no longer valid, comment on new science cases that the instrument could still address.

The report shall review both the project and stage objectives and cover how the project has performed to date against its planned targets and tolerances for schedule, cost, quality, scope, and risk. This description shall include a comparison with the start of project baseline and the beginning of stage baseline. It shall include a review of key metrics.

The report shall include a review of team performance, particularly highlighting outstanding individual and team performance for project recognition.

The report shall review the status of stage deliverables and describe any shortfalls. It shall describe major successes and failures of the stage. The report shall contain report lessons learned, a review of what went well, what went badly, how the project may adapt going forwards, and any recommendations for Gemini's consideration.

It shall include the current set of issues and risks affecting the project and should include any requests related to deviations associated with the next stage.

The report shall conclude with a project manager's forecast for the project and the next stage against planned targets and tolerances for time, cost, quality, scope, benefits, and risks.

A.8.3 **Composition (Shall include, but be not limited to, the following sections)**

- Summary (Summarizing the stage performance)
- Review of the driving Science Cases
- Performance Review of Project and Stage objectives.
- Team Performance Review
- Stage Deliverable Status (major successes and failures)
- Lessons Learned
- Issues and risks
- Forecast

A.8.4 **Change Control**

Once submitted, discussed, reviewed, and accepted, the document shall be archived.

A.9 Stage Plan [XXXX-09, XXXX-14, XXXX-25, XXXX-32 & XXXX-36]

NOTE: This description covers all the Stage Plans, one required for each stage.

A.9.1 **Purpose**

The purpose of the Stage Plan is to communicate the tasks, schedule, and cost breakdown of the next stage of the project.

A.9.2 **Description**

The Stage Plan shall state the main objectives of the stage and how they shall be achieved. It describes the stage deliverables and the activities, resources and controls planned to produce them. The plan is used as a baseline against which to monitor stage progress.

The Stage Plan shall include any prerequisites, fundamental aspects that must be in place, and remain in place, for the plan to succeed. It shall also include external dependencies that may influence the plan.

The Stage Plan shall clearly state any assumptions made in its creation and any incorporated lessons learned from either previous stages and past projects.

The Stage Plan shall include details of how the stage shall be monitored and controlled. It shall include the summary of the scope, budget, and schedule. The stage plan shall also provide budget, schedule and scope tolerances for the stage.

The Stage Plan shall include tasks to produce the stage deliverables and tasks to manage the creation of stage deliverables – including tasks for assurance, quality management, risk management, configuration management, communication, and any other project controls required. All risks with active mitigations should have associated tasks in the plan.

Attached appendices shall include the latest version of the following items (as previously described in the PMP and SEMP): Performance and Error Budgets, Requirements, Gantt Chart, WBS, Cost Estimate, and Risk Register.

A.9.3 **Composition (Shall include, but be not limited to, the following sections)**

- Plan description
- Plan prerequisites
- External dependencies
- Planning assumptions
- Lessons incorporated
- Monitoring and control
- Budgets
- Tolerances Time
- Stage deliverable descriptions
- Schedule

Change Control

Once submitted, discussed, reviewed, and accepted, the document shall be archived once the described stage is complete.

A.10 Instrument Interface Control Documentation Set [IICDS] (XXXX-11x)

A.10.1 **Purpose**

The purpose of the Instrument Interface Control Documentation Set (IICDS) is to communicate the instrument's internal interfaces.

A.10.2 **Description**

The IICDS shall document all interfaces between internal hardware or software subsystems including any software systems from third–party vendors.

A.10.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Interface Details

A.10.4 **Change Control**

This document shall be created during the Conceptual Design Stage and reviewed at the Conceptual Design Review. It shall then be placed under change control and resubmitted at every stage review thereafter.

A.11 Acceptance Test Plan [ATP] (XXXX-12)

A.11.1 **Purpose**

The purpose of the Acceptance Test Plan (ATP) is to communicate the test plan for the instrument both pre- and post- delivery.

A.11.2 **Description**

For each top-level instrument and science requirement, the ATP shall contain a verification matrix containing the verification method (e.g. by analysis of the design document, by inspection of the completed hardware or software, or by execution of an acceptance test procedure) and that stage(s) during which (e.g. pre-delivery and/or post-delivery) the test shall occur.

For every requirement that is to be verified, the ATP shall contain sufficient information to plan the verification, perform the verification, and to repeat the verification at a later date.

For every requirement, the ATP shall name the person expected to carry out the verification and identify the estimated duration for configuring the instrument or associated test equipment, the duration of performing the verification, and the anticipated duration to perform adequate analysis.

The ATP shall clearly state the success criteria and any test prerequisites, including specific software or hardware needed, for each tested requirement.

A test set-up section should describe any special set-up either involving the instrument (such as being attached to a flexure rig, or within an environmental chamber) or attached to the instrument (such as a calibration sources or turbulence injector).

The step-by-step procedure for each verification procedure shall be sufficiently detailed to allow AURA to both evaluate the appropriateness of each procedure (with respect to the requirements and success criteria) and to repeat the test independently of Contractor.

The plan shall include a subset of the pre-delivery tests that shall be performed post-delivery to demonstrate that nothing has changed during transportation or in changing environments.

The ATP does not include on-sky tests. These tests are included in the Commissioning and Science Verification Plan.

A.11.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Verification Matrix [Test, Requirement, Stage of Verification (pre-delivery, post-delivery)]
- Test
    - Tester
    - Log
    - Estimate Duration (configuration time, test time, analysis, and report time)
    - Success Criteria
    - Prerequisites
    - Safety Issues
    - Test Set Up
    - Test Procedure

A.11.4 **Change Control**

The ATP shall go under change control when delivered.

A.12 Service and Maintenance Manual [S&MM] (XXXX-16)

A.12.1 **Purpose**

The purpose of the Service and Maintenance Manual is to provide Gemini with the information necessary to service and maintain the instrument.

A.12.2 **Description**

The S&MM shall include a list of inspection and maintenance procedures developed during the project. The S&MM shall describe each procedure, including its purpose, the duration required to perform it, and the recommended frequency of performance.

The S&MM shall reference specific as-built drawings as required for component identification and specifications. It shall reference the Technical Manual (see Section A.14) for procedures that are described there and shall reference the pre-delivery acceptance test report for results pertaining to testing as required.

A.12.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Safety
- Required Facilities and Equipment
- Regular inspection procedures
- Regular maintenance procedures
- Engineering Troubleshooting Guide

A.12.4 **Change Control**

The S&MM shall be under change control when delivered.

A.13 User Manual [UM] (XXXX-17)

A.13.1 **Purpose**

The purpose of the User Manual (UM) is to provide a Gemini Instrument Scientist with an understanding of the instrument and its operation. It shall provide information on the instrument's configuration, modes of operation, user calibration procedures, and instrument performance characteristics.

A.13.2 **Description**

The UM shall contain all information necessary to enable a Gemini Instrument Scientist who is familiar with the Gemini telescopes, but not necessarily familiar with the instrument, to understand the operation of the instrument.

The UM shall begin with a technical overview of the instrument, written for someone familiar with astronomical instrumentation, but not an instrument engineer or builder. This section shall include a description of the mechanisms in the instrument, the optical path, and the detector and controller type and general capabilities.

The UM shall be delivered before the instrument is integrated at the Gen 4#3 Delivery Location with the Gemini's Observatory Control Software; hence it shall also describe how to use the instrument in the laboratory. Any safety issues associated with operation shall be clearly stated or referenced.

The UM shall contain a description of all functionality available to the user on any user-level graphical user interfaces. It shall communicate the meaning of all warnings and alarms and explain how to appropriately respond to them.

The UM shall include any user-controlled calibrations that are performed during day-time instrumentation preparation and night time observing. It shall also include procedures for taking calibration data such as flats, arcs, etc.

The UM shall contain an overview of the different operational modes and how to execute them in the instrument software.

The UM shall cross-reference material in the Concept of Operations Document and Technical Manual when appropriate.

A.13.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- The instrument design and configuration
- Operating the instrument as a user
- Safety Issues
- Modes of operation
- Calibration procedures
- The instrument performance characteristics

A.13.4 **Change Control**

The UM shall go under change control when delivered.

A.14 Technical Manual [TM] (XXXX-18)

A.14.1 **Purpose**

The purpose of the Technical Manual (TM) is to provide Gemini with the necessary technical information to assemble, align, internally calibrate, cable, and place the instrument into an operational state. It should also provide a technical understanding of the design and structure of the instrument.

A.14.2 **Description**

The TM shall provide a technical description of the instrument and explanations of its working. Material from design documentation shall be updated (to reflect the as-built instrument) and placed into the Technical Manual.

The TM shall describe the step-by-step assembly and disassembly procedures referring to Gen 4#3 Associated Hardware as needed. It should include a step-by-step alignment procedure identifying any challenging steps or known difficulties.

The TM shall include internal instrument calibration procedures and the population of any look-up tables referring to any Gen 4#3 Associated Software if external software routines are needed to complete tasks.

The cabling procedure should be provided, highlighting any steps that require special attention for safety. Warm up/cool down procedures and power up/power down procedures should also be provided.

By referencing the as-built records, the technical manual should allow the reader to build and prepare a clone of the instrument.

A.14.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
    - Technical description of the instrument and subsystems
- Safety
- Required Facilities and Equipment
- Assembly/Disassembly procedure
- Alignment procedure
- Internal mechanism calibration procedure
- Cabling procedure
- Warm-up/Cool-down procedure
- Power up/power down procedure

A.14.4 **Change Control**

The TM shall go under change control when delivered.

A.15 Software Maintenance Manual [SMM] (XXXX-19)

A.15.1 **Purpose**

The purpose of the Software Maintenance Manual (SMM) is to provide Gemini with a description of the Gen 4#3 Instrument software at a level of detail that a programmer familiar with the Gemini software environment, but not initially familiar with the instrument software, can maintain it properly.

A.15.2 **Description**

The SMM shall include detailed written descriptions of all software systems and subsystems at a high level, describing purpose, organization, and interaction with other software systems and subsystems.

The SMM shall include any systems analyses, data flow diagrams, data dictionaries, structure charts, and specifications developed during the software design process reflecting as-built condition.

The SMM shall also include listings of all software delivered as part of the system, including firmware in all ROMS, and PROMS on any custom or semi-custom designed electronics boards, etc.

All software source code modules shall include a standard header documenting the module contents. Each module shall contain a sufficient number and quality of comments explaining the purpose and function of each few lines of code so that a programmer unfamiliar with the software can understand it.

A.15.3 **Composition (Shall include, but be not limited to, the following sections)**

The composition should include the items contained within the description and shall be structured in the manual in a way which makes the most sense.

A.15.4 **Change Control**

The SMM shall go under change control when delivered.

A.16 Data Reduction Software Programmer Manual [DRPM] (XXXX-20)

A.16.1 **Purpose**

The purpose of the Data Reduction Software Programmer Manual (DRPM) is to provide Gemini with a description the software and routines at a level of detail that a programmer familiar with the Gemini data reduction environment, but not initially familiar with the software, can maintain it properly.

A.16.2 **Description**

The DRPM shall include a summary of data processing choices and the system design. It shall include a list and design description of data reduction recipes tied to the major instrument observing modes should be included. It shall continue to describe each software module in detail.

The DRPM shall describe software tools needed to build and run all data reduction software. It should describe how the instrument's data reduction software fits in to Gemini's architecture.

The DRPM shall contain the processing requirements for data processing and the execution time for each process.

All software source code modules shall include a standard header documenting the module contents, and each module shall contain a sufficient number and quality of comments explaining the purpose and function of each few lines of code so that a programmer unfamiliar with the software can understand it. All algorithms, products and data formats should be well documented.

A.16.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction to the Instrument
    - General Description
    - Description of the Modes
    - Required Calibration and Associated Observations
    - Important Instrument Characteristics and Issues
- Typical Data Reduction Flows
    - List of Typical Sequences
    - Top-Level Flow Charts for Processing of Calibrations
    - Top-Level Flow Charts for Processing Science
- AstroData Types
    - Relevant AstroData Types
    - Association Table
- Recipes and Contexts
    - Contexts
    - Recipes
    - Technical Flow Charts
    - Issues and Limitations
- Primitives
    - Primitive #1 (alphabetical)
        - Purpose
        - Inputs and Outputs
        - Input Parameters
        - AstroData Type(s)
        - Inheritance and Primitive Set

        - Location
        - Algorithms
        - Issues and Limitations
    - Primitive #2…
- Test Suite
    - Available Tests
    - Missing or Desirable Tests
    - Running the Tests

“AstroData”, “Recipe”, “Primitive”, “Context” are components of the Gemini Python data reduction platform.

A.16.4 **Change Control**

The DRPM shall go under change control when delivered.

A.17 Data Reduction Software User's Manual [DRUM] (XXXX-21)

A.17.1 **Purpose**

The purpose of the Data Reduction Software User Manual (DRUM) is to provide the Gemini users with a description of the software and routines, and their usage, at a level of detail such that an astronomer with no expertise with the software can efficiently and confidently use the software to reduce their data in preparation for scientific analysis.

A.17.2 **Description**

The DRUM shall include a detailed description of the data processing flow and options for each of the major instrument observing modes. It shall include general description of the algorithms used on the data.

The DRUM shall include instructions on how to install and use the software to create analysis-ready products.

The DRUM shall include a list and description of each of the data processing components that can be used to create or modify a recipe, and a description of their usage and of the optimization options available through input arguments.

A.17.3 **Composition (Shall include, but be not limited to, the following sections)**

- Overview of Gen4#3 and its data
    - Description of the Instrument
    - Description of the Data
- Recipes for Gen4#3
    - Typical Processing Flows
    - Other Processing Flows
- Tips and Tricks for Processing Gen4#3 Data
- Issues and Limitations
- Primitives for Gen4#3
    - Primitive #1 (alphabetical)
        - Purpose
        - Inputs and Outputs
        - Algorithm
        - Issues and Limitations
    - Primitive #2…

A.17.4 **Change Control**

The Data Reduction Software User Manual shall go under change control when delivered.

A.18 Transportation and Telescope Integration Plan [TTIP] (XXXX-22)

A.18.1 **Purpose**

The purpose of the Transportation and Telescope Integration Plan (TTIP) is to provide procedures that successfully transport, unpack, integrate, test the instrument in the summit lab, and mount the instrument on the telescope to integrate it into the telescope control system.

The TTIP shall be created by Contractor with input from Gemini.

A.18.2 **Description**

The TTIP shall contain sections and information that reflects the changes resulting from refocusing the remaining work from Contractors facility to the Gen 4#3 Delivery Location.

A section containing context, assumptions and constraints shall provide target dates, facility accessibility, team resources and availability and remaining budget. Changing or new roles and responsibilities of the project team shall be provided along with a communication plan specific to the stage that conforms to Gemini daytime support.

The TTIP shall contain the details of knowledge transfer tasks and define periods in which Gemini staff will be trained in the operation, repair, and maintenance of the instrument, from optical, mechanical, electronics, and software perspectives during the stage.

The TTIP shall include a description of the equipment needed to complete this stage of the project, including both Contractor provided equipment and AURA provided equipment at the Gen 4#3 Delivery Location to complete tasks contained within this document.

The TTIP shall include checklists related to the step-by-step procedures contained within the plan. These checklists shall be placed in appendices. They shall be followed and completed by team members when performing the procedures and placed into the Transportation and Telescope Integration Report before submission.

The TTIP shall contain a section containing step-by-step instructions describing how to prepare the Gen 4#3 Contract Deliverables for transportation. This section shall include information on packing the Gen 4#3 Instrument and Gen 4#3 Associated Hardware, identifying the sensors to be attached. A packing list shall be included as an appendix. The TTIP shall contain a section containing information on transportation and insurance. The associated checklist shall include items needed both before and during transportation.

The TTIP shall contain information on unpacking and storage. It shall cover inspections, unpacking, reassembly (if required), cabling, and clean room inspection. The TTIP shall include the storage location of spares.

The TTIP shall include a section on the procedures relating to fundamental operations, including connecting services (air supply, glycol, etc.), power up and basic status and alignment checks. It shall include any computer configuration, low-level mechanism tests and monitoring scripts to ensure safety.

The TTIP shall contain a section detailing software integration tasks to enable the software systems to be integrated as much as possible before being mounted on the Instrument Support Structure. The TTIP

shall also include a description of the flexure rig characterization process and post-delivery acceptance tests (referencing the ATP) that would be performed before installing the instrument on the Instrument Support Structure (ISS).

The TTIP shall include a procedure to move the instrument from the instrument test room to the dome floor and a procedure to mount the instrument to the ISS. It shall contain all procedures and testing prior to obtaining first light on the instrument. These tests shall include monitoring the effects of vibration and testing optical alignments using GCAL or other telescope subsystems.

A.18.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Context, assumptions, and constraints
- Knowledge Transfer
- Equipment
- Packing and Preparation
- Transportation and Insurance
- Unpacking and Storage
- Fundamental Operation and Survivability Tests
- Software Integration
- Flexure Rig Characterization
- ISS Installation
- Post Delivery Acceptance Testing

A.18.4 **Change Control**

Once submitted, the plan shall go under change control until the Transportation and Telescope Integration stage is completed, at which point it shall be archived.

A.19 Assembly, Integration, and Verification Plan (XXXX-23)

A.19.1 **Purpose**

The purpose of the Assembly, Integration, and Verification Plan is to provide Gemini with the technical procedures to assemble, integrate, and verify the Gen 4#3 Instrument.

A.19.2 **Description**

This Assembly, Integration, and Verification Plan shall provide all of the information needed to successfully install, align, integrate and calibrate all the components of the Gen 4#3 Instrument so that it meets its Gen 4#3 Requirements.

The plan shall include step-by-step assembly and integration procedures and alignment plans.

A.19.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Assembly Procedures
- Integration Procedures
- Alignment Procedures

A.19.4 **Change Control**

Once submitted, the plan shall go under change control until the AIV stage is completed, at which point it shall be archived.

A.20 As-built Records (XXXX-26)

A.20.1 **Purpose**

The purpose of the As-built Records is to provide Gemini with all the specifications, 3d models, 2d manufacturing drawings, wiring diagrams, and software code to successfully refabricate and acquire the components of the Gen 4#3 Instrument such that it could be cloned.

A main document should be provided explaining how record documentation is structured.

A.20.2 **Description**

The As-built Records shall include as electronic copy of the following items:

- 3D CAD model of the entire instrument,
- 2D manufacturing drawings, (also provide a hardcopy)
- Parts List,
- Electronic schematics,
- Wiring Diagrams,
- Software source code,
- Procurement Specifications and quotations for purchased components, including those not selected,
- Items required for assembling components. (bonding materials, glues, etc.)

The As-built Records shall represent the as-built instrument and NOT the as-designed instrument.

A.20.3 **Composition (Shall include, but be not limited to, the following sections)**

Multiple files. The main document should contain (at least):

- Introduction
- Methodology
- Structure of records (including filenames and document codes)

A.20.4 **Change Control**

The As-built records go under change control when delivered.

A.21 Recommended Spares List (XXXX-27)

A.21.1 **Purpose**

The purpose of the Recommended Spares List is to provide Gemini with a list of spare Gen 4#3 Instrument hardware components Contractor believes are important for Gemini to obtain. It shall include a list of spares that shall be delivered with the Gen 4#3 Instrument as part of the Gen 4#3 Associated Hardware.

A.21.2 **Description**

The Recommended Spares List shall contain a list of recommended instrument components. The Recommended Spares List should consider a number of factors including component reliability (factoring any mean-time-to-failure statistics), obsolescence (our ability to purchase the component in the future), lead-time (how long it will take to procure a replacement) and impact (how the instrument performance would be affected were the item to fail).

The document shall include links to the original specifications and quotation from the As-built Records.

The Recommended Spares List shall also describe any spares that will be provided with the instrument.

A.21.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Methodology
- Spares provided with the instrument (include table)
- Recommended Spares (include table including the following)
    - Component/item
    - Reliability Score
    - Availability Score
    - Impact Score
    - Overall Ranking
    - Cost
    - Supplier
    - Link to specification and quotation
    - Notes

A.21.4 **Change Control**

The Recommended Spares List shall be delivered to Gemini at the end of the Build Phase.

A.22 Pre-Delivery Acceptance Test Report [pre-ATR] (XXXX-28)

A.22.1 **Purpose**

The purpose of the Pre-Delivery Acceptance Test Report (pre-ATR) is to document the results of the requirement verifications performed on the Gen 4#3 Instrument before it has been delivered to the Gen 4#3 Delivery Location.

A.22.2 **Description**

The basis of the pre-ATR is the Acceptance Test Plan (ATP).

The pre-ATR shall report on all the requirements marked in the ATP verification matrix as needing verification prior to delivery to the Gen 4#3 Delivery Location.

The pre-ATR shall retain the structure of the ATP, removing test procedures not requiring pre-delivery verification. A test results section shall be added for each test and shall contain the results, conclusion, and a clear PASS/FAIL assessment as to whether the verification demonstrates the requirements were met. Any deviations from the test procedure contained in the change controlled version of the ATP shall be noted and explained.

A.22.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Verification Matrix [Test, Requirement]
- Test
    - Tester
    - Log
    - Estimate Duration (configuration time, test time, analysis and report time)
    - Success Criteria
    - Prerequisites
    - Safety Issues
    - Test Set Up
    - Test Procedure
    - Test Result

A.22.4 **Change Control**

Once submitted, discussed, reviewed, and fully accepted (expected on successful completion of the stage review), the document shall be archived.

A.23 Commissioning & Science Verification Plan [CSVP] (XXXX-29)

A.23.1 **Purpose**

The purpose of the Commissioning and Science Verification Plan (CSVP) is to communicate the plan and procedures needed to systematically characterize the performance of the instrument in all of its modes and verify any remaining concept of operations requirements and science requirements.

A.23.2 **Description**

The CSVP describes the set of on-sky observations and tests that shall be performed to measure all aspects of instrument performance that will be necessary or helpful for planning science observations using the instrument.

The CVSP shall contain estimates of the time and resources (both supplied by Contractor and its associated Subcontractors and by AURA) required to perform each procedure and an analysis of the total time and resources necessary to fully perform the plan.

The CVSP shall include commissioning tasks associated with the data reduction software.

A.23.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Overview (containing a summary table)
- Compliance Matrix (associated with remaining concept of operations and science requirement)
- Test (For each test)
    - Description
    - Prerequisites
    - Observing Condition
    - Team Lead
    - Gemini Lead
    - On-sky time required
    - Post observation time required (to analyze data and create report)
    - Step-by-step Observing Procedure
    - Results (blank for the plan, completed for the report)

A.23.4 **Change Control**

The CSVP shall go under change control when delivered. If situations arise that cause a real-time change in the test during execution, Contractors shall update the CSVP accordingly.

A.24 Science Campaign Proposal (XXXX-30)

Contractor shall submit the Science Campaign Proposal to Gemini. Gemini shall then submit the proposal to the Gemini Board for their consideration. Please review and follow the Long and Large Program format at the time of submission hosted on the www.gemini.edu website.

A.24.1 **Purpose**

The Science Campaign Proposal shall be created and submitted by the Gen 4#3 science team following the format of the LLP process for assessment.

A.24.2 **Description**

The proposal is expected to promote collaborations across the partnership's communities, to have significant scientific impact, and to provide the community with a significant science result from the Gen 4#3 Instrument.

The science team involved in this proposal must be representative of the Gemini partnership.

The Gen 4#3 science team should include a management plan, and the added value to the astronomical community through data products, software, or other outcomes. The Gen 4#3 science team will be required to report on their progress annually.

Investigators must use the Gemini Phase I Tool (PIT) for creating and submitting the proposal.

The proposal narrative is submitted as a pdf attachment to the PIT. LaTeX and Word templates will be available. The proposal narrative must include:

- a discussion of the primary **scientific justification** of the project;
- a description of the **experimental design**, including sample selection, scheduling requirements, calibration, etc.;
- a statement of the time requested each semester, including required instruments and observing conditions in the **technical case**;
- a description of the **mode of observation** and explanation of required mode for classical and fully queue mode requests;
- a **management plan** that describes staffing and resources available to complete the science program and the expected contributions of each participant;
- a discussion on **added value** to Gemini Observatory and the broader astronomical communities through the public release of data products, catalogs, software, public outreach, or other outcomes beyond the proposed science results . This should also include a description of any delivered products and the timeline for their release;
- Program considerations if allocated in band 2, included in the **experimental design**;
- Supplemental proposal information, such as previous time allocations, relevant publications, etc.;
- An estimate of the distribution of targets and time allocation throughout the lifetime of the proposed program;
- Sample, relevant Integration Time Calculator output supporting time request.

Other required information, entered directly into the PIT:

- title, abstract, Time Allocation Committee category, keywords, and the investigators' names and institutions;
- a list of targets, observing conditions, and instrument configurations;
- Scheduling constraints if there are time-critical or synchronous observations involved, or impossible dates for classical programs in the semester.

The proposal narrative is limited to a total of 10 pages, and the science justification cannot exceed 5 pages, including figures and references. The page limit does not include ITC attachments or the distribution of targets table.

A.24.3 **Composition (Shall include, but be not limited to, the following sections)**
See above

A.24.4 **Change Control**
N/A

A.25 Transportation & Telescope Integration Report [TTIR] (XXXX-33)

A.25.1 **Purpose**

The purpose of the Transportation and Telescope Integration Report (TTIR) is to document the results from the tests and processes contained within the Transportation and Telescope Integration Plan (TTIP).

A.25.2 **Description**

The TTIR shall contain the results of procedures followed during the Transport and Telescope Integration stage. It shall contain images documenting the various steps described within the TTIP that will help with continued staff training. The TTIR shall include explanations, results, and completed checklists.

A.25.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Packing and Preparation Results
- Transportation and Insurance Results
- Unpacking and Storage Results
- Fundamental Operation and Survivability Tests Results
- Software Integration Results
- Flexure Rig Characterization Results
- ISS Installation Results

A.25.4 **Change Control**

Once submitted, discussed, reviewed and fully accepted (expected on successful completion of the stage review), the document shall be archived.

A.26 Post-Delivery Acceptance Test Report [post-ATR] (XXXX-34)

A.26.1 **Purpose**

The purpose of the Post-Delivery Acceptance Test Report (post-ATR) is to communicate the results for the requirement verifications performed on the Gen 4#3 Instrument after the instrument has been delivered to the Gen 4#3 Delivery Location.

A.26.2 **Description**

The basis of the post-ATR is the Acceptance Test Plan (ATP).

The post-ATR shall report on all the requirements marked in the ATP verification matrix as needing verification after delivery to the Gen 4#3 Delivery Location.

The post-ATR shall retain the structure of the ATP, removing test procedures not requiring post-delivery verification. A test results section shall be added for each test and shall contain the results, conclusion, and a clear PASS/FAIL assessment as to whether the verification demonstrates the requirements was met. Any deviations from the test procedure contained in the change control version of the ATP shall be noted and explained.

A.26.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Verification Matrix [Test, Requirement]
- Test
    - Tester
    - Log
    - Estimate Duration (configuration time, test time, analysis, and report time)
    - Success Criteria
    - Prerequisites
    - Safety Issues
    - Test Set Up
    - Test Procedure
    - Test Result

A.26.4 **Change Control**

Once submitted, discussed, reviewed and fully accepted (expected on successful completion of the stage review), the document shall be archived.

A.27 Commissioning and Science Verification Report [CSVR] (XXXX-37)

A.27.1 **Purpose**

The purpose of the Commissioning and Science Verification Report (CSVR) is to document the results of the activities, observations and analyses specified in the Commissioning and Science Verification Plan (CSVP)

A.27.2 **Description**

The CSVR shall be an expansion of the CSVP, see Section A.23.
Results including data, analysis, and material related to performing the procedures in the plan shall be included.

The CSVR shall document any as-performed deviations from the plan not reflected in the revised CSVP.

A.27.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Overview (containing a summary table)
- Compliance Matrix (associated with remaining concept of operations and science requirement)
- Test (For each test)
    - Description
    - Prerequisites
    - Observing Conditions
    - Team Lead
    - Gemini Lead
    - On-sky time required
    - Post observation time required (to analyze data and create report)
    - Step-by-step Observing Procedure
    - Results

A.27.4 **Change Control**

Once submitted, reviewed, and accepted the document shall be archived.

A.28 Gen 4#3 End Project Report (XXXX-38)

A.28.1 **Purpose**

The purpose of the Gen 4#3 End Project Report is to review how the project performed against its baseline. It shall also contain lessons learned and details of ongoing risks, and potential future enhancements and upgrades.

A.28.2 **Description**

The Gen 4#3 End Project Report shall compare the actual delivered specification against the requirements, the actual completion date and schedule against the Gen 4#3 Completion Date and baseline schedule, and the actual cost of the project against the baseline stage budgets, building on the information contained within the last stage report.

It shall also contain a number of lessons learned during the final stage of the project in addition to summarizing the major lessons learned over the entire project.

Any tasks that were not completed or requirements that were waived that require further work should be identified and detailed to provide AURA enough information to continue working on those items, if desired.

Ongoing risks should be identified and the latest version of the risk register should accompany the report.

Potential future enhancements should be presented with cost and schedule estimates.

A.28.3 **Composition (Shall include, but be not limited to, the following sections)**

- Introduction
- Performance Review
- Lessons Learned
- Unfinished Work
- Ongoing Risks (accompanied with Risk Register)
- Potential Future Enhancements and Upgrades

A.28.4 **Change Control**

Once submitted, reviewed, and accepted the document shall be archived.