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Gemini 8-M Telescopes Project

Controls Group

SOFTWARE CONFIGURATION

CONTROL PLAN

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Action Items

- ☐ 3.2.2 - Status Monitoring System
- ☐ Should we standardize on GNU C?
- ☐ 1.3.1 - Document ID for the IRS

PREFACE

This document covers the software configuration control aspects of the Gemini Software and Controls Project and it is intended to be used by both Gemini and and Gemini partners, e.g., universities, industries, etc., in the development of Gemini software and controls. The present document contains the following major sections:

- Introduction
- Management
- SCM Activities
- Tools, Techniques, and Methodologies
- Supplier Control
- Records, Collection, and Retention

Appendices may be provided for some specific topics and shall be considered as applicable.

- Must and shall are used to indicate mandatory practices, should and may are used, respectively, for recommendations and guidelines. The provisions of the SCCP are applied to the whole Gemini Software and Controls, whether developed in house or by external partners.

This document follows IEEE Standard 1042-1987, *Guide to Software Configuration Management,* in both its form and content.

The intent in providing this document is to enforce standard engineering practices on the development of software and controls for the Gemini Project.

1 INTRODUCTION

The Software Configuration Control Plan [SCCP]) describes the software configuration management activities to be performed in support of the Gemini Software and Controls Project (GSCP). The objective of the Gemini Software and Controls Project is the construction, installation, commissioning, and operation of two 8-meter telescopes systems together with the necessary infrastructure at Mauna Kea, Hawaii and Cerro Pachon, Chile.

This group is tasked to provide the software and controls required to control and operate the telescope itself and its associated instruments both locally, i.e. at the telescope site, and remotely, for example, from Gemini headquarters at Tucson or from one of the partner countries.

1.1 Purpose

This document describes how the software development activity supports GSCP management in delivering systems that enable the project to meet its scientific requirements on budget and on schedule.

The SCCP also describes the process by which the software and controls package will be delivered by the developer to Gemini in the following three distinct releases:

1) The *control system simulator* - which shall be functional at the user level, simulate all interfaces to higher level systems, but must not control any physical devices.
2) The *functional control system* - which must control all devices but not necessarily to within specifications.
3) The *specification control system* - which is the control system that will be subjected to acceptance testing.

This delivery process is covered in Section 4.3.

Section 4.4 of the SCCP describes the system for reporting problems encountered with the Gemini Software and the procedures for dealing with those problems.

Documents will be placed under configuration control once reviewed and approved. Code shall be placed under configuration control at the end of the implementation phase, i.e., after module acceptance. Once a configuration item, both document and code, has been placed under configuration control, it shall not be changed without formal approval.

1.2 Scope

The scope of the SCCP encompasses the tasks of Software Configuration Management (SCM). This subsection identifies specific SCM concerns, defines what the SCCP does and does not address, and identifies the items to be managed.

A number of software configuration items (CI) are being developed as part of this Project. They all will be assigned to various Work Package Responsibles (WPR) and will be managed by the appropriate member of the Gemini staff. This is typically one of the following: *Systems*

Software Engineer (SSE), *Real Time Engineer* (RTE), or *Servo Control Engineer* (SCE) who will act as the *Gemini Work Package Responsible* (GWPR).

1.3 Reference Materials

This subsection provides a complete list of all documents and other sources referenced in the SCCP. Each document is be identified by title, report number, date, author, and publishing organization. Any deviations from referenced standards or policies are identified and justified.

1.3.1 Applicable Documents

The following documents of the exact issue shown form a part of this document to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this document, the conflict shall be resolved by the *Gemini Controls Manager* (GCM).

[SMP] *Gemini Software and Controls Management Plan*, PG-C-G0005

[SPS] *Gemini Programming Standards*, SPE-C-G0009

[SRS] *Gemini Software Requirements Specification*, SPE-C-G0014

[IRS] *Gemini Interface Requirements Specification, TBD*

1.3.2 Reference Documents

The following documents are not part of this project, but are relevant to the management of the configuration control of the Gemini software and are referenced in the text of this document:

IEEE 828-1990 -- *Standard for Software Configuration Management Plans*

IEEE 1042-1987 -- *Guide to Software Configuration Management*

P Ward and S Mellor, Yourdon Press, 1985 -- *Structured Development for Real-Time Systems*

J. Osier, FSF, 1993 -- *Bug Management With GNATS*

1.4 Glossary

The following abbreviations and acronyms are used in this document:

CDR	Critical Design Review
CI	Configuration Item
CM	Configuration Management

GCM	Gemini Controls Manager
GSCP	Gemini Software and Controls Project
GWPR	Gemini Work Package Responsible
PCRB	Program Change Review Board
RTE	Gemini Real Time Software Engineer
SCCM	Software Configuration Control Manager
SCCP	Software Configuration Control Plan (this document)
SCE	Gemini Servo Control Engineer
SCI	Software Configuration Item
SCM	Software Configuration Management
SCR	System/Software Change Request
SMP	Software and Controls Management Plan
SQA	Software Quality Assurance
SQAM	Software Quality Assurance Manager
SSE	Gemini Systems Software Engineer
VDD	Version Description Document
WPR	Work Package Responsible

2 MANAGEMENT

This section of the SCCP relates the elements of the SCM discipline to specific activities of the project's management organization. It also lists the budgetary, schedule, and resource requirements necessary to carry out the plan.

2.1 Organization

In this section of the SCCP, functions are allocated to organizational entities. Interfaces between organizations are discussed in section 2.3. The functions of the SCM department are defined in section 2.2.

All authority for managing the SCCP is vested in the Gemini Software and Controls Group. The organizational structure for software configuration control of this group shall be:

- the SSE shall manage the software configuration control plan and shall also be known as the *Software Configuration Control Manager* (SCCM).
- the RTE shall manage the software quality assurance plan and shall also be known as the *Software Quality Assurance Manager* (SQAM).
- both the SSE and the RTE shall report to the GCM in the manner defined in the SMP.

2.2 SCCM Responsibilities

This section provides a specific description of the role the SCCM plays in the overall SCM process.

The general responsibities of the SCCM are to process the information needed to control changes in the software as it develops and to capture the as-built documentation, test data, and reports, and code that represent each successful release. The emphasis is placed on supporting the project change activities by independently handling all of the required paperwork thus making the CM process transparent to the Gemini Project Office management.

Specific organizational responsibilities of the SCCM are as follows:

2.2.1 Identification

Naming conventions are defined in the Gemini Software Programming Standards document. Those naming conventions relevant to the SCCP are:

1) *Unit Names.* These are designed so that unique identification of each item is possible. In addition, the unit naming conventions are structured so that it is possible to determine which SCI each unit belongs to by simply looking at the unit name.
2) *File Names.* These are designed with the same mnemonic capability as the units.
3) *Component Names.* These are given unique names so the source code can be matched to the supporting documentation.

4) *Configuration Item Names.* These are defined in the same manner as the Work Package statement of work.

2.2.2 Control

Control of all changes is maintained by

1) Preparing and tracking approval system/software changes request (SCR) throughout implementation and testing.
2) Acting as software librarian, controlling the release of code to
    - The integration library for integration and testing.
    - The master library for installation and demonstrations at the site(s).

2.2.3 Status Accounting

The SCCM provides the necessary status reports to the groups and project management. Typically, the reports cover:

1) SCR opened during period XXXX-XXXX.
2) SCR closed for period XXXX.
3) Major SCR remaining open for three or more weeks.

2.2.4 Audits And Reviews

See the SMP. Relevant details are outlined below in section 3.4 [Configuration Audits and Reviews].

2.3 Resource Requirements

This section provides an estimate of the resource requirements for managing configuration control within the Gemini Project. It does not attempt to estimate the resource requirements for the work package developers.

About 15% of the time for the SSE is expected to be taken up with configuration control activities. A smaller percentage of time is expected of the Gemini Administrative Assisitant. The operation of the SSE as the SCCM is expected to be somewhat sporatic, with no fixed schedule. There is no specific budget allocated for configuration control.

2.4 Interface Control

The theme of this section is how SCM disciplines are coordinated and how they are used to manage interfaces throughout the Gemini project's life.

The sole interface between the GCSP and the WPR is through the GWPR.

Each Work Package Description shall contain a section referencing the interface control documents and/or drawings. The maintenance of these drawings/documents will be part of the

SCCM task. The SCCM must assess the impact of change requests to these items on the Software Controls tasks, must distribute change requests for comment to affected parties, and must promulgate official change requests to relevant parties.

Some of the interfaces within the Gemini Telescope system are:

- The Graphical User's Interfaces (GUI), between the user and the system
- The Command Line User's Interfaces (CLUI), between the user and the system
- The local intertask interfaces, between tasks on the same system
- The remote intertask interfaces, between tasks on different systems
- The system/real-time interfaces, between Unix host and real-time target tasks
- The database interfaces, between the control system and information databases
- The remote access interfaces, between the local control system and remote sites

These interfaces are specified in more detail in the Interface Requirements Specification document. In many cases, both a hardware and a software interface are required between two system components.

2.5 SCM Plan Implementation

This Plan Implementation section provides details concerning the implementation of the key SCM milestones identified in the plan.

Key milestones are:

- SCCP under change control
- Standard instrument controller under change control
- For each work package: work package deliverables under change control (generally after acceptance testing)
- Observatory simulator under change control
- Functional control system under change control
- Specification control system under change control

2.6 Applicable Policies, Directives, And Procedures

This section identifies and defines the degree to which existing and future SCM policies and procedures apply to the plan.

2.6.1 Existing Policies And Procedures

The following Gemini Software and Controls Project policies are used for configuration management for the Work Packages:

- *Gemini Software and Controls Management Plan*
- *Gemini Programming Standards*
- *Gemini Software Requirements Specification*

2.6.2 New Policies And Procedures To Be Written

The following procedure(s) will be developed for the Work Package configuration management:

- *Gemini Software Configuration Control Plan* [This document].

3 SCM ACTIVITIES

The SCM organizational descriptions in section 2 described who has what responsibilities for software configuration management. This section describes how these groups accomplish their responsibilities.

3.1 Configuration Identification

The theme of this subsection is to document an identification scheme that reflects the structure of the project.

3.1.1 Documentation

The required system documentation and its maintenance procedure is described in this subsection.

The following documents are the *minimal* required documentation to be provided with any Gemini software component:

(1) *man pages* - These are to be in classic Unix style using the -man macros with troff. Both formatted and unformatted pages are to be provided electronically. Manual pages shall be placed under the same configuration control as the software source code. Formatted paper copies of all man pages are to provided with the software.

(2) *user's guide* - The User's Guide is to be available in both electronic and paper form. The users guide is expected to be clearly written. The User's Guide shall be placed under the same configuration control as the software source code.

(3) *technical reference* - The Technical Reference must include a complete description of the functional behavior of the system. It must be suitable for testing, maintenance, and upgrade use. The technical reference is to be available both electronically and as hardcopy. Included in this reference are risk analyses, test procedures, and full descriptions of all external and internal routines.

The original document form is not specified, but deliverable versions should be provided for one or more of: *AmiPro*, *TeX*, or *troff*. All support files for the electronic versions must be provided (style sheets, macro packages, etc.).

All documents are given identifications by the GSCP and include the work package identification as part of the document id.

3.1.2 Software Parts

As stated in the SRS, the Gemini Project recognizes these types of software:

(1) *Developed Software* - covered by the *Software Requirements Specification*.

(2) *Supported Software* - 'off-the-shelf' software used for Gemini telescope control

(3) *External Software* - ancillary software that is not integral to Gemini telescope control.

When possible, all three types of software should be identified as described here. Developed software is required to do so.

Software modules are to contain CVS (RCS) identification strings, assigned to static variables so that the identifications are also embedded in the binary versions of the module. This ID string must include the module name, version number and date, and implementor information. Each module is identified with an ID that includes the Work Package ID (the same as the documentation).

The appropriate naming of files is the responsibility of the development group. However, this naming is to follow accepted practice in Unix environments. The organization of files is to likewise follow accepted Unix practice. All software for a given work package is to be rooted in a single directory hierarchy. Details of the layout for this hierarchy follow in Section 4 of this document. It *must be possible* to transfer this entire hierarchy to another location on another system and still be able to configure, build, and install the software with minimal effort using *make*. The steps involved in these processes are to be well documented in the Technical Reference.

3.1.3 Gemini Project Baselines

Baselines are an effective mechanism to allow many people to work together at the same time. They are a way of synchronizing people working on the same project. The SCM discipline, as in all CM, focuses its activity around the construction and maintenance of baselines. The modifiable units need an identifying mechanism, and a way of describing what is contained in their aggregates, if needed.

Baselines can be generated using the CVS version management system *if the proper heading labels are maintained* to ensure identification of source, object, and documentation files. When complete packages are delivered to the SCCM, they are treated as forming a new baseline. Subsequent modifications are kept as updates to that baseline until the next full release forces a new baseline. No updates to a baseline are brought into service until thorough testing of the system has been completed.

3.1.4 Gemini Project Labeling

This part of the Plan defines the procedures and labels for identifying the CI, components, and units. This is important for identifying and retreiving information, reporting status. and for legal protection of data rights.

The CVS identification strings embedded as part of all source, object, and documentation form a vital part of the labelling for system software. This identification is insufficient, however, for full labeling. All software source developed specifically for use in the Gemini system is subject to, and labelled with the *Gemini Software Copyright*. This copyright notice permits the distribution of this software while protecting the Gemini Project's rights to this software. A copy of the proposed text for this copyright is included at the end of this document.

Additional software labeling requirements are discussed in the Gemini *Software Programming Standards* document.

3.2 Configuration Control

This subsection describes how the configuration control process is managed. The theme here deals with identifying the procedures used to process changes to known baselines. An appropriate level of authority for controlling changes must be identified or delegated for each baseline.

3.2.1 Function Of The GSCP

In this subsection the authorities needed for granting change approvals are identified. Subsection 2.2. of the management section of the Plan has outlined the general role of the SCCM. Here attention is paid to the details of this role and authority. It should be remembered that the SCCM has traditionally been concerned with managing changes to established baselines of documented configuration items and the components of those configuration items.

The requirements for authorization for change approval depends in part on the nature of the requested change. It is the responsibility of the SCCM to determine the necessary authorizations and to then coordinate the approval process.

3.2.2 The System/Software Change Request

This subsection describes the general method to be used for processing change requests. Generally, no single procedure can meet the needs of all levels of change management and approval levels. Therefore, this subsection concentrates on

1) Defining the information needed for approving a change,
2) Identifying the routing of this information,
3) Describing the control of the library(ies) used in processing the changes,
4) Describing the procedure for implementing each change in the code, in the documentation, and in the released program.

The SCCM is responsible for managing change requests. All pertinent information, including the reasons for the change, impacts of the change, and costs of making the change must be provided to the SCCM.

In general, change requests originating from the developer would pass through the WPR to the member of the Gemini staff who is managing that package and then to the SCCM. The WPR should ensure that sufficient information has been provided before passing the request on. The SCCM logs the request, determines the authorization, and ensures proper tracking of the request.

A system is to be provided to permit developers and Gemini staff alike to monitor the status of a change request.

All approved changes to the code or documentation are to be documented in the source code, using the logging facility available through CVS. Substantial changes require a change in version identification. Under no circumstances is an approved change permitted to be back propogated through a baseline system.

3.2.3 Software Change Authorization

The levels of authority required to make changes to configuration items under SCM control can vary. The system or contract may often dictate the level of authority needed. It is the responsibility of the SCCM to determine the appropriate level of authority required for any particular change authorization.

3.2.4 Interface With Other Systems

Large or complex systems, like the Gemini telescopes, can have many hardware-software interfaces (as documented in subsection 2.4 [Interface Control]) that require continued ongoing change coordination. The Work Package specification is to include a description of how these interfaces are handled and documented so all of the people on the project know how to get the job done.

3.2.5 Change Control Support Software

Support software, which may be user-furnished, developed in-house, leased from a vendor, or purchased off-the-shelf, is the class of software which may or may not be delivered with a subsystem, but is necessary for designing, enhancing, or testing the changes made during the lifetime of a delivered computer program product. The developer or maintainer needs to ensure that the support software is available for use as long as necessary. For example, compilers need to be archived for use later *as is* when implementing enhancements to prevent subtle compiler dependencies from turning simple enhancements into major upgrades.

In particular, developers are to make no assumptions on the availability of support software at the Gemini Project office beyond the following:

(1) CVS

(2) ANSI-compliant C compiler

(3) make

(4) standard Unix tools (yacc, lex, etc.)

If other software is required for proper configuration, construction, and installation of Work Package software, the WPR *must check with the GWPR* to ensure its availability and suitability for use at the GPO.

3.3 Configuration Status Accounting

The theme of this subsection is identifying what information is needed for various activities, obtaining the information, and reporting it. The concern is with the acquisition of right information at the right time so reports may be made when they are needed. In essence, this is a typical data management problem. The configuration status accounting function, at a minimum, is basically reporting the transactions occuring between SCM-controlled entities.

Status accounting is accomplished by tracking the changes to units through use of the SCR form. This manually generated form is updated (upon release) with the version number of the release.

Status of each CI is reported periodically to the GWPR or at the GWPR's request. The status of the revisions to the units and components is reported weekly to the WPR. When a software system is released to the GSCP office, the release and version are recorded and the units contained in the system are listed, along with their current change level.

3.3.1 System/Software Change Request Form

The following data elements are included on the SCR form:

ELEMENT	**VALUES**
CI	The name of the configuration item involved.
Environment	The hardware site involved.
Change type	Legal values: new function, error correction, design change.
Date requested	DD/MM/YR
Narrative description	Description of the change desired in language as explicit as possible, description of the problem in the case of error reports.
Disposition	Final disposition: fixed, accepted but delayed, rejected. If fixed, description of the changes made are included here.
Requester	Person making the request for the change.
Requester site	Location of the person making the request.
Release and version	The release and version number in which the problem existed.
Implementation data	List of modules involved in the change on the system/software change request form.
Implementation release and	Release and version number in which the change appears.

version	
Implementation ship date	Date on which the change is shipped to the sites.
WPR signature	
GWPR signature	

3.4 Configuration Audits And Reviews

This subsection involves the procedures used to verify that the software product (executable code) matches the configuration item descriptions in the specifications and documents, and that the package being reviewed is complete.

There will be no formal audits of the Work Package system, instead the progress of the system development will be monitored by a series of preliminary and critical design reviews. There will be a formal acceptance testing of the system.

These reviews and final acceptance testing shall be augmented by regular (typically weekly) dialogs between the WPR and the GWPR, regular (typically weekly) examination of the current software by the GWPR, and by periodic on-site inspections by the GWPR.

4 TOOLS, TECHNIQUES, AND METHODOLOGIES

The theme of section 4. of the Plan is making it all happen - the easy way. A well planned project typically takes advantage of planning tools such as PERT charts and Gantt charts. The audit trail reports should reflect directly back to the milestones and other activities on the planning charts, thus giving management a tool for tracking progress on the project.

4.1 Tools For Use Internal To Gemini Project

Within the GSCP configuration control shall be implemented via CVS. Each site's WPR shall ensure compatibility between their internal configuration control tools and the CVS system used by Gemini.

As mentioned in Section 3, Work Package software is to be bundled in a single directory heirarchy. At the root of this hierarchy should be the directories: *doc*, *host*, and *target*. The host and target directories are to hold the host (Unix) specific and target (VxWorks) software, respectively. The host directory should contain the directories: *bin*, *lib*, *include*, *man*, and *src*, with the contents arranged accordingly. A similar arrangement is appropriate for the target directory.

Makefiles are to be used to simplify configuration, construction, and installation of the software. All configuration, construction, and installation instructions shall be placed in the Technical Reference and in Read.Me files in the source hierarchy.

At anytime during the course of development, the GSCP shall be able to electronically retrieve a current baseline system from the developer. (This implies that the developer is implementing all software using auxilliary directories for developing and testing.) The WPR is to provide the SCCM with precise instructions on this retrieval. The retrieval process must be fully automatable.

4.2 Tools Bundled With Vendor Supplied Systems

In the case that a vendor provides their own configuration control system with the delivered product then that system shall be used by the GSCP for configuration control of that software. Case in point: the current EPICS system assumes the use of SCCS.

4.3 Delivery Of Packages

Upon completion of any of the releases, the *entire* package, including source code, support facilities, documentation, etc. are to be made available to the GSCP. The same electronic means as described above (Section 4.1) for retrieving baseline systems may be used for the transfer of deliverable systems. An acceptable alternative is the delivery using 8-mm tapes with the information archived using either *tar* or *cpio*.

Delivery is to be coordinated by the WPR and the GWPR. Full installation, system build, and system testing instructions are to be provided seperately in electronic form.

4.4 Problem Tracking

Problem tracking is expected for all Gemini software. The GSCG serves as the central site for all problem reporting. The *GNATS* Problem Report Management System is the proposed vehicle for managing this tracking, and is available from the SCCM. The WPR is responsible for managing problem reports that are internal to that work package, or forwarded from the SCCM. Problem tracking follows the recommended procedures found in the GNATS documentation (also available from the SCCM).

GNATS is the *GNU Problem Report Management System*, an electronic mail based problem reporting and tracking system that enables a central site to effectively manage problem tracking within a widely distributed software development environment. GNATS provides:

- organization of problem reports into a database and automatic notification of responsible parties
- provision for support personnel to edit and query information on problems
- a reliable archive of problems the history of problems with a project

5 SUPPLIER CONTROL

The theme of Section 5 is how to place effective CM on the computer programs over which you have no direct CM control. Computer program suppliers are considered to fall into one of two classes:

1) Work package software, subcontracted software, or those contractors that develop unique or dedicated software under contract to a developer.
2) Vendor software, or those contractors that provide privately developed and existing software, and bundled application software such as operating systems, compilers, word processing tools, software configuration management tools, and data-base management systems.

5.1 Work Package Or Subcontractor Software

If a portion of a software development project is to be subcontracted to another organization, the responsibility for SCM is generally passed to that organization. However, the subcontractor can only be responsible for the portion of the work that his organization is tasked to perform, not for the integration of the subcontracted work with the final product.

Any software that is distributed between individual work package development sites must pass through the GSCP Office.

5.2 Vendor Software

Warranties contained in purchase orders may be difficult to enforce. The specific criterion is that the vendor should furnish the computer program *media* as specified by a purchase order or as specified by the supplier's documentation referenced in the purchase order.

Vendor supplied tools managed by the GSCP office will be distributed from the Tucson Gemini Project Office. This office will act as a clearinghouse for all code distributions. Part of the responsibilty of the GSCP office will be to coordinate the installation of upgrades to vendor supplied tools with the development sites, to ensure a uniform configuration across all work packages. In particular, development sites must check with the GSCP office before upgrading any tool used in the Gemini control system (VxWorks, EPICS, etc.) for compatibility.

6 RECORDS, COLLECTION, AND RETENTION

The theme of section 6 of the Plan is to *keep the information necessary only for the time required.* This is another service aspect of configuration management. Good configuration management practices including maintaining copies of released material for backup and disaster protection. Also the liability and warranty provisions and responsibilities make considering the retention of test and approval records a necessity. If a master disaster recovery plan exists for the company, the Plan needs to disclose all information regarding the location of backups and records that are impounded in relation with that plan.

6.1 Backup Procedures

6.1.1 Local Procedures

Each site shall manage their own local backups which shall, at a *minimum*, consist of a weekly full backup. Backups should be kept for at least 10 weeks. The *preferred* method is to use a rotating set of 3 weekly, 3 monthly, 3 quarterly, and one annual backup, with the annual being kept in perpetuity and stored off-site.

6.1.2 Remote Procedures

The GSCP Office shall have the capability of remote backups of any system used by the Work Package Development groups for the purposes of monitoring the progress of the WPR. At a minimum, Gemini requires read access to all development directories and files in order to implement remote backups using `rcp`.

This remote backup system shall also be used to implement a master disaster recovery plan. The GSCP shall archive backups equivalent to the local backups defined section 6.1.1 [Local Procedures] for Work Package development sites.

The GSCP does not assume responsibility for either commerical subcontractor sites or for vendors.