GENI Project Office: Reference Design & Requirements

GDD-06-34

GENI: Global Environment for Network Innovations

November 27, 2006

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Note to the Reader: This document is in preparation by the Project Management Team, and it represents the analysis of that team. It is anticipated that development or completion of the GPO Reference Design will be a principal element of the project management plan for GENI. The current document is the first revision of the GPO Reference Design & Requirements. The reader is requested to see the Appendix for a summary of changes made to the original document posted as Release Version 1.0.

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Table of Contents

Executive Summary

GENI will be a large network construction project that will develop and deploy a nationwide network facility – federated with similar networks around the globe – that will serve the computer sciences, networking, distributed services, and similarly oriented research communities in the pursuit of a new architecture and design for the future "Internet". Because of the scope of this project, a well-design management entity – which we call the GENI Project Office (GPO) – will be required to direct GENI activities during each stage of the project – planning, facility construction, and full facility operations.

This *GPO Reference Design & Requirements* document is one of the principal components of the GENI Project Execution Plan (PEP). It is organized into four parts: 1) presentation of the core principles that must drive development of the GPO, and a discussion of the broad *responsibilities* of the GPO as developed by the Project Management Team (PMT) during project planning; 2) an outline of a GPO that would meet these broad responsibilities; 3) details of a GPO design; and 4) a list the specific *requirements and responsibilities* a successful GPO must meet.

The GPO will be the management entity for the GENI project. As such it will have responsibilities in several *functional* areas, as well as responsibilities for the development of policies, procedures, and processes that will support the ongoing operation of the project. Key among the functional area responsibilities are: administration, contracting, finance and budget, legal, systems engineering, project operations, and communications-liaison with many communities of interest to the project.

In Section 1 of this document, the PMT describes what these responsibilities entail. Then, in Section 2, it describes how these responsibilities might be grouped into four management offices that would constitute the GPO. This integration is based upon two objectives: 1) the desire to keep project management costs at an acceptable level, and 2) the desire to maximize effective communications and collaboration throughout the project office. The design of the GPO is based upon a set of four *core principles* that focus on: adaptability and flexibility in the GPO; trust and transparency among individuals and organizations; collaboration and fate-sharing; and the promotion of innovation, both in management and in technology.

Sections 3, 4, 5, and 6 of the document describe each of the four GPO offices in detail, including the organizational structure of each office, its principal responsibilities, and its likely operational processes, including responsibilities for development and use of a comprehensive Project Management Control System, a Risk Management Plan and process, and a plan and process for Change Control Management. The emphasis in each case is guided by the core principles enumerated above and discussed in this document.

Finally, in Section 7 we provide a detailed list of the requirements for each of the GPO offices. This list is intended to be a guideline for the future operator of the GPO. Additional requirements may be added as the GENI planning process continues.

1 Introduction

This document is a *reference design* with a set of functional area requirements for the GENI Project Office (GPO). It is one of six documents that, taken together, constitute the plan for the management of GENI. The other five parts of the management plan include: Risk Management Plan; Change Control Management Process; GPO Work Breakdown Structure; the Project Management Control System (which includes processes and tools for budgeting, communicating, monitoring and tracking of the project), and the GENI Management Transition Plan. These six elements of GENI management are published separately [cf. Bibliography], and are all part of the GENI Project Execution Plan (PEP).

Since the GPO will ultimately be operated by the successful bidder to an NSF solicitation for the GPO, the final details of the structure of the GPO will likely differ from those presented here. The purpose of this document is to outline the *fundamental requirements* for a GPO and to describe a *potential management design* for the GPO – developed by the GENI Project Management Team during the Conceptual Design Stage of planning – that will meet both government and project requirements for the management of the GENI project during construction and afterwards. This design takes into account both the uniqueness of GENI as a project and the detailed requirements of the government (NSF and MREFC in particular) for the management of large, government-funded construction projects.

1.1 General Organizational Requirements

The overall design of the GPO must be such that it is able to effectively communicate and work with a broad range of people and organizations – from government sponsors of the project, to research and educational users of the GENI Facility, to groups federated with the project, to the general public. Figure 1.1 below schematically illustrates some of these key relationships.

[Note: Most diagrams in this document are meant to convey information about communications among various parts of the GENI organization, or between GENI and its sponsors or users. Diagrams are generally not indications of direct reporting relationships. Such relationships will ultimately be developed by responders to a solicitation for the GPO.]

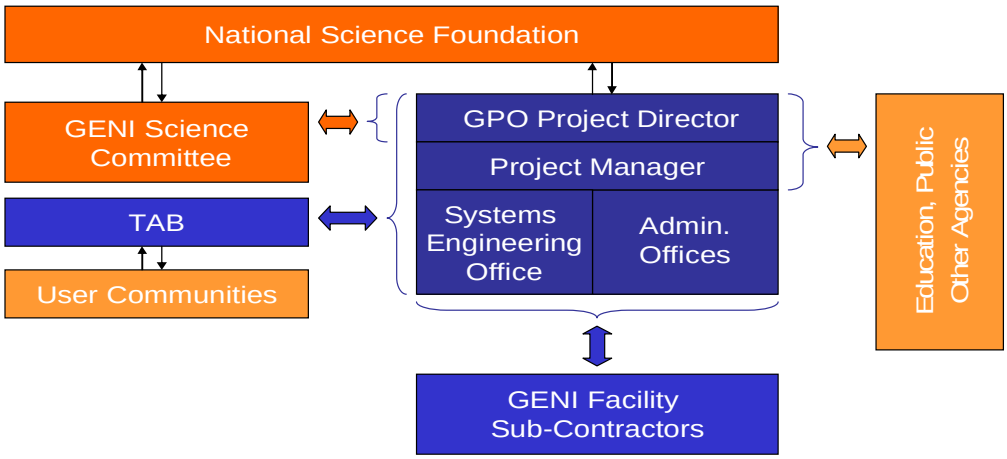

Figure 1.1: Key relationships of GPO. Note that these are not direct reporting relationships, but rather lines of communication between the GPO and other key components of GENI.

Note that an important relationship will be that with GENI Facility developers, who will be subcontracted to construct the GENI Facility. Finally, the GPO design must support continuing communications with the computer sciences and networking communities, as represented by a GENI Sciences Committee (GSC) and researchers in universities across the US and abroad. *The specifics of the communication relationship with the user communities and the GPO have not been entirely worked out at this time.* However, it is likely that there will be more than one communications channel. Here, we show this channel as being through a Technical Advisory Board (TAB) that could be made up (in part) of the leaders of the Working Groups established during GENI planning. The issue of communications between Working Groups and the GPO and Facilities Users and the GPO continues to be discussed by the Project Management Team. Results of these discussions will be incorporated in future releases of this GENI Design Document (GDD-06-34).

Apart from the critical role of communications in the design of the GPO, this organization must be able to effectively meet certain functional needs in areas such as finance, contracting, office administration, legal, engineering, and operations. For this project, *systems engineering* will be a particularly important function. Further, the organization must be guided by a set of policies and procedures that enable it to function on a day-by-day basis, as well as in periods of crisis where rapid decision-making is essential. No part of the management organization must ever be allowed to be isolated from the rest, and this means that not only must the organizational structure be "transparent" to all involved in it, but that the inner workings of each functional area must be sufficiently visible for collaboration, cooperation, and openness to prevail.

Finally, the organization of the GPO must be such that it is *flexible and readily adaptable* to change. The GPO will be established during the planning stage of the project, continue through a 5-to-7-year construction stage, and then move into full operations for a period that could be as long as 15-20 years. During these stages, and over this period of time, the GPO will of necessity

be required to adapt to entirely different environments. It is essential that this *adaptability* requirement be carefully considered at the earliest stages of GPO design and deployment, and built into the structure and processes of the GPO from the start.

1.2 Functional Area Requirements

The GPO requires that several *functional areas* be developed in order for it to meet project management requirements on a continuing basis. These include – *but are not limited to* – the following areas:

Financial Management and Control: Effective financial management is critical to the success of the GENI project. This functional area addresses tasks in the areas of financial planning, budgeting, accounting, financial procedures and control, documentation and records, as well as financial reporting. A particularly important responsibility is that of directing all financial aspects of the Project Management Control System (PMCS).

Legal: Legal services must be available from the GPO during all phases of the project, but particularly during GENI construction. It is expected that more than two-dozen contractors will be involved in the development and deployment of the GENI Facility. This will require contracts and numerous other legal documents to protect the assets of GENI as it is developed. In addition, legal policies must established, cooperative agreements developed, and compliance with local, state and federal requirements met. These, and other, legal issues must be addressed by the GPO.

Project Operations: Several activities within the area of operations will require regular management and leadership from the GPO during the course of the GENI project. These include: project planning, scheduling, and tracking; supervision of contractors during construction; management of GENI Facility node sites; maintenance of installed equipment; reporting on project progress; and other related tasks. It is envisioned that *overall ownership of the PMCS* will fall within this function, although it is expected that each functional area will contribute significantly to PMCS databases and direction of the overall project – this is particularly the case for the financial function and systems engineering.

Systems Engineering: Systems engineering is at the heart of the technical part of this project and the GPO must be able to carry out this function effectively. Although individual platforms and related software will be developed and built by contractors to GENI, the *Systems Engineering function within the GPO must be able to ensure that all of the component elements built by vendors actually work together in a networ*k. This will require that there be a Systems Engineering function that is able to develop requirements and specifications for network components; test these components (both individually and in a network environment) in a laboratory; and deploy proven network platforms (hardware and software) to the field. After field deployment, this systems engineering function must be able to maintain and provide upgrades to the GENI Facility, and even assist in the instruction of network users on the use of the Facility for research and education. The PMT allows that there are many ways in which this function could be implemented; one possibility is described in Section 5 of this document.

Liaison & Communications: The GPO will be required to interact with a broad range of organizations and individuals – both inside and outside of the GENI Project. For this reason,

the Project Management Team believes that the GPO must have an organization that is dedicated to the role of "liaison and communications" – with industry, government, federation partners, university researchers, educators, as well as the general public. Such a function should, of course, be very closely tied to the Project Director and Project Manager so that the GENI organization as a whole would speak with one voice. It is expected that the Project Director will make frequent use of this function to communicate both outside of an inside of GENI. *Clearly, however, communications with respect to GENI – and particularly those with the NSF – are the direct responsibility of the GENI Project Director.*

Education & Training: Education is a key role for GENI. This will extend initially to researchers who will need training in order to effectively use the research facility, then to universities, high schools, visitors to the Facility, and the public. An important continuing role will be to educate congressional leaders who will need to understand what GENI is doing and why funding of it is important.

Administration: Administration of the GENI project will fall to the GPO. At the highest level, this will include services to the Project Director and the Project Manager, but also included supervision of satellite operations; direction of human resources services, including salary administration, benefits, etc.; capital procurements; plant safety; and various other administrative services. Here, administration is taken quite broadly and incorporates some functions (e.g., contracts, procurements) not usually assigned to "administration". This will be addressed in detail in Section 3 of this document.

1.3 Policies, Procedures, and Tools

Underlying the above functional area requirements for the GPO will be the ability of the GPO to develop the policies, processes, and procedures that will be required for smooth operation of the project through multiple stages. In addition, it will be important for the GPO to select the right project management tools that will provide the means by which the project can be planned, tracked, and managed during each phase of its development. Three areas are of particular importance.

Risk Management: Risk management is a critical element in the management of any large project. This major construction project will build a facility that will span the United States, federate with similar networks in the U.S. and abroad, interconnect with the legacy Internet, and ultimately be used by thousands of researchers around the globe who will lead the way in development of the future "Internet". In order to accomplish this, the GENI Facility will be used during its construction to ensure that the Facility, when completed, will meet the requirements of all intended user communities. This will involved significant – *but manageable* – risk, providing the GPO is able to develop and carry out an effective Risk Management Plan such as that designed by the Project Management Team during the GENI Conceptual Design Stage [see Bibliography]. More important, it will be necessary that a *culture of proactive risk management* is instilled in every project participant (i.e., management team, user communities, contractors, federated networks…). This will be a core responsibility of the GPO.

Change Control Management: A close companion to risk management will be the processes and procedures that will be called upon to control and management changes to the GENI Facility construction plan that could be necessitated by a variety of events (e.g., advances or

delays in technology development, budgetary / funding changes, resource availability, etc.). An effective *Change Control Management* process must be put in place by the GPO. This process must be integral to the overall management plan, and be visible to all appropriate project participants – including GPO management, research users, financial and technical committees, as well as contractors [Note: Risk Management and Change Control Management are the subjects of two separate management documents. Cf. Bibliography]. *It is expected that the Change Control Management process will be directed from the highest levels of the GENI organization as noted in Figure 2.3.*

Project Management Control System: The development of an effective, computer-based and networked Project Management Control System (PMCS) will also be a key responsibility of the GPO. This PMCS must be useable by all project participants for project planning, budgeting, scheduling, monitoring, tracking, responding to risk events, and documenting project progress. In addition, the tool – which may be several individual tools that are integrated so that they act as a whole – must also allow collaboration and information-sharing among project participants.

2 Project Management Design Concept

Following the broad outline of requirements for an effective GPO as proffered above, the GENI Project Management Team developed a concept for a specific implementation of the GENI Project Office. This concept is developed in the remaining sections of this document.

2.1 Core Principles

To begin the design of a workable GPO, the PMT identified four closely related principles that it believes will be essential to effective management of the GENI project through its several stages of operation. These core principles are described briefly below.

Adaptive Flexibility: Adaptive flexibility refers to the ability of the GPO to make rapid transitions in structure, focus, methods of operation, etc., as required – not only at key transitions points (e.g., planning-to-construction; construction-to-full operations), but also as events dictate during the ordinary course of the project. Such events could arise due to changes in technology, changes in project funding, departure of key personnel, and other similar events.

Trust and Transparency: Today's business and project organizations are too often run on the basis of mistrust, isolation of functions, and compartmentalized responsibilities. The principle of *trust and transparency* acknowledges that the GPO must be built on a structure that shares information, that makes information of all kinds available to all parts of the organization, and that is based on the idea that project personnel and organizations are trustworthy.

Collaboration and Fate Sharing: To move forward in an uncertain environment, collaboration and information sharing are critical to success. Similarly, participants in such an organization must be willing to share the downsides of task / event failures as well as the upside of event successes. This concept should not only be built into the GPO itself, but should become a part of all of the GPO's dealings with external organizations (e.g., contractors, federations…).

Innovation: GENI will be driven by opportunities to innovate. The management style of the GPO must not only be able to accept the disruptions that innovation frequently engenders, but be innovative itself in the management of the project – minimizing strict dependency on legacy management methods in order to move forward as flexibly as possible.

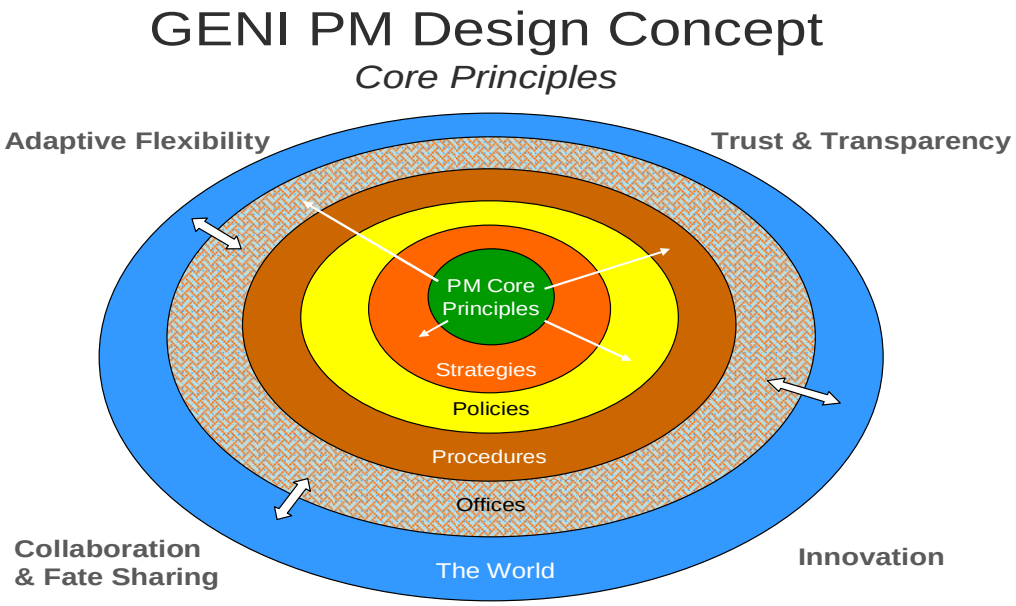

Figure 2.1: Design concept for GENI Project Office, based on four core principles and their influence on strategies, policies, procedures, and offices established by the GPO to management the GENI project.

The figure above illustrates these four core principles in the broad structure of the GPO. At the center of this figure are the core principles. These drive the development of a management strategy, the creation of policies and procedures that enable the organization to function, and finally determine the nature of the offices of the GPO that implement GENI management on a day-by-day basis.

2.2 Mapping Functional Areas to GPO Offices

The next step in the process of designing the GPO is to map the required functions of the GPO into the area offices that will carry out the day-to-day business of the GPO. This process is shown schematically in Figure 2.2 below.

After considering several possibilities for functional-area offices of the GPO – one of which was described in the GENI Project Execution Plan of January 2006 – the PMT decided to specify four functional-area GPO offices. These include: Contracts-Legal-Administration Office (CLAO), Financial Management and Control Office (FMO), Systems Engineering and Operations Office (SEO), and External Liaison and Communications Office (ELO). The decision to define these particular offices was based on the desire to combine functions that were closely aligned in

order to reduce the overall cost of the GPO organization and to ensure frequent communication among functions that most depended upon one another – thus, hopefully, achieving more rapid decision-making during critical situations in the GENI construction stage.

Thus, it was logical to combine contracts with legal, and systems engineering with operations. Financial management – so key to the success of the project – was deemed best to be a separate office. And liaison/communications was thought to be a function that cut across the entire GPO operation.

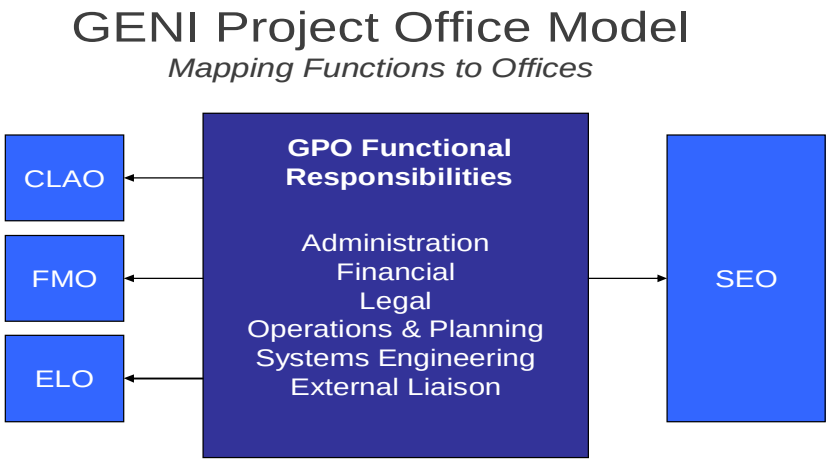

Figure 2.2: Mapping of functional areas into GPO offices.

2.3 Office Functional Responsibilities

In Figure 2.3 below, we show the structural organization of the GPO, now composed of four primary offices – CLAO, FMO, SEO, and ELO. Also shown are the principal responsibilities of each office, which will be described in detail as we continue.

Contracts are developed in the CLAO, which also includes the legal function. The PMT sees contract development and award as being separated from contract administration, which is placed in the SEO because the largest contracts will be awarded to the builders of the GENI Facility, who will require engineering contacts with the GENI organization rather than administrative or legal contacts in most instances.

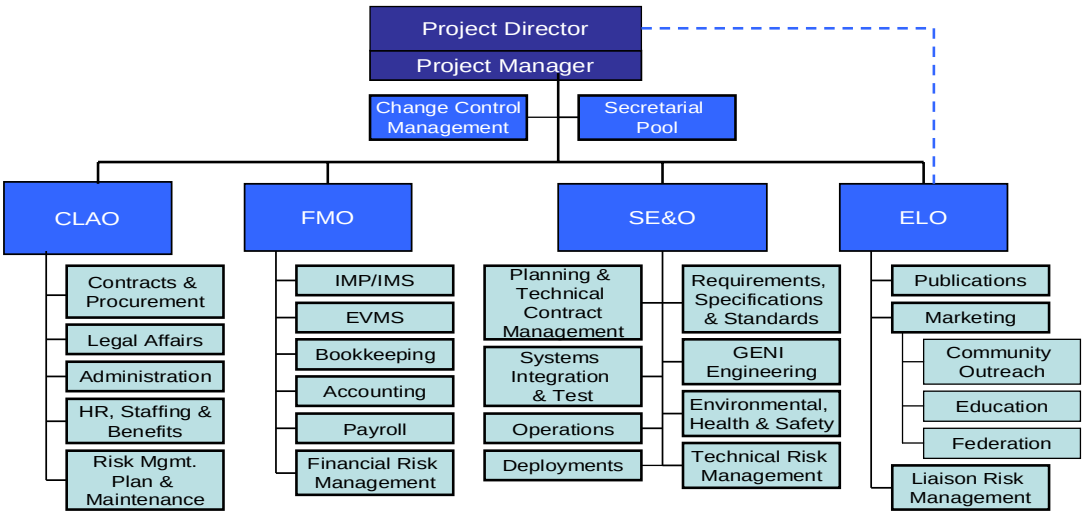

Figure 2.3: GPO structural organization, showing the functional responsibilities of each office of the GPO model considered here.

Systems Engineering is a major function, with broad responsibilities for the development of technical specifications, for systems engineering of the GENI Facility, and for the testing and deployment of platforms produced by GENI's construction-stage contractors. The SEO is also responsible for the engineering of node sites and for ensuring that all codes (local, state, and federal) are met, including safety and environmental.

The ELO addresses communications at all levels, but primarily faces outward into the external communities that will be associated with GENI and the research use of the GENI Facility. These are expected to include universities, research laboratories, educational researchers, and others. This office is also responsible for education and training related to GENI and its use. We note again at this point that the *ELO should be very closely tied to the Project Director*; in many ways, it will be one of the principal tools of the Director to get the message about GENI out.

Finally, the FMO has overall responsibility for the financial aspects of GENI. This includes responsibility for the use of PMCS tools to document and convey information related to the financial status of the project and the measurement of project progress in terms of cost.

Figure 2.4 below shows schematically the relationships among the offices of the GPO and the principal areas of expertise communicated from one office to another. Notice that the GENI Facility developers (contractors) are included in this chart. It is through these contractors that the component parts of the GENI Facility will be developed and manufactured. However, there must be continuous communications between the GPO and each of its offices with these contracting organizations – initially to establish the contracts, but then to manage the GENI-contractor relationships throughout the Facility construction stage. The FMO will oversee financial areas, providing information to the CLAO and SEO as these offices manage the day-to-day operation of the project with contractors. The CLAO provides legal and related information to the ELO, which has the responsibility for communicating (under the guidance of

the Project Director) with external communities, including the government, on the progress of project work.

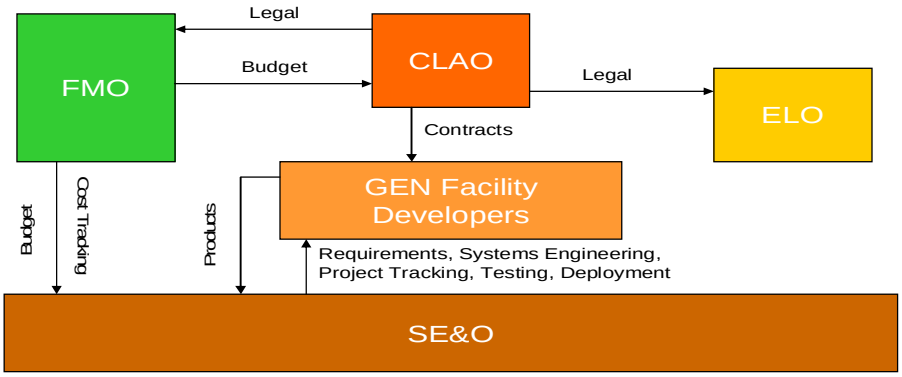

Figure 2.4: Relationships among the offices of the GPO and areas of expertise communicated from one office to another.

We now begin a more detailed description of each of the four functional offices of the GPO. In particular, we describe their organizational structures, their principal responsibilities and the requirements that they must meet, the processes and procedures that they must develop and own, and some aspects of how they are expected to operate. We start with the CLAO.

3 CLAO: Contracts-Legal-Administration Office

The administrative, contracting, and legal functions of the GPO are seen to be closely associated and sufficiently synergistic to combine into a single office. The PMT refers to this office as the CLAO. The office is envisioned to have very broad responsibilities that include: development of administrative policies and procedures; preparation and execution of contracts, cooperative agreements, non-disclosure documents, and similar; operation of a Human Resources function, including hiring, salary administration, and benefits; protection of GENI assets, including the development of policies related to intellectual property; provisioning of administrative services; and other similar functions.

These functions and responsibilities overlap significantly. For example, contracts and procurements (C&P) require a legal affairs (LA) framework in which to function, including tight legal review of these activities to ensure that there is compliance with various local, state, and federal regulations. On the other hand, hiring of consultants – normally a contracts and procurement function – and hiring of regular staff (normally an administrative function) become very similar in a highly virtual world in which collocation is only via computers. Administrative (ADM) record-keeping activities also involve a high degree of collaboration among all of these entities in order to achieve the success frequently illusive in traditional organizations.

3.1 CLAO Organizational Structure

The components of the CLAO, namely ADM, C&P, and LA, and the relationships among its parts are illustrated in Figure 3.1. Below we discuss each of these components, their individual responsibilities, and the areas of overlap and dependence among them.

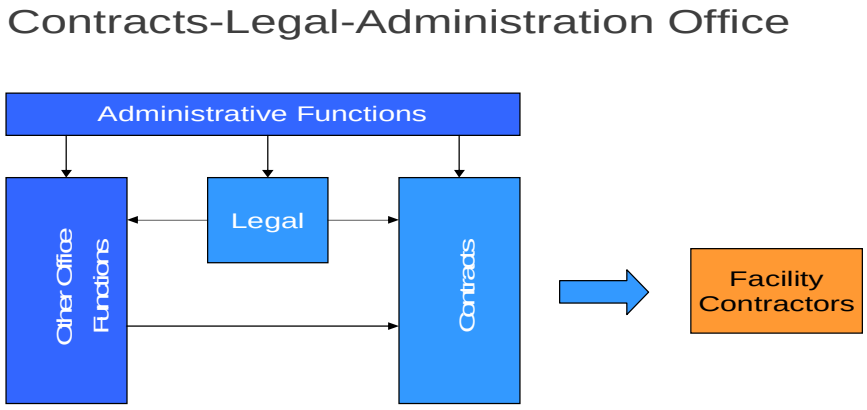

Figure 3.1: Components of the CLAO and relations among them.

Administrative Services (ADM): The administrative services function ties together the several components of the CLAO as well as functions that are parts of other GPO offices (i.e., Financial Management & Control, Systems Engineering & Operations, and External Liaison). Administrative Services is responsible for the documentation, dissemination, and management of the many policies and procedures that will guide the GENI project through its various stages. These policies and procedures will deal with legal issues, hiring practices, salary administration, benefits selection, safety, contractor relationships, interactions with the government and industry, and a host of others.

Another significant role of the Administrative Services unit is the establishment of a Human Resources component. This part of the ADM is responsible for hiring (and all related services) of both contractors and regular GPO staff.

Contracts and Procurement (C&P): The Contracts and Procurements unit will lead negotiations and make formal contractual commitments with Facility builders, equipment suppliers, and many others who will contribute to the construction of the GENI Facility. The exception will be negotiations with other governments, international organizations, and federation applicants; in these cases, the LA unit will lead negotiations and will finalize contracts. Formal documents that will be developed by C&P will include, among others, NDAs, RFIs, RFPs, contracts, cooperative agreements, property leases and rentals, partnering contracts, and more.

Once contracts, agreements, etc., have been concluded, C&P will collaborate with other GPO offices to ensure that the conditions of these contracts are fulfilled. In some cases, C&P will take

the lead in dealing with contractors, and in others the lead will be taken by the relevant GPO office unit. For example, Systems Engineering & Operations (SEO) will be responsible for the direct management and supervision of contractors responsible for constructing the GENI Facility, but will continue to work with C&P to ensure that all contract conditions are met and appropriately tracked. In the same way, SEO will work with the Financial Management & Control Office (FMO) to ensure that the work of Facility constructors is properly supervised from the financial perspective.

Legal Affairs (LA): The Legal Affairs unit is responsible for all legal matters that must be addressed by the GPO. This will include – but not be limited to – preparation of Non-Disclosure Agreements; preparation and review of all legal aspects of contracts; procurements of facilities (including leases and rentals of properties); preparation of legal agreements with federations and international organizations; protection of assets, both physical and intellectual; development of all legal policies; protection from suits and other liabilities related to unlawful use of others' intellectual property; and more. The foregoing are parts of the prescribed duties of the LA.

The nature of the prescribed responsibilities of work in focused areas is naturally time phased. For example, government contracts, compliance, and regulation will be especially important at the start of the GENI project. As Facility construction starts, contracting associated with construction of the facility will dominate (e.g., with vendors, universities, research institutes, etc.). This second phase will also necessitate establishing and maintaining the legal framework by which universities and other organizations start to participate in GENI as a research facility (to be used by several communities during the Facility construction). Finally, a third phase will focus on anticipation and execution of full operations for the GENI Facility following its completion and commissioning. This phase will continue legal focus on user relationships, but also be expanded to international organizations seeking the use of the Facility, establishment of federations with other similar large networks, and outreach to a much broader community that will want to use the Facility for education. While the central focus in each of these phases is different, significant overlap and recurrence of activities are to be expected.

In addition to the prescribed duties of the Legal Affairs office, this unit of the CLAO will also provide ongoing expert legal advice to the senior management of the GPO. Such advice is likely to include coordination of legal activities with the government, compliance with government regulations in the execution of project activities, employment and consulting agreements, organizational conflicts of interest (OCI), and many others.

It is important to once again stress the value of establishing a GPO that is highly flexible, as transparent as possible, and that emphasizes collaboration and cooperation among its various office units. Because the GPO will function over several stages in the GENI project, the ability to adapt to these stages gracefully is highly important. It is far better to define a GPO structure and working strategy in the beginning that will be adaptive rather than to be compelled to change the structure and operating practice each time a transition to a new stage is made.

3.2 General CLAO Requirements

CLAO Staffing and Expertise: Overall, staffing of the CLAO is expected to be at the highest professional level. The manager of the CLAO must have significant experience in the

management of a large, multi-disciplinary function and have some level of expertise in each of the functional areas of the CLAO (i.e., administration, legal, contracts, procurement), but most of all must have a vision for this office that incorporates the core principles stated in Section 2.1.

The senior staff of the CLAO (the leaders of the ADM, LA, and C&P offices) should likewise be mature professionals, each expert in his or her own area. Again, expertise alone is not sufficient to function effectively in this organization. Willingness to collaborate, cooperate, and share failures as well as successes is equally important. It is expected that, once the CLAO manager and his/her unit leaders are chosen, these leaders will select the best staff support available.

Project Management Tools: It will be required that the CLAO is tied into the Project Management Control System (PMCS) of the overall GPO. The management and staff of the CLAO must be able to identify the requirements of this office for the PMCS that will be selected, and to be able to specify how the particular features and functions required by the CLAO should operate within the overall umbrella of the PMCS. An important function of the PMCS will be that it has collaborative capabilities to facilitate communications from/to the CLAO and other GPO offices. The tool should be able to create reports and documents on line, and be fully secured for private communication of project information (i.e., legal, financial, contractual, etc.).

3.3 CLAO Operations

The CLAO will be a principal participant in all aspects of the GPO. In a sense, it is the "glue" organization for the GPO since its work cuts across all of GENI management. Thus, apart from its specific responsibilities, CLAO will serve as a unifying entity for much of GPO's activities, many of which will be addressed in GPO management meetings. Such meetings are expected to bring together discussions of the entire aspect of the PEP, including: 1) examination of technical objectives, 2) data reviews, 3) schedule and critical path reviews, 4) risk management and response planning, 5) policies and procedures development, 6) systems engineering and testing, 7) deployment of the GENI Facility, 8) financial planning and budgeting, 9) legal issues, and 10) contracts and compliance.

Outside of GPO strategy meetings, CLAO will interact with other internal GPO offices to provide support in the areas of its expertise. Beyond internal support to the GPO, the CLAO will be involved in relationships that stretch the GPO into the communities represented by academia, business, industry, and government. It is, therefore, critical that the CLAO be managed in a way that allows it to stretch in many directions as needs emerge. Isolation is to be avoided at all costs.

Although the CLAO must interact across the GPO, there should not be strict requirements on office facilities for the CLAO. All personnel could work from the same location, and even be from the same organization (i.e., a successful bidder for the GPO, a university administrative office, or a portion of an industrial or consultant's office). On the other hand, distributed facilities would also work, and may even reduce operating expenses for the CLAO. This option should be evaluated.

4 FMO: Financial Management & Control Office

Effective financial management and control are crucial to the success of GENI. Therefore, an important office of the GPO will be the Financial Management & Control (FMO) office, which will have full responsibility for all financial matters related to the project.

Some principal responsibilities of the FMO office are expected to include: 1) financial planning in accordance with the overall long- and short-term plan for the construction of the GENI Facility and its use for research and education; 2) development of annual and longer range (e.g., 5-year) project budgets; 3) development of financial procedures and control processes that will ensure that financial objectives are met within the funded and allocated budget; 4) maintenance of records as required by good management practice, relevant laws, and required audits; and 5) financial reporting as required by law. Overall, the FMO must ensure that the GENI project operates in a manner consistent with state and federal statutes, regulations, and government policies and directives. An important part of the FMO's operation will be management of all financial aspects of the Project Management Control System (PMCS), as well as related risk management and change control management processes that affect the financial status of GENI.

In the sections below, we outline how the structure of the FMO will ensure that the GPO will be able to successfully carry out its financial responsibilities. We also describe what requirements are essential to good practice in the FMO, and how the FMO would operate in the broader context of the GPO.

4.1 FMO Organizational Structure

The broad organizational structure of the FMO office is depicted in Figure 4.1, together with the relationship of the various units of the office with key processes and control methods.

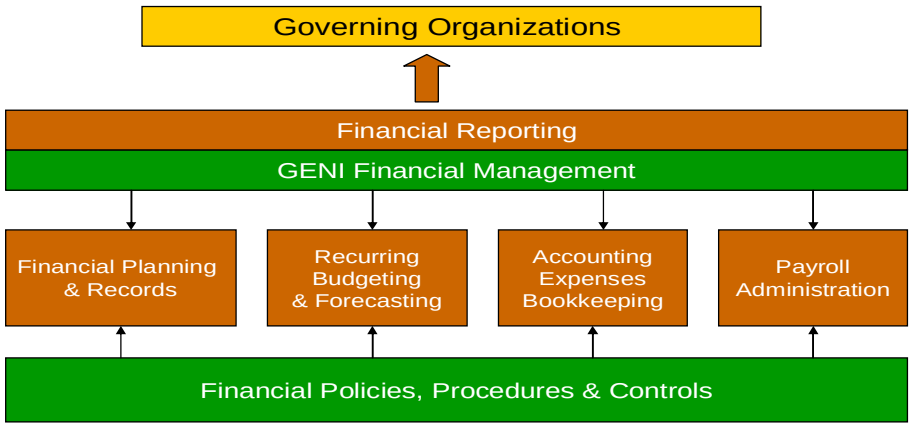

Figure 4.1: Financial Management & Control Office and its principal areas of responsibility.

Four principal units make up the FMO. These units are: Financial Planning & Records, Recurring Budgeting & Forecasting, Accounting & Bookkeeping, and Payroll Administration. These functional units, each of which is expected to have a lead manager, will develop the policies, procedures, and controls that will enable the FMO to function properly. These same units will each contribute to financial reporting and, together, be responsible for the overall financial management of GENI.

Financial Planning & Records: The Financial Planning and Records unit of the FMO will be responsible for all financial planning, including capital planning, contingency financial planning, financial impact analysis, forecasting, master schedule and master integrated project plan maintenance.

The unit will also be responsible for maintenance of the Work Breakdown Structure (WBS), particularly as it relates to the budget, contingency budget, and the cost of mitigation plans. It is responsible for coordinating with other GPO offices to ensure that the entire WBS is kept up to date. Changes in the WBS are to be properly reflected in the GPO annual budgets and in its long-range financial forecasts. This unit must maintain appropriate databases for budgeting, including up-to-date bases of cost and appropriate templates and data for cost breakdown structures of each WBS Element.

Financial Planning & Records is also responsible for maintenance of that part of the overall GPO Risk Management Plan that focuses on financial responsibilities of the GPO. This will involve coordination with other GPO offices in areas relating to the technical content of the WBS as well as in the scheduling of tasks. It finalizes GPO resource estimates for all elements of the WBS.

The unit is responsible for developing financial policies and controls and for making these known throughout the GPO. It will develop and put on line the appropriate templates related financial policies and reporting.

The Financial Planning & Records unit is responsible for all records development and maintenance related to financial issues. This will include records of Facility construction expenses, upgrades to the network, maintenance, capital investments, collaborations, federations, and any external funding of GPO activities. It will regularly report at GPO management meetings on the financial status of the project, including monthly financial reports, quarterly reports, Present View reports, status of contractual work and liabilities. It will also report on opportunities for new funding and the potential impact of these on GPO operations.

Finally, Financial Planning & Records will be responsible for preparation of transition plans for each transition period, including the transition of GENI planning stages to GENI construction, and from GENI construction to GENI Facility full-time operations.

Recurring Budgeting & Forecasting: The Budgeting and Forecasting unit within FMO will prepare annual budgets, both expense and capital; forecast costs that will be associated with federations, collaborative agreements for research, educational offerings or educational use of the GENI Facility. It will develop budget reports as required by the Project Manager and Project Director, and prepare PV forecasts for continuing operations. It will track government plans for future funding and incorporate these into the budget if/as appropriate.

The unit is responsible for tracking financial expenditures and for reporting of these according to all applicable government regulations. It is also responsible for assessing the financial impact of GPO liabilities and for determining the financial impact of various cooperative agreements, including federations, inclusion of industrial organizations in GENI construction and operations, and the financial impact of using the GENI Facility for education and other public applications.

This unit is responsible for the support of annual audits – both internally and by independent external auditors.

Accounting & Bookkeeping: This unit of the FMO is responsible for all accounting and bookkeeping activities. It must establish and adhere to standard accounting methods recognized by the U.S. government and the National Science Foundation in particular.

The accounting and bookkeeping system must incorporate all of the necessary capabilities for receipt and disbursement of funds, including all contract, capital, expenses and payroll activities. The records shall separately account for GENI construction and upgrades, GENI capital investments, GENI operations, GENI maintenance and GENI collaboration activities or externally funded efforts.

The bookkeeping task detail shall enable the earned value management data gathering and reporting elements to be tracked as well as the turning off and on the related time phased cost accounts. These data must be enterable into the PMCS adopted by the GPO.

The unit is responsible for tracking all expenditures within the GPO for salaries, materials and supplies, travel, construction contracts, etc.

The accounting and bookkeeping function is responsible for establishing cost accounting capabilities in each unit of the GPO and for tracking and supervising the activities of cost accountant managers.

Accounting and bookkeeping must establish and early warning method that will inform senior management of impending budget overruns. In particular, it must ensure that at no time will actual expenses plus contractual commitments ever be allowed to exceed the allocated and committed government resources.

Payroll Administration: The GPO shall establish (or acquire) a payroll administrative function that, at a minimum, incorporates: 1) timecard administration; 2) payment of employee wages; deductions, withholding, and deposits for taxes; 3) reporting of federal, state, and local taxes; 4) payments of federal and state unemployment taxes; 5) deductions, withholding, and payment of child support; 5) making advanced earned income credit payments, 6) deductions and withholding of employees' benefit contributions, and 7) development and maintenance of payroll records.

The payroll administration function will also be responsible for working throughout the GPO to educate the GPO staff on matters related to pay, withholding, savings, and related. This functional unit will have an especially strong tie to the CLAO office, which includes legal and administrative expertise for the GPO.

4.2 FMO General Requirements

Detailed requirements for all of the functional units of the FMO are contained in Sections 7.2.1 and 7.2.2. Here we describe some of the *broader aspects* of FMO requirements, concentrating on staff requirements and the FMO's responsibilities related to GENI project management and the computationally based tools used for financial management.

FMO Staffing and Expertise: The head of this office (normally designated a controller or chief financial officer) is expected to have several years of experience in senior management involving financial administration, long- and short-term financial planning, accounting, records keeping, as well as in the other functional areas that compose the Financial Management Office.

As with other senior management positions in the GPO, the manager of the FMO should be committed to the idea that flexibility and adaptability are critical to the success of the GPO. This manager should have broad interests outside of the areas of finance and accounting that will enable him or her to perform effectively in an engineering and scientific environment. Further, this senior manager must be committed to the idea that management systems associated with finance will be incorporated into a Project Management Control System that will be used by the entire GPO and that financial information will be shared (as appropriate) in order to manage all of the GPO's responsibilities.

Other FMO personnel will be responsible for all the bookkeeping, accounting, forecasting, payroll, electronic funds transfer, and use of the computer-based Program Management Control System (PMCS) and Earned Value Management System (EVMS) to produce an Integrated Master Plan and Integrated Master Schedule (IMP/IMS) for GENI. The staff shall be skilled at

performing entry and analysis of all tasks, schedule and financial data, as well as the producing schedule and financial reporting as specified in Section 7.2 of this document.

Project Management Processes and Tools: The FMO will have full responsibility for financial management of the GENI project within the GPO. All of the functional responsibilities described above and in Section 7.2 must be integrated into the PMCS selected by the GPO, and be consistent with all other management processes and procedures as represented by the Risk Management Plan, IMP/IMS, EVM, CCM, WBS, and others that might be developed by the GPO during the course of the project.

4.3 FMO Financial Operations

It is anticipated that the FMO will be a permanent office of the GPO, operated by the GPO and not subcontracted by the GPO. The purpose of this to assure continuity of operations and records maintenance as the GPO moves through the several stages of the GENI project. Like the CLAO, however, it will not be essential that the FMO be physically housed with administrative or technical functions of the project. If the FMO is not physically housed with other GPO functions, and particularly if FMO units themselves are separated physically, it will be the responsibility of the FMO manager to ensure that the overall FMO office is tied into the Project Management Control System adopted by the GPO, and that databases, processes, procedures, documentation, reports, etc., are available at all times on the PMCS. The head of the FMO will be expected to personally attend all senior management meetings and to provide up-to-date reports of financial status at these meetings. He/she is also responsible for delivery of all financial reports on schedule.

5 SEO: Systems Engineering & Operations Office

Systems Engineering and Operations (SEO) is responsible for ensuring that the GENI Facility is well-engineered, that systems requirements and specifications are met by vendors supplying or building network platforms (software and hardware), and for the orderly deployment (including field testing and commissioning) and subsequent maintenance of the network. Its organizational structure, the policies and procedures that it develops, and its operating methodology must all support these responsibilities.

5.1 SEO Organizational Structure

We begin with a description of *an example* organizational structure for the SEO that the PMT believes would be able to effectively address the roles and responsibilities assigned to the SEO function in the GPO. This structure is illustrated in Figure 5.1 below. It includes several key sub-components: 1) an organization that will address issues associated with the development of technical requirements and specifications for the platform elements (and the network itself) that will constitute the GENI Facility; 2) a systems engineering component that will actually carry out the systems-level engineering for the overall GENI Facility (this is not the engineering for the platforms themselves, but rather for the interconnection of the platforms in a network); 3) a capability to carry out simulations and emulations of network platforms in a networked environment (to evaluate engineering designs rapidly and at low cost); 4) a Systems Integration

and Test (SI&T) laboratory in which to build subsets of the GENI Facility so that network platforms can be tested in a GENI-like environment; 5) a means by which "first-sites" field

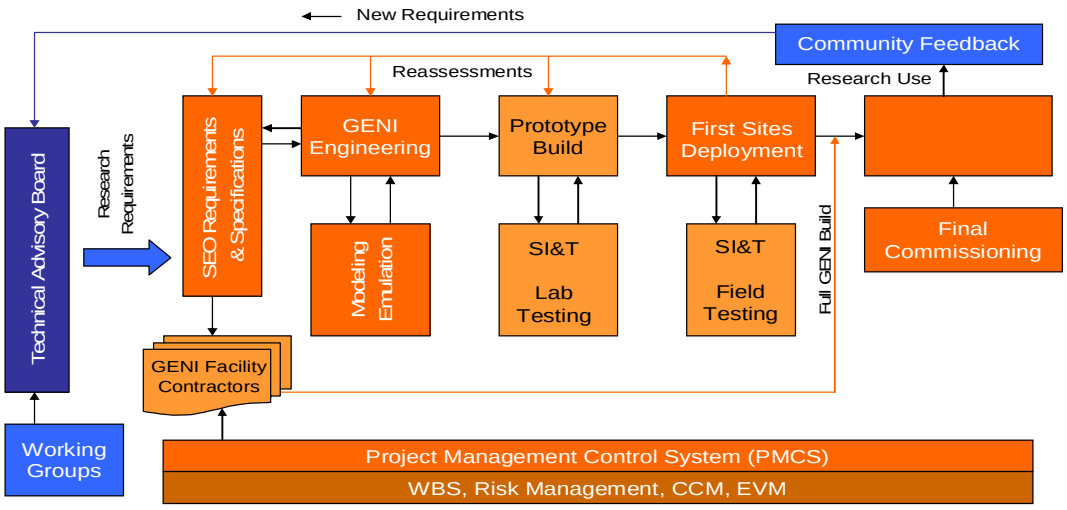

Figure 5.1: Illustration of the SEO, showing its functional components for systems engineering, testing, and facility deployment.

installations can be realized so that testing can be carried out in the field (on a subset of the field node sites) before the GENI Facility is completely populated by platforms that have not been proven outside of the laboratory (i.e., SI&T); 6) a means for moving new platforms, technologies, or platform upgrades into the full GENI network; and 7) an appropriate feedback process whereby the research or education user communities can assess new Facility capabilities and report back on these to the SEO.

The organizational structure of the SEO also includes a mechanism for commissioning the GENI Facility at various stages of its development. It is anticipated that such commissioning of the Facility will occur *at least three times* – one at the end of the first year of construction, another at the midpoint of construction, and one at the end of construction as GENI is moving into full-scale and full-time research operation.

Finally, the organizational structure of the SEO shows a means by which the SEO communicates with contractors – supplying network requirements and specifications, tracking project/task progress (via the PMCS/EVM capability), and maintaining contact with *risk management* and *change control management* issues.

5.2 SE&O General Requirements

In order to meet the responsibilities defined above, the SE&O must satisfy several requirements. The details of these requirements are contained in Section 7.3 of this document. Here, we discuss at a higher level some of the major categories of these requirements.

SEO Staffing and Expertise: The SEO is the most technical within the GPO. Therefore, it will require a manager with a proven technical and project leadership background, with verifiable major successes in the area of large systems engineering and deployment. This person should have an advanced degree in engineering or science and 10-15 years of significant project management experience. In addition to the technical skills of the manager, strong inter-personal communications skills will be essential because this is the manager who will deal most frequently with individual contractors and their organizations.

Support for the SEO manager must be provided by an engineering staff with backgrounds in many areas, including: preparation of engineering specifications; both hardware and software systems engineering; platform and network systems testing and evaluation; node site engineering and deployment; broad knowledge of local, state, and federal regulations related to network installations, including safety and environmental protection; contract negotiation; systems deployment engineering; management tool utilization for project monitoring, tracking, and reporting.

Project Management Processes and Tools: The SE&O staff and management must be connected into the overall GPO Project Management Control System (PMCS). Systems operated solely by the SEO staff must be able to be interconnected with the PMCS if they provide downloadable project information that can be used to track the project. A critical element of the PMCS, particularly for the SEO is that it has *collaboration capabilities* – that is, a capability to interconnect people and organizations in real time for "white boarding", conferencing, and similar processes. The system must also incorporate the key elements of the risk management processes (e.g., watch lists, risk matrices, etc.) and the change control management processes.

5.3 SEO Operations

The SEO will interoperate with several organizations inside and outside the SEO itself. Regular meetings will be held by the SEO manager with senior project management, contractor management, suppliers, federated partners, user groups, and funding sponsors. It is expected that these interactions will frequently be conducted by means of audio and video conferencing, and by direct tie-in to the PMCS through its collaboration capabilities.

The SEO will receive equipment from contractors and other suppliers, carry out tests (including initial acceptance tests on individual platforms as well as integrated systems tests that evaluation interoperability with other network systems) on this equipment, and report back to equipment sources and other communities in order to correct problems – either with system performance, platform performance, or delivery schedules.

Upon completion of successful testing and evaluation, platforms will be deployed in small numbers to selected field sites for in-Facility evaluation. Here, for the first time, new platforms and technologies will be required to inter-work with a wide variety of systems already deployed in the network. Based on the performance of these new systems, they will either be returned to the laboratory for further testing and "bug fixing", returned to the supplier, or be moved into the queue for full field deployment and use by the research community.

At appropriate times during the operation of the Facility, commissioning of the up-dated network will take place and expansion of network capabilities (i.e., features, functionality,

performance) to be advertised to network users. Network users will comment on the performance of the new capabilities through GENI Working Groups (or their equivalents) which will start the cycle of requirements, specifications, engineering, test, and deployment again.

It is suggested that offices and testing laboratories for the SEO be co-located. While many of the management offices of the GPO can easily be geographically dispersed, this is not the case for the SEO, where frequent face-to-face interactions will occur to connect requirements and specifications to engineering, and these to system-level testing, and these to deployments or interactions with vendors and users to address issues related to the functionality or performance of various platforms.

Facilities for the SEO should include: 1) engineering stations with systems integration, modeling, and emulation capabilities; 2) lab spaces to build small networks that mimic parts of the larger GENI Facility so that *in situ* testing can be carried out in the laboratory in an environment as near to that of the GENI Facility as possible; 3) lab space for receiving and testing many different elements of the network as supplied by vendors (both hardware and software); 4) a wide array of test equipment and intra-office switching equipment for rapidly reconfiguring a network to meet ever-changing test requirements; and 5) field-deployable test systems for evaluation of new network platforms and technologies in the actual GENI Facility.

> **Strategy Issue:** In the foregoing discussion, we have suggested that the functions associated with testing, systems integration, end-to-end interoperability, deployment, field testing, and ultimately, full deployment, be carried out by the SEO. The alternative to this is that such activities could be subcontracted by the SEO to external organizations with the appropriate expertise and facilities. If this route is taken, then the SEO must be able to confirm that all such functions are properly carried out. It will also be necessary to show that such an approach will be "less costly" in the fullest sense of "cost" – for example, those costs related to schedule delays, SEO personnel required to supervise and monitor subcontractors, etc.

6 ELO: External Liaison & Communications Office

The GPO will include an Office for External Liaison & Communications (ELO). The ELO will provide the *day-to-day* formal interface between the GENI project and the government, academic institutions, business and industry, federated projects, and the general public. Its function will include both information dissemination related to the GENI project and marketing of the GENI Facility to potential new users. As part of this responsibility, the ELO will be responsible for the preparation (including printing) and appropriate distribution of all publications, research reports, financial reports, and similar.

The ELO is expected to be one of the principal tools of the Project Director and Project Manager for all communications related to GENI. Its job, overall, is to ensure that GENI management speaks with one voice to all communities. Some parts of its function are expected to be addressed directly by the Project Director and/or Project Manager; this would include, for example, communications with the National Science Foundation – a principal responsibility of the GENI Project Director.

6.1 ELO Organizational Structure

The ELO has four principal functions and four main audiences as shown in Figure 6.1 below. The office functions include: 1) project communications; 2) liaison with customers, including sponsors; 3) marketing; and 4) education and training. The audiences include the U.S. government (through the Project Director), academic institutions (including research institutes), business and industry, and finally, Facility users and the general public.

The relationships among these functions and audiences are too complex to represent in a simple drawing because, in many ways, each audience will tap into more than one function of the ELO. Thus, the structure of the ELO must be fluid, with the leader of each functional area willing to participate in the other functional areas and to be able to effectively address audiences with significantly different needs and areas of expertise. Project communications, for example, may include information related to the technical progress of the project (or, in later stages, the progress of particular research projects), its financial/budget status, resource issues, or project schedule. How each of these is presented to an audience group will vary according to the interests and expertise of the particular audience.

ELO Project Communications: The requirements for GENI communications will be both broad and diverse. The principal target audience for project communications will be the government, and particularly the National Science Foundation and the U.S. Congress. Here, project progress reports will cover both technical and management issues. The Project Communications function of the ELO will have the responsibility for ensuring that such communications reach their intended audiences on time and that all reporting requirements related to them are met. [Again, the responsibility for the content of such reports ultimately falls upon the Project Director].

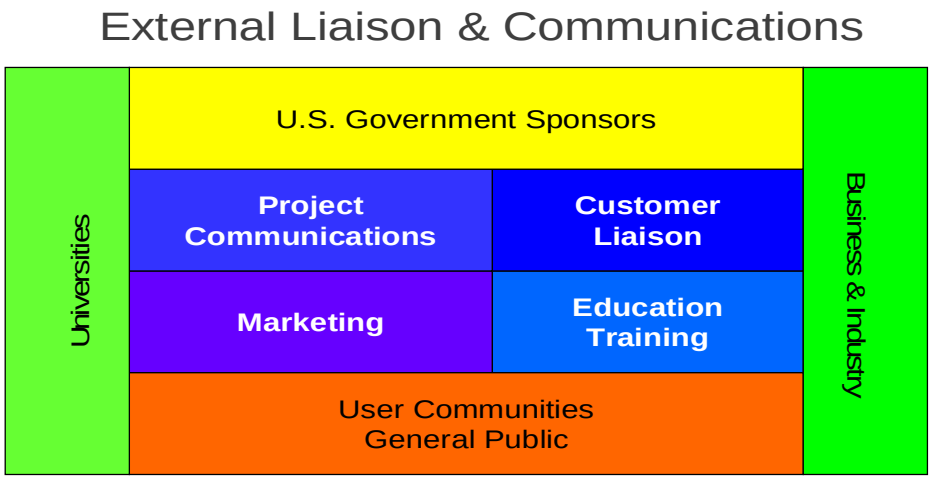

Figure 6.1: Functional structure of the EL&C and its audiences.

In addition to communications with the government, it is expected that other communities will also have a project communications need, including GENI Facility users, research collaborators, federated networks, and the public. Such communications will also be the responsibility of the ELO Project Communications unit.

ELO Customer Liaison: Apart from formal project communications to sponsors and research users, frequent liaison with these audiences and others will be important to the project. The ELO Customer Liaison unit will be responsible for establishing the policies and the controls necessary for customer liaison. It will also develop the methods that will safeguard the export of information related to GENI and the research carried out on the GENI Facility. In particular, this unit will be one of the principal interfaces to federations established by the GPO.

ELO Marketing & Business: Communications with some audiences will go beyond simple reporting and, in fact, be *proactive* in attracting new Facility users and additional funding for the long-term support of the Facility. Although such funding will not be required until the construction stage is completed, it will be prudent to start this process as early as possible.

Some responsibilities of the Marketing & Business component of the ELO should include (but not be limited to) the following: 1) development of a database of regulations and requirements for federations in targeted areas (both geographical and topical); 2) development of a website with a marketing focus (different from a research-related website); 3) aggressive work to identify collaboration and / or federation opportunities; and 4) development of opportunities for business use of the Facility (including sponsorships for enhanced network features).

The Marketing & Business unit will be responsible for providing budget information to the GPO, and for forecasting resource requirements based on new research, funding, and business opportunities.

ELO Education & Training: Although research is the principal intended use of the GENI Facility, it is expected that it will also play an important role in the education of future generations of computer and network scientists. It will be the responsibility of the ELO Education & Training unit to develop a long-term strategy and plan for the educational use of the GENI Facility. This plan is expected to include courses based on the results of research projects run on GENI, opportunities for student research (including high school, college, graduate, and post-doctoral), video presentations for the public, Webinars, and more.

In addition to educational initiatives, the Education & Training unit is expected to developing training materials and to conduct training sessions for potential users of the GENI Facility. Such training is expected to include not only researchers interested in computer science and networking, but those involved in developing new services and applications that could become a part of the infrastructure of the future “Internet”.

6.2 ELO General Requirements

Detailed requirements and responsibilities of the ELO are specified in Section 7.4.1 and 7.4.2. Here, we outline some basic requirements of staffing, office operations, and computer-based tools that will be necessary for successful operation of this office.

ELO Staffing and Expertise: The senior manager for the ELO must have a strong background in education and training and a technical background in science, engineering, and research that is sufficient to be able to convey to a broad range of audiences deeply technical material in an understandable way. This individual must be highly motivated by the opportunity to teach diverse audiences in ways that move well beyond classical classroom presentations and that start to make use of the future "Internet" as it evolves. Furthermore, this manager must be able to attract the very best professional staff to work in this area.

Project Management Processes & Tools: The responsibility of the ELO for tools will go well beyond the need for the PMCS, although it will be essential that the ELO tools (as appropriate) tie into the PMCS. The special function of the ELO will dictate that it develop extensive databases related to multiple uses of the GENI facility in the future. These databases will include applications as well as network services (in fact, the projected applications are likely to drive development of the required network services). Such databases might include medical, environment, ground and air traffic, education, games, health and safety, and more. The ELO must also develop websites, blogs and other electronic methods for dispersing information concerning the GENI Facility and its potential uses. Such methods should be highly interactive and at least simulate some of the features that are being incorporated into GENI. To some extent, the ELO could become a test user of GENI for future applications.

6.3 ELO Education & Training Operations

The operation of the ELO will need to look outward as much as it looks inward. It must proactively seek information from many outside sources that represent opportunities for new collaboration, federations, applications, as well as opportunities for future funding and for ideas that could drive changes in the design of the GENI Facility. It will be expected to establish working "laboratories" with educational organizations that will explore better ways to provide education and training to many audiences – reaching into high schools as well as into colleges and universities.

The "facilities" for the ELO are expected to be highly distributed – both physically and virtually – with most communications carried out electronically. The leadership of the manager of the ELO will determine its success and its value to the GPO. Here, the *core principle of innovation* is critical to success.

7 GPO Detailed Requirements & Responsibilities

This section of the GPO Reference Design and Requirements document describes the detailed technical requirements for each office of the GPO (i.e., CLAO, FMO, SEO, and ELO). Requirements are sorted by the four GPO Offices that we have described in the document. *There is, however, no inherent reason why the GPO could not be organized differently.* The following Requirements and Responsibilities, however, are essential to the successful operation of the GPO and must be addressed, regardless of the specific organizational structure of the GENI Project Office.

Important Note: These requirements and responsibilities are not yet complete; updates are being regularly. The reader is advised to use the most recent version available.

7.1 CLAO Detailed Requirements & Responsibilities

The GPO will establish an office, or multiple offices, to address project management tasks in the areas of contracting and procurement (C&P), legal affairs (LA), and administration (ADM). The following are the minimum requirements for implementation of these functional areas.

7.1.1 Contracts and Procurements (C&P)

7.1.1.1. Government Contracts

7.1.1.1.1. C&P shall receive the GPO prime contract and coordinate the modification and review process with GENI senior management as well as with NSF-CISE and the MREFC Accounts Office.

7.1.1.1.2. C&P shall be responsible, with the project director and project manager, for contract negotiations and all contract modifications of the GENI prime contract with NSF.

7.1.1.1.3. C&P shall prepare, negotiate and be the signature authority for all NSF contract modifications, technical and financial, re-basing orders and any other legal documents or directives issued by the federal, state, or local governments or their agents.

7.1.1.1.4. C&P shall be responsible for assuring that all government deliverables under government contracts are issued and delivered on schedule, or delivered as required in coordination with the administrative unit of the CLAO.

7.1.1.1.5 C&P shall prepare and maintain a set of processes and procedures for the GPO that enable all necessary contractual (and/or procurement) activities to be carried out in accordance with a uniform and high standard for government contracts.

7.1.1.1.6 C&P shall conduct periodic audits and reviews together with Legal Affairs (LA) to ensure that all GPO processes and procedures are in alignment with contract requirements, and regulations and to ensure that all required processes and procedures are being followed.

7.1.1.1.7 C&P shall establish guidelines for the creation of intellectual property, carefully distinguishing the boundaries between its various forms, in concert with Legal Affairs.

7.1.1.1.8 C&P shall review all intellectual property, both legacy or new, and ensure that all contractual obligations with NSF and other involved government entities are being met.

7.1.1.1.9 C&P shall establish procedures and necessary files regarding potential conflicts of interest, as well as monitoring relevant GPO activities to ensure that conflicts of interest do not compromise any decisions within the GPO.

7.1.1.1.10 C&P shall periodically review all environment, health and safety aspects of the work of the project to assure that best practices are being followed and that GENI is in full compliance with all applicable regulations and requirements.

7.1.1.1.11 C&P shall be the responsible organization to assure that NSF is fully informed and in agreement with any GENI licensing, partnering, or federation activities, including cooperative agreements.

7.1.1.1.12 C&P shall be responsible for maintenance of all GENI archival records, regardless of format or technology (i.e., electronic, paper, laser disc, magnetic).

7.1.1.2 GPO Contracting, Compliance, and Commitment

7.1.1.2.1 C&P shall be responsible for the issuance of all funding authorizations and stop-work orders associated with all GPO contracts, procurements, and agreements.

7.1.1.2.2 C&P shall maintain a secure, limited access, on-line database of all GPO contractual obligations, including duration, scope, dates of deliverables, GENI obligations, and contractual success criteria. Any connections between the contractual entity and any other organization will also be recorded.

7.1.1.2.3 C&P shall be responsible for all administrative activities associated with all GPO contractual obligations.

7.1.1.2.4 C&P shall be responsible for the identification of issues that must be tracked and the effectiveness of all tracking (technical, financial, legal and administrative) associated with all GPO contractual obligations. The lead responsibilities within GPO shall be included in the Contract Database discussed in 7.1.1.2.2.

7.1.1.2.5 C&P shall be responsible for creating and approving all contractual obligations (contracts, procurements, and agreements) made by the GPO.

7.1.1.2.6 C&P shall be responsible for the development and/or approval (with LA) of final contractual language to assure that tracking of progress (programmatic, financial, and technical) can be accomplished on an acceptable schedule.

7.1.1.2.7 C&P shall lead the team responsible for negotiation of all project contracts. This team shall include the project manager and other appropriate GPO office management – but always with representation from the FMO and SEO to ensure appropriate financial and technical expertise in contract matters.

7.1.1.2.8 C&P shall perform a contracts and procurement risk assessment of all aspects of the GENI project with the government, providing to the Project Manager a complete risk watch list, assessment of the potential consequence and probability of occurrence for each risk, and recommendations as to what steps are to be taken to avoid, share, or minimize these risks.

7.1.1.2.9 For those risks in which impact is potentially very high, even if probability of occurrence is very low, C&P will develop a risk mitigation and response plan and provide this to the Project Manager and Project Director.

7.1.1.2.10 C&P shall regularly review potential *conflict of interest* issues that could impact GPO or other project management or staff personnel involved in contract negotiation, selection, and approval.

7.1.1.2.11 C&P shall establish a standard set of terms and conditions for GENI Facility Use Agreements with user research and education communities.

7.1.2 Legal Affairs (LA)

7.1.2.1 Government Contract, Compliance and Regulation before GENI Construction Stage

7.1.2.1.1 Within the total scope of GENI, LA shall be solely responsible for the legal consistency of all contracts, GPO contracts, and agreements entered into by the GPO, except for those that establish the CCC and related requirements and regulations.

7.1.2.1.2 LA shall establish and regularly review and update an on-line database of applicable state, federal, and (where appropriate)

local regulations relevant to GENI construction and operation. Such database shall be integrated with and visible from the Project Management Control System (PMCS) tool adopted by the GPO for overall project management.

7.1.2.1.3 LA shall review applicable regulations for required waivers or requests for relief.

7.1.2.1.4 Recent and pending federal/state/local legislation shall be reviewed for impact with relevant entries added to the database as needed.

7.1.2.1.5 Environment, health and safety regulation shall be included in the database of 7.1.2.1.2.

7.1.2.1.6 Alternatives to traditional contract language that might be beneficial for GENI shall be developed (as appropriate) for use in contract negotiations with the government and potential contractors. Use of such language must be employed with full understanding of the risk management plan and be designed to improve the probably of overall project success.

7.1.2.1.7 LA shall participate in all GPO strategy meetings and approach reviews for proposed data generation, distribution, and/or submission of contract deliverables, and similar.

7.1.2.1.8 LA shall participate in Project Manager and Project Director Reviews of the GENI Project Execution Plan (PEP), with particular attention to Legal issues and risks.

7.1.2.1.9 LA shall ensure that compliance requirements are incorporated into all PEP work elements.

7.1.2.2 **Government Contract Negotiations**

7.1.2.2.1 LA will assist the Project Manager and Project Director by participating in government contract negotiations and finalization of contracts for signature.

7.1.2.2.2 LA shall perform a legal risk assessment of all aspects of the GENI project with the government, providing to the Project Manager a complete Risk Watch List, assessment of the potential consequences and probability of occurrence for each risk, and recommendations as to what steps should be taking to avoid, share, or minimize these risks.

7.1.2.2.3 For those risks in which impact is high and probability of occurrence is above 33%, alternatives for risk control shall be suggested 7.1.2.1.2.

7.1.2.2.4 For all risks where the consequence of the risk is very high, regardless of the probability of occurrence, LA shall prepare a risk mitigation strategy and course of action in anticipation of risk event occurrence.

7.1.2.3 **Government Contract Performance**

7.1.2.3.1 LA shall assure full FAR and DAR, as well as protection of GENI, NSF, and other government intellectual property unless explicit contractual waivers have been included in the government contract for such IP.

7.1.2.3.2 LA shall conduct periodic audits to assure legal commitments are being met, all regulations are being enforced, and intellectual property being developed is properly protected.

7.1.2.3.3 Throughout the lifetime of GENI, LA will properly coordinate its legal activities and procedures with the NSF and any other relevant government agencies involved in the project.

7.1.2.3.4 Whenever technical or financial changes to the program direction occur, LA will review all proposed actions (including contract modifications), altering them as required in concert with the GPO, to protect both the best interests of GENI and the best interests of its principal stakeholders.

7.1.2.3.5 A risk mitigation plan shall be prepared by LA for those legal risks in which impact is potentially high, regardless of probability of risk event occurrence.

7.1.2.4 **Contracting, Compliance, and Commitment**

7.1.2.4.1 Three (3) Non Disclosure Agreements (NDA) shall be prepared for only-receipts of sensitive materials from a party to the agreement, for only-disclosure recipients of sensitive materials to the party to the agreement without any receipt from that party, and exchange of sensitive materials among all signing parties.

7.1.2.4.2 Wherever GPO-authorized release of sensitive data is to occur, LA must explicitly review the proposed data to be released and the form of the authorization to use by another party prior to signature.

7.1.2.4.3 LA shall lead the preparation of a plan to assure isolation of all sensitive data received by the GPO from outside parties, and

ensure that a process for proper protection of sensitive received data is implemented by the GPO.

7.1.2.4.4 The GPO contract preparation and review process for construction of GENI shall occur with full participation of LA, with initial drafts being provided by LA in collaboration with C&P.

7.1.2.4.5 GPO contract terms and conditions shall be in full alignment with all GENI legal requirements and regulations. Potential conflicts of interest will be identified and explicitly dealt with either in the negotiation process or under the terms and conditions of the contract.

7.1.2.4.6 Incentive-based contracting processes will be developed in cooperation with LA prior to introduction into the GPO contracting process. Incentives to meet contract commitments shall include (but are not limited to) the potential for contractors to expand (or have reduced) the initial contracted scope of work based upon their GENI contract business, technical and financial performance, and their adherence to GENI contract milestones.

7.1.2.4.7 Contractor incentives for good overall multiple-supplier-based teamwork shall be incorporated into contracts and agreements whenever such incentives can, with a high degree of certainty, significantly improve GENI milestone achievement.

7.1.2.4.8 GPO contracting language will be developed to assure that capabilities exist and are required to support contingency planning for unexpected events such as labor disputes, software development challenges, raw material shortages, natural disasters, program stretch outs, or other program funding constraints.

7.1.2.4.9 Delivery acceptance procedures and testing processes shall be explicit in GENI contracts, using industry standard procedures where applicable.

7.1.2.4.10 A product quality process shall be specified where possible, using industry standards as the preferred approach.

7.1.2.4.11 Best-effort contracting shall be restricted to those activities where no other alternatives exist.

7.1.2.4.12 Provisions for maintenance and support for either hardware or software shall be specified with the financial obligations and the duration of the obligations clearly defined.

7.1.2.4.13 LA shall perform a legal risk assessment of all aspects GPO contracting, providing to the Project Manager a complete Risk Watch List, assessment of the impact and probability of occurrence for each risk, and recommendations as to what steps should be taken to avoid , share, or minimize these risks.

7.1.2.4.14 For those risks in which impact is high and probability of occurrence is above 33%, alternatives to risk control will be suggested and full risk mitigation plans prepared in accordance with 7.1.2.3.11.

7.1.2.4.15 LA shall be responsible to creating a unified responsibility and liabilities flow-down matrix that includes all GPO contracts, as well as the prime government contract with GPO. This matrix shall explicitly indicate who has financial and/or legal responsibilities and under what circumstances, as well as any limits to these responsibilities. Of particular concern are liabilities of the user community (frequently university parties) to other users and/or to GENI operations for damages due to actions taken.

7.1.2.4.16 Operations and usage of GENI will also be subject to contracts or cooperative agreements. These will be drafted by LA in cooperation with C&P.

7.1.2.4.17 LA will, in particular, assure the organizational conflict of interest (OCI) issues are addressed in each contracting instance.

7.1.2.4.18 LA will assume full responsibility for identification and inclusion in all contracts (as appropriate) of any legal issues associated with safety and/or environment health or hazard.

7.1.2.4.19 Coordination with the Technical Advisory Board (or its equivalent) and, in particular, the Distributed Services Working Group (or its equivalent), will be maintained by LA to minimize inconsistencies between construction activities and research being conducted on GENI, as well as to help assess contract compliance issues and risks.

7.1.2.4.20 LA will be responsible for all contract compliance issues, and shall conduct periodic audits to assure legal commitments are being met, all regulations are being enforced, and intellectual property is being developed, properly used, and protected as expected.

7.1.2.4.21 LA shall take the lead in creating licensing agreements for hardware and software to be incorporated into GENI where the rights to use are owned by others. Of particular concern is the

user vs. machine-based licensing agreements by current owners (e.g., Microsoft for the Windows OS).

7.1.2.4.22 LA shall develop appropriate licensing procedures to address multiple, simultaneous-user situations, as appropriate. (expected in the GENI Facility).

7.1.2.4.23 Whenever technical or financial changes to the program direction occur, LA shall review all proposed actions, including contract modifications, altering them as needed in concert with the GPO to protect the best interests of both GENI and its principal stakeholders.

7.1.2.4.24 LA shall become involved early in all contractor issues where contract modifications are likely; further, LA shall aid in the review and revision, if appropriate, of all relevant GPO contracts.

7.1.2.4.25 LA shall prepare initial drafts of all Facility Use Agreements and participate in the final negotiations of these.

7.1.2.4.26 LA shall prepare and make available on-line a guidance regarding definitions and boundaries between different forms of intellectual property as well as explicit interests in specific kinds and topics of intellectual property which are not all encompassing.

7.1.2.4.27 LA shall be responsible for the flow-down of environmental, health, and safety issues for GENI to the contracted or internal organizations best suited to deal with them.

7.1.2.4.28 LA shall be responsible for identification and control processes and procedures to prevent the export of inappropriate data or technology.

7.1.2.4.29 LA shall create on-line intellectual property disclosure forms and templates. The on-line system developed by LA shall inter-work with the overall PMCS tool adopted by the GPO.

7.2 FMO Detailed Requirements & Responsibilities

The GPO will have a Financial Management & Control Office (FMO) that will be responsible for all financial planning, budgeting, forecasting, cash flow analysis, accounting, contingency financial planning, financial reporting, master schedule and master integrated program plan maintenance and analysis, earned value management, and all financial procedures and controls.

7.2.1 Initial Planning and GENI Setup (5 Year Horizon)

7.2.1.1 A program bookkeeping and accounting system shall be set up that incorporates all of the necessary capabilities for receipt and disbursement of funds, including all contract, capital, expenses and payroll activities.

7.2.1.2 Records shall separately account for GENI construction and upgrades, GENI capital investments, GENI operations, GENI maintenance, GENI collaboration activities, and externally funded efforts.

7.2.1.3 Bookkeeping task detail shall enable the Earned Value Management (EVM) data gathering and reporting elements to be tracked as well as turning off and on of related time-phased cost accounts.

7.2.1.4 The FMO shall set up an initial task schedule in the PMCS with the WBS and data provided by the SEO.

7.2.1.5 Technical, financial, and business milestones shall also be included in the PMCS model with proper task and milestone linkages.

7.2.1.6 The FMO shall set up a payroll system for GPO employees that will enable electronic transfer of salaries to employees as well as electronic payment to creditors.

7.2.1.7 The FMO shall set up payments systems to suppliers (electronic preferred) that are based upon CLAO-negotiated terms and conditions and triggered by SEO organization authorizations.

7.2.1.8 The FMO shall establish “bottoms-up” resource requirements with corresponding databases for cost estimates for all GPO contracted or internal activities. This effort to be carried out in collaboration with SEO.

7.2.1.9 The FMO shall incorporate the time-phased resource data, rate data, and the time-phased contract commitment data into the initial task plan of 7.2.1.4 to create the initial IMP / IMS.

7.2.1.10 The FMO shall create a capital expenditures plan for GENI Facility deployment and add these elements to the IMP / IMS.

7.2.1.11 The FMO shall finalize estimates for resources for GENI operations and expenses budgets as well as maintenance budgets, and incorporate them into the IMP / IMS.

7.2.1.12 Government funding plans shall be added to the IMP / IMS, and cash flow analyses performed to enable balancing of planned cash inflow with outflow.

7.2.1.13 Using about 10 performance-based milestones, an EVMS shall be set up in which work packages are no longer than 2 months duration and financial

requirements do not to exceed 1- 2% of total functional milestone budgets. This EVMS is to be included as part of the IMP / IMS system.

7.2.1.14 The FMO shall perform contingency planning activities to assess the robustness of the financial plan against unplanned government funding cuts and the possibility of technical plan high-risk elements not performing.

7.2.1.15 The IMP / IMS plan shall be adjusted, parallelized to minimize schedules, and contingency plans added to improve reportable performance against the established performance milestones.

7.2.1.16 The FMO shall perform risk assessments of all aspects the GPO financial plan, providing to the Project Manager a complete Risk Watch List, assessment of the impact and probability of occurrence for each risk, and recommendations as to what steps should be taken to avoid, share, or minimize these risks.

7.2.1.17 For those risks where potential impact is high and probability of occurrence is above 33%, alternatives to risk control must be recommended and full risk mitigation plans prepared.

7.2.1.18 For those risks that are deemed to have a very high impact of the overall project, regardless of probability of occurrence, a mitigation strategy and course of action to avoid such risk events must be prepared.

7.2.1.19 The IMP / IMS shall be examined for risk reduction opportunities, incorporating all practical options.

7.2.1.20 Any realistic plans for federation or incorporation of other existing or planned capabilities into GENI will place both opportunities and demands on the GENI plans. The FMO will perform a financial impact analysis of each expected event and incorporate the financial impacts of high probability events into the complete IMP / IMS. If probabilities of occurrence are low to moderate, then the FMO shall assess these financial impacts by establishing a three-tier approach to analysis, namely, no impact, full impact, and partial impact. Each re-plan for accommodation will then be compared to create a final set of contingence approaches.

7.2.1.21GENI interests in education as well as community outreach will also lead to financial concerns and direct project impacts. The FMO shall assess these financial impacts by establishing a three-tier approach to analysis, namely, no impact, full impact, and partial impact. Each re-plan for accommodation will then be compared to create a set of final contingence approaches.

7.2.1.22The FMO shall next analyze the IMP / IMS for resource availabilities, aggressive task parallelization opportunities, incentives for procurement

activities, removal of any redundancies, and fine-tuning to create the first documented baseline version of the IMP/IMS.

7.2.1.23 The FMO shall take the lead in drafting and finalizing a complete set of financial policies, procedures, and controls that will establish documented GPO financial roles and responsibilities, chains of authority, and authorization limits.

7.2.1.24 Financial controls shall be established to ensure that amounts owed are paid promptly. Safeguards shall be put in place to guarantee this, including the assignment of authority (and backup) for all check signers.

7.2.1.25 Overall financial policies shall be approved and established by an Executive Committee composed of the Project Manager, heads of the GPO offices, and appropriate external representation, reporting to the Project Director, and become the responsibility of the Project Director to ensure that these policies are carried out.

7.2.1.26 The FMO shall establish a set of financial reporting templates for delivering the required financial and schedule data as well as the EVMS reporting data to the requesting stakeholders. The financial reporting templates shall be electronically linked to each other and, where possible, electronically linked directly to the data sources to minimize transcription error and reduce labor requirements.

7.2.1.27 The FMO shall research all government contract financial requirements and obligations with potential or real impact on GENI, and establish a plan and set of procedures to deal with these requirements. Any policy impacts identified shall be reported to the Project Director as soon as possible.

7.2.1.28 The FMO shall establish a procedure and distribution system for three-month Present View (PV) forecasting of expenditures, commitments, and cash flow, as well as cost performance indices and schedule performance indices for each functional milestone from the EVMS, with updates at the end of each month.

7.2.1.29 The FMO shall establish a plan and procedures for forecasting contractual liabilities for each FMO reporting period.

7.2.1.30 FMO shall provide a candidate set of metrics to the Project Manager for use in the GENI project to aid in good decision-making. These metrics shall be generated through FMO's initiative and in collaboration with other GPO offices and staff.

7.2.2 GENI Execution (>5 Year Horizon)

7.2.2.1 The FMO shall maintain all the financial records, income, disbursements, and non-cash transactions in appropriate journals and ledgers that will be

regularly available to the CCC, GPO and the National Science Foundation and/or its authorized agents.

7.2.2.2 The FMO will designate cost account managers within the GPO and identify similar assignments within all organizations having contractual commitments with the GPO.

7.2.2.3 The FMO shall establish a process for assessing the cost of all work performed and the fraction of all work completed.

7.2.2.4 The FMO shall establish a set of methodologies, deliverable to the CLAO prior to GPO contract negotiations, by which completion of partial GPO contract financial obligations can be systematically assessed, either based upon task completions (within EVMS) or other means of tracking technical progress as necessary.

7.2.2.5 The FMO shall work with SEO and CLAO to assure incorporation of a financial expenditure tracking system (fully compatible with the EVMS system) into all GPO contracts and internal systems to enable adequate financial status reporting.

7.2.2.6 The FMO shall work closely with the CLAO and SEO when GPO contract modifications or new contract/agreement obligations are being considered or executed. Financial impact analyses shall be prepared prior, as well as subsequent, to the issuance of a contract modification or new contracts or agreements.

7.2.2.7 Subsequent to a contract modification, the FMO shall update the IMP/IMS baseline, including the EVMS, to incorporate these changes.

7.2.2.8 The FMO shall update the IMP/IMS for each actual government contract funding allocation in order to maintain accurate records of the fraction of allocated funds currently unspent or uncommitted.

7.2.2.9 The FMO shall alert the Project Manager and the Project Director, as well as meet any reporting obligations for government or supplier contracts, regarding remaining government allocated contract funds when these reach 15%, and when these reach 10% (unspent plus uncommitted).

7.2.2.10 The FMO shall never allow actual expenses plus contractual commitments to exceed allocated and committed government funding resources.

7.2.2.11 The FMO shall perform risk analyses for the Project Manager regarding the current IMP/IMS, including the risk of funding reductions by the government, on a quarterly basis, and generate recommendations for meeting near-term milestones as well as other financial commitments.

7.2.2.12 The risk analysis shall include a complete Risk Watch List, assessment of the impact and probability of occurrence for each risk, and recommendations as to what steps should be taking to avoid, share or minimize these risks.

7.2.2.13 For those risks in which impact is high and probability of occurrence is above 33%, alternatives to risk control will be suggested and full risk mitigation plans prepared.

7.2.2.14 For risk events that would have a major impact on the project, a risk mitigation plan must be prepared, regardless of the probability of the event occurring.

7.2.2.15 The FMO shall examine the financial impact of the CLAO liabilities and obligations assessment for the user community (frequently university parties) to other users and/or the GENI operations for damages due to its actions. These results shall be properly included in the Risk Management Plan.

7.2.2.16 Federation or incorporation of other existing or planned capabilities into GENI shall cause the FMO to incorporate the financial impacts, including possible direct financial commitment either by or to GENI, into the complete IMP/IMS, as well as a proper assessment for the Risk Management Plan.

7.2.2.17 The risk analyses associated with actual incorporation of items in 7.2.2.15 and 7.2.2.16 into GENI shall be delivered to both the Project Manager and the Project Director within 10 days of authorization.

7.2.2.18 The FMO shall incorporate the financial impacts into the complete IMP/IMS of successful GENI interests in education as well as community outreach. Risk analyses associated with these inclusions shall be performed and delivered to both the Project Manager and the Project Director within 10 days of authorization.

7.2.2.19 The FMO, in cooperation with the TAB (or its equivalent) and the CLAO will accommodate industry participation in GENI.

7.2.2.20 Since financial impacts and risks are associated with industrial participation in the GENI project, the FMO shall incorporate the expected financial impacts of such participation into the complete IMP/IMS, and perform a risk analyses associated with these inclusions. This information is to be delivered to both the Project Manager and the Project Director within 10 days of authorization.

7.2.2.21 GENI operations for full-time research will involve new funding sources and financial obligations. The FMO shall incorporate the financial impacts into the complete IMP/IMS, as well as perform risk analyses associated

with these inclusions. The results of such analyses are to be delivered to both the Project Manager and the Project Director within 10 days of authorization, based upon decisions to proceed.

7.2.2.22 The FMO shall perform schedule analyses (i.e., critical- or near-critical path analyses) for the SEO, as requested, to form input to both risk assessments and examinations of work changes by the SEO.

7.2.2.23 The FMO will perform IMP/IMS, including the EVMS, re-base lining activities as required by either government organizations or the Project Director.

7.2.2.24 The FMO will finalize the financial metrics to be reported, which will at least include cost performance index, schedule performance index, remaining allocated budgets by month, and total expenditures to date for each milestone as well as for each task performed by FMO personnel.

7.2.3 Transition to GENI Full Operations and Support

7.2.3.1 Six months prior to GENI commissioning, and in connection with SEO, ELO and the project manager, FMO shall develop financial policies and procedures for the types of activities that will be funded by government resources after construction completion, and which types of activities will require independent funding.

7.2.3.2 FMO shall examine the current accounting and bookkeeping system to accommodate any necessary changes required for the Operations phase following Facility construction, with a goal of minimizing those changes to assure fidelity and relevance of archived data.

7.2.3.3 Six months prior to completion of GENI construction, expenditure forecasts subsequent to construction shall be prepared that are based upon GENI actual operations, maintenance, and normal upgrade records to date.

7.2.3.4 Six months prior to GENI commissioning, the FMO shall prepare operations plans and bottom-up budgets. Current financial tracking methodologies shall be reviewed for government-funded operations, independent of other financial resources generated by GENI serving the research, government, and industry communities on a yearly basis.

7.2.3.5 FMO shall examine the Operations phase to discover any new requirements beyond those needed for the GENI construction phase.

7.2.3.6 FMO shall review all of its current policies and procedures for appropriateness within the operations phase of the GENI lifecycle, modifying any as required for the scope of added project activities.

7.2.3.7 Based upon maintenance and upgrade plans, FMO shall prepare and release capital expense budgets at least 3 months prior to GENI commissioning.

7.2.3.8 Three months prior to GENI commissioning, FMO shall provide to CLAO options for an Operations phase manpower requirements and distribution allocation document that clearly defines any staff reductions necessary to achieve target government funding available for GENI operations. This financial plan shall consolidate and reconcile input from all GPO organizations, and shall recommend personnel requirements appropriate for the Operations phase.

7.3 SEO Detailed Requirements & Responsibilities

The GPO shall have a Systems Engineering and Operations (SEO) Office that will bring together all of the major technical activities to be carried out by the GPO. There are six specific functions to be performed by this office, including: 1) GENI Operations and Planning, 2) GENI Sub-Contracts Procurements and Management, 3) Facility Requirements, Specifications, and Standards Development, 4) Systems Integration and Testing, 5) GENI Systems Engineering, and 6) GENI Facility Deployment and Commissioning.

It is intended that the SEO Office will serve the GENI project during all of its phases, including the final planning stages (Preliminary Design, Final Design), Facility Construction, and Full Facility Operations following construction and final Facility commissioning. The PMT has integrated this objective into the development of the following Detailed Requirements and Responsibilities for the SEO Office.

7.3.1 GENI Operations and Planning

7.3.1.1 The SEO shall define several (5-10) project milestones that will demonstrate (at a specified point in time during the course of the construction phase of the project) the features, functionalities, and performance of the GENI Facility for project supporters and users.

7.3.1.2 The SEO shall be responsible for preparing and maintaining a dynamic, top-level set of project goals and success criteria, and a plan for achieving these goals based upon relevant stakeholder inputs.

7.3.1.3 The SEO shall be responsible for development (in collaboration with appropriate GENI Working Groups during project planning), review, modification, and (most importantly) implementation of the GENI systems architecture and design. This shall include all aspects of hardware, software, facilities plant, and distributed services.

7.3.1.4 SEO shall be responsible for periodic reviews of the emerging GENI to senior project management as-well-as to the government and other project sponsors.

7.3.1.5 The SEO shall be responsible for performing (and coordinating with other offices, as required) all SEO budgeting, including, but not limited to, top-down cost estimates, detailed bottom-up budgeting of the Facility and related, contingency budgeting, and risk mitigation budgeting.

7.3.1.6 The SEO shall be responsible for performing trade-off analyses leading to the selection of a GENI Project Management and Control System that will be fully interoperable with those parts of the PMCS used by other GPO offices.

7.3.1.7 The SEO shall be the licensee and internal owner of the PCMS software and will be responsible for its regular maintenance and updating.

7.3.1.8 The SEO shall be responsible for management and maintenance of the GENI Work Breakdown Structure (WBS), including all of its parts for budgeting, scheduling, cost reporting, etc.

7.3.1.9 The SEO shall be responsible for managing and maintaining a WBS Dictionary, including all of its WBS Elements provided by internal offices as well as subcontractors. This Dictionary is to be maintained down to the Work Package level as required for budgeting and detailed project scheduling.

7.3.1.10 The SEO shall be responsible for gathering all necessary data to enable the GENI schedule to be prepared, including inter-task relationships and the predecessor-successor hierarchies.

7.3.1.11 The SEO shall direct critical path analyses performed by the FMO.

7.3.1.12 The SEO shall direct periodic near-critical path analyses, carried out that by FMO, to assess and improve the robustness of the project schedule.

7.3.1.13 The SEO shall lead, in cooperation with the FMO, and support the parallelization and refinement of the program plan (schedule and resources vs. time).

7.3.1.14 The SEO shall perform all GPO budgeting for technical aspects of the GENI Facility.

7.3.1.15 The SEO shall be responsible for leading the conversion of bottoms up budgets into specific task resource requirements for use in the PMCS.

7.3.1.16 The SEO shall develop the cost account management structure (with FMO support) for use in tracking GENI Facility development progress.

7.3.1.17 SEO shall conduct a technical risk assessment of all aspects the GENI project, providing to the Project Manager and Project Director a complete risk watch list, assessment of the impact and probability of occurrence for

each risk, and recommendations as to what steps should be taking to avoid, share, or minimize these risks.

7.3.1.18 For those risks in which impact is potentially high and probability of occurrence is above 33%, alternatives for risk control shall be suggested.

7.3.1.19 For risks that potentially have a major impact on the project, regardless of the probability of occurrence, a risk mitigation plan must be developed and provided to the Project Manager and Project Director.

7.3.1.20 The SEO shall create a method for recording, tracking and reporting on all GPO risks, including non-technical risks, to the Project Manager. This method should be updated regularly, but no less frequently than annually.

7.3.1.21 SEO shall suggest optional forms of a complete work package structure to FMO for the creation of the EVMS plan.

7.3.1.22 SEO shall be responsible for providing the required data necessary for initializing, rebase-lining and updating both the IMP/IMS and EVMS systems (up to weekly as required).

7.3.1.23 The SEO shall be responsible for the preparation of all GENI technical reports or briefings and the content for all GENI technical video recording and publications. This shall include periodic technical status reports as required.

7.3.1.24 The SEO shall be responsible for the handling of all security incidents.

7.3.2 GENI Sub-Contracts Procurements and Management

7.3.2.1 The SEO shall take the lead in the preparation of the technical content in all GPO RFIs, RFQs, contracts, and agreements.

7.3.2.2 The SEO will participate in the evaluation of responses to all RFIs, RFPs, RFQs, and related, and coordinate its participation with that of other GPO offices to ensure a balanced review of potential contracts.

7.3.2.3 The SEO shall direct all budgeting, including cost estimates, contingency budgets, mitigation budgets, etc., for all GPO contract elements.

7.3.2.4 The SEO shall provide to GPO all technical oversight and supervision as required for all GPO contractual activities.

7.3.2.5 The SEO will have direct responsibility for the supervision of all contractor awardees related to the construction, maintenance, and upgrade of the GENI Facility.

7.3.2.6 The SEO shall gather the contractor IMP/IMS and EVMS, updating data and supplying it to FMO on a rigidly held time schedule.

7.3.2.7 The SEO shall be responsible for coordinating and attending all Project Manager Technical Reviews of GENI work in progress.

7.3.2.8 The SEO shall be responsible for developing a summary report of the highlights of Facility work for each technical review.

7.3.2.9 The SEO shall maintaining an Action Items database defining the Action Item, who issued it, who is responsible for it, when it is to be closed, and when it is actually closed out.

7.3.2.10 The SEO shall set up a Change Management Board with the Project Manager as Chairman.

7.3.2.11 The SEO shall develop a Technical Change Management Review and Approval process in which the relevant technical baseline and the current configuration are used as the starting point. The review shall contain all the risk / benefit and impact analyses from a programmatic, technical, and financial perspective.

7.3.2.12 The SEO shall develop a Process Change Management Review and Approval process in which the relevant baseline processes and procedures are the starting point. The review shall contain all the risk / benefit and impact analyses from a programmatic, technical, and financial perspective.

7.3.2.13 The SEO shall be responsible for either providing or coordinating the technical content preparation of all intellectual property for Legal Affairs.

7.3.3 Facility Requirements, Specifications, and Standards

7.3.3.1 The SEO shall be the principal interface with the research and education user communities of the GENI Facility and, in collaboration with the TAB (or its equivalent), accept for reject user community suggestions and recommendations for changes to the Facility.

7.3.3.2 The SEO shall be responsible for identification and compliance with the hardware standards to be employed on GENI.

7.3.3.3 The SEO shall be responsible for identification and compliance with the software standards to be employed on GENI.

7.3.3.4 The SEO is responsible for developing and maintaining a database of technical requirements, specifications, and standards as implemented in the GENI Facility.

7.3.3.5 The SEO will ensure that all relevant state, federal, and local standards and requirements are incorporated into the construction of the GENI Facility, and that such requirements are incorporated into test plans for Facility components, and that no element of the Facility is deployed without passing required tests or certifications.

7.3.3.6 The SEO shall prepare a SEO Policies and Procedures document that spells out how SEO will perform all of its functions.

7.3.3.7 The SEO shall prepare a detailed set of hardware technical, functional, and performance requirements and specifications for each component, sub-system and system to be included in any way within the GENI Facility and identify where it is expected to reside in the GENI architecture..

7.3.3.8 The SEO shall prepare a detailed set of software technical, functional, and performance requirements and specifications for each component, sub-system, and system to be included in any way within the GENI Facility and identify where it is expected to reside in the GENI architecture.

7.3.4 Facility Systems Engineering

7.3.4.1 The SEO is responsible for all systems engineering related to the design, development, construction, and deployment of the GENI Facility.

7.3.4.2 SEO will work with sub-contractors to ensure that all contracted sub-systems will incorporate component interfaces standardized in the GENI Facility engineering design.

7.3.4.3 **…MORE TO COME**

7.3.5 Systems Integration and Testing

7.3.5.1 The SEO shall be responsible for developing a test plan hierarchy starting at the component level and proceeding to full GENI system validation testing.

7.3.5.2 The SEO shall prepare test specifications and recommend test methods to be used by vendors supplying Facility components, subsystems, and systems to GENI.

7.3.5.3 The SEO shall develop an independent, fully equipped laboratory suitable for testing and evaluation of all physical and software systems to be deployed in the GENI Facility.

7.3.5.4 The SEO shall develop modeling and emulation systems for evaluation of engineering designs related to the GENI Facility.

7.3.5.5 The SEO shall carry out Facility component, sub-system, and fully integrated system testing of all components of the GENI Facility in a laboratory environment suitable to evaluate features, functionality, and performance of Facility elements prior to fielding.

7.3.5.6 SEO shall carry out acceptance testing of all products received from vendors and/or system contractors, and accept or reject such products based upon contracted specifications or published (or otherwise committed) vendor specifications.

7.3.5.7 … MORE TO COME

7.3.6 GENI Facility Deployment, Field Testing, and Commissioning

7.3.6.1 The SEO shall be responsible for the deployment, field testing and evaluation, and all commissioning phases of the GENI Facility, including the construction phase where several partial commissioning events may be required as the Facility it built or modified based on the Change Control Management process.

7.3.6.2 The SEO is responsible for coordinating and supervising the work of contractors involved in deployment or test/evaluation of specific parts of the GENI Facility. This includes wireless sub-networks as well as the core backbone, its nodes, and extensions of the backbone to campuses, to the legacy Internet, or to federated networks in the U.S.

7.3.6.3 SEO shall be responsible for the development and publication of field test specifications and methods for all parts of the GENI Facility, including integration and inter-working testing of all Facility components, sub-systems, and systems.

7.3.6.4 The SEO shall be responsible for the assembly of the GENI technical baseline system and appropriate baselines for each of the GENI functional milestones.

7.3.6.5 The SEO shall be responsible for all aspects of configuration management to be used in the project. The configuration management process shall be at a level comparable to industry best practice.

7.3.6.6 The SEO shall carry out field testing of the GENI Facility at all points involving the deployment of new network elements or sub-systems, and for verifying that such new deployments do not deteriorate the features, functions, or performance of the network in any way for Facility users.

7.3.6.7 The SEO shall regularly publish a Network Status Report that specifies the status of the network, recently added features, performance improvements, and similar. This report should be updated and distributed electronically each time a new feature or function is added to the Facility.

7.3.6.8 The SEO is responsible for developing a User Guide to the GENI Facility, and for updating this on-line guide any time a new feature or function is added to the Facility.

7.3.6.9 SEO shall be responsible for commissioning the Facility at each milestone point in the project, and for fully documenting such commissioning activity, including publication electronically for the benefit of Facility users and project supporters.

7.3.6.10 … MORE TO COME

7.4 ELO Detailed Requirements and Responsibilities

The GPO will have an External Liaison & Communications Office (ELO) that will be responsible for all GENI marketing, including partnering and federation activities, as well as community outreach. In addition, ELO will be responsible for the review, release, and distribution of all technical publications, briefings and video recordings produced by GENI. Another special responsibility of ELO will be the identification and implementation of educational opportunities provided by GENI.

As with other offices of the GPO, the ELO is expected to start operations during the later parts of project planning, to continue through construction of the GENI Facility, and to continue into full GENI Facility operations. The requirements and responsibilities for the construction period are described below. It will be the responsibility of the GPO, when established, to develop similar plans for GENI Operations following Facility construction.

7.4.1 GENI Construction and Construction Operations

7.4.1.1 The ELO shall lead an effort, with CLAO support, to develop a database of regulations and requirements for each target area of the world where federation with GENI appears promising.

7.4.1.2 ELO is responsible for conveying the database of 7.4.1.1 to Legal Affairs, which will use it in developing draft Federation Agreements.

7.4.1.3 The ELO shall take the lead in drafting and finalizing a complete set of external liaison policies, procedures, and controls that will establish documented GPO roles and responsibilities.

7.4.1.4 The ELO will put in place safeguards to guarantee that export data controls are met. Overall safeguard policies shall be approved and established by the Project Manager and become the responsibility of the CLAO to ensure that these policies are carried out.

7.4.1.5 The ELO shall be responsible for all GENI external communications, public relations issues, and activities including press or publication interviews.

7.4.1.6 The ELO shall establish and maintain a website for the GENI project that will convey up-to-date information on the project, progress of Facility construction, research papers, technical information on the Facility, instructions for potential users, information on meetings to be held by the project, and similar.

7.4.1.7 The ELO shall perform all marketing activities on behalf of GENI.

7.4.1.8 The ELO shall take the lead in the identification and development of federation opportunities for GENI.

7.4.1.9 The ELO shall develop draft language for the basis of a Federation Agreement unless the federating party is a foreign government, in which case CLAO-LA will take the lead.

7.4.1.10 The ELO shall be responsible for all community outreach initiatives to the potential user community. This shall include government or industry research and/or development, academic research, and emergency uses of GENI by appropriate authorities for local or national emergencies.

7.4.1.11 The ELO shall identify and develop educational and training uses of GENI, including drafting appropriate agreements to commit GENI to such efforts.

7.4.1.12 The ELO will lead the effort to incorporate new users into GENI, including industry.

7.4.1.13 The ELO will convene advisory committees from time to time to receive advice and recommendations from the broader community on the uses and operation of GENI.

7.4.1.14 The ELO shall be responsible for identifying potential licensees of or licensors to GENI property.

7.4.1.15 The ELO shall performed risk assessments of all aspects the ELO plans, providing these to the Project Manager, including a complete risk watch list, assessment of the impact and probability of occurrence for each risk, and recommendations as to what steps should be taking to avoid, share, or minimize these risks.

7.4.1.16 For those risks in which impact is high and probability of occurrence is above 33%, alternatives to risk control will be suggested and full risk mitigation plans prepared.

7.4.1.17 The ELO shall be responsible for coordination with NSF (under the GENI Project Director's direction) regarding all proposed federation or partnering arrangements that significantly alter the makeup or risk of operations of GENI.

7.4.1.18 ELO shall be responsible for extending distribution of all programmatic, technical, financial, or legal reports.

7.4.1.19 The ELO shall provide budgeting information for resource requirements with corresponding basis-of-cost estimates for all GPO contracted or internal activities of ELO.

7.4.1.20 The ELO shall be responsible for the review, release and distribution of all GENI technical publications, briefings and video recording of GENI on behalf of the GPO.

7.4.1.21 Wherever release of sensitive GENI data are to be authorized, ELO shall coordinate such releases with the CLAO-LA to assure that no violations or contract compliance issues have been overlooked and proper NDAs are in place.

7.4.1.22 The ELO shall be responsible for implementation of all GENI export controls necessary to avoid all inappropriate export of data or technology. This shall include the CLAO-LA policies and procedures dealing with such events, as well as the CLAO-LA review of all activities.

7.4.2 Transition to GENI Operations and Support

7.4.2.1 Six months prior to GENI commissioning, and in connection with SEO, FMO, and the PM, the ELO shall develop financial policies and procedures for what types of activities will be funded by government resources after

construction completion and what types of activities will require independent funding.

7.4.2.2 Six months prior to completion of GENI construction, ELO shall provide to FMO expenditure forecasts for ELO subsequent to construction completion, as well as forecasts for monthly cash flow to GENI based upon current status of external marketing, educational and other community outreach efforts.

7.4.2.3 ELO shall examine the Operations phase to determine any new requirements beyond those needed for the GENI construction phase.

7.4.2.4 ELO shall review all of its policies and procedures in place for appropriateness within the operations phase of the GENI lifecycle, modifying any as required for the new scope of activities.

7.4.2.5 Based upon maintenance and upgrade plans, ELO shall examine all pending or potential federation, partnering, or use agreements for capital requirements. ELO shall provide these data to FMO for proper inclusion in the capital expense budgets being prepared at least 3 months prior to GENI commissioning.

7.4.2.6 ELO shall recommend personnel requirements and associated support needs for the Operations phase at least six months prior to the start of full-time operations.

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List of Acronyms

ADM	Administrative Office of the CLAO.
CLAO	Contracts – Legal – Administrative Office of the GPO
CCM	Change Control Management Plan
DAR	Defense Acquisition Regulations
ELO	External Liaison & Communications Office of the GPO
EVM	Earned Value Management
FAR	Federal Acquisition Regulations
FMO	Financial Management & Control Office of the GPO
GENI	Global Environment for Network Innovation
GDD	GENI Development Document
GPO	GENI Project Office
GSC	GENI Science Committee
IMP	Integrated Master Plan
IMS	Integrated Master Schedule
IP	Intellectual Property
LA	Legal Affairs Office of the CLAO
MREFC	Major Research Equipment & Facilities Construction Account
NDA	Non Disclosure Agreement
NSF	National Science Foundation
PEP	GENI Project Execution Plan
PMCS	Project Management Control System
PV	Present View
RMP	Risk Management Plan
SEO	Systems Engineering & Operations Office of the GPO

APPENDIX: Comments on GDD Version Changes

Version 1.1 – November 27, 2006

Revisions made in Version 1.1 focus primarily of a few areas: 1) changes to Figure 1.1 to properly reflect the overall communications structure to / from the GPO and the NSF, GSC, Working Groups, and research users; 2) clarification of the position of the Project Director within the GPO (e.g., Figure 2.3); 3) clarification of the role of the ELO with respect to communications with the NSF and related bodies; and 4) providing more visibility to the importance of the CCM process (cf. Figure 2.3). Minor changes to the text were made to address these four issues and to correct previous spelling or grammatical errors. A note was added on p. 6 to indicate that most figures in this document address issues related to communications between / among offices or units of the GPO. In particular, diagrams are not necessarily meant to convey reporting relationships.