

WBS: Guidelines for Completion

GDD-06-30

GENI: Global Environment for Network Innovations

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Note to the Reader: This document was prepared to provide guidelines to GENI Working Groups in the preparation of the WBS Outline and the WBS Dictionary. It is a living document, updated frequently as the GENI Working Groups address new stages of WBS construction.

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1 Purpose of this Document

This document has been prepared in order to provide guidelines for completion of the Work Breakdown Structure (WBS) document that is part of the GENI Project Execution Plan.

The document is an update of an earlier set of instructions included with Release 1.0 of the GENI WBS on June 6, 2006 [WBS01]. It contains much of the same material in a somewhat simpler form, and is extended by the inclusion of *preliminary instructions* for the use of the GENI Risk Management Plan to prepare a contingency budget component in the WBS Dictionary. Additions to this document will periodically be made as the WBS evolves.

2 Introduction

During the course of planning for GENI, several documents must be prepared to meet NSF and MREFC requirements. One of these is the GENI Work Breakdown Structure (WBS). The overall WBS has two parts, a *WBS Outline* and a *WBS Dictionary*. The WBS focuses just on the *work to be done during the construction stage*, and is written from the perspective of the deliverables that will be provided during the construction stage and the tasks that must be carried out to complete the deliverables; it specifically does not include any work to be completed either during any of the planning stages or during Facility operations following construction.

The organization of the WBS Dictionary is in the form of an outline that states the end-stage deliverables at the highest level of the WBS, and defines sub-deliverables at deeper layers of the WBS. Each WBS level is numbered and these numbered levels are ultimately used to generate both the bottom-up cost and schedule for completion of deliverables.

These notes are intended as a guideline to for GENI Working Groups completing the WBS during project planning stages. A template (Version 1.0) for the WBS was released on June 6, 2006 and is a companion to this document; it should be consulted to develop the WBS (both Outline and Dictionary).

Other than completion of the WBS, Work Groups are responsible for development of *Reference Designs* and *Technical Requirements* for their parts of the GENI Facility or management structure. It is important that the three documents are well synchronized.

3 Organization of WBS

The WBS is composed of two primary components: 1) a WBS Outline, and 2) a WBS Dictionary. These components are described below in Sections 3.1 and 3.2.

3.1 WBS Outline

The WBS Outline is a document of just a few pages that provides a complete outline of the WBS of the project. It shows all levels that are to be treated in the WBS Dictionary. An example of this outline is contained in the GENI Work Breakdown Structure distributed on June 6, 2006 [WBS01] and repeated here in Appendix A. This WBS Outline is a *template* based on the thinking of the GENI Planning Group as of January/February 2006; the actual WBS Outline is to be created by the Working Groups in concert with the Project Management Team (PMT) using

the guidelines provided in the present document. In general, it is expected that the WBS Outline will become more and more detailed as the planning process continues. It is important to note, however, that the Outline may change many times during the planning process – as the planning becomes more refined, and as dependencies among the various parts of the project are recognized.

3.2 WBS Dictionary

The WBS Dictionary is the detailed account of each task and the activities to be performed during the course of GENI construction. It includes deliverables, component tasks associated with deliverables, dependencies associated with task completion, resources expected to be assigned to complete tasks, a cost breakdown structure, a basis of cost (both expense and capital), and a schedule for completion of each task. This Dictionary allows the development of a bottom-up budget and a bottom-up schedule for the project. It also allows the development of a contingency element for each budget or schedule related to a task. These contingency figures are based on the Risk Management Plan for GENI [GDD03].

The WBS Dictionary is divided into six major components: 1) Project Management; 2) Facility Construction; 3) Systems Engineering; 4) Facility Commissioning; 5) Science Support; and 6) Education and Outreach. Although the MREFC does not fund the Education and Outreach work during GENI construction, this category (because of its expected importance) will be retained in the WBS (at least in its early versions) at the request of the MREFC Account office.

Each of the above six components of the WBS is supported by subtasks, and these in turn by even more detailed “sub-sub” tasks, as the numbering system shows. Some of the major tasks can be subdivided several times. Others cannot. What we need to do is to subdivide tasks as deeply *as is reasonable* at each stage of planning. For the first stage of WBS development, this will be about 5-6 levels. Creating the WBS Dictionary will be an iterative process as planning continues. The bottom line is that we need to create a document that will both guide our own work and convince the NSF/MREFC (and ultimately Congress) that we have a well-defined project in terms of what we plan to do, what it will cost, and that a realistic schedule (firmly grounded in terms of available resources, technology selection, etc.) has been developed.

4 Preparing the WBS Outline and Dictionary

Preparing the WBS is a multi-step process. The best place to start is with the *WBS Outline*. Once this has been completed to the satisfaction of the WG, it is safe to move forward with the Dictionary itself. It is suggested that WGs not linger too long on the WBS Outline. Best to move along to the Dictionary, then return to the Outline as new information is seen to be necessary in the Dictionary. This will be an iterative process.

4.1 WBS Outline Preparation

First, decide on the major categories of your task. Examples of these are shown in Appendix A. These may not have changed at all as a result of the WG planning since CDR, but they may also have changed significantly. If so, then forget about what was valid at CDR and proceed with what you have now. You should try to make the outline as deep as you can reasonably go – although you may only use just 3-4 of those levels in the first instantiation of the Dictionary. It

is best not to go too deep on the first try in the Dictionary. We will account for the lack of precision with a larger contingency budget initially, then cut back on the contingency budget as more task clarity develops during planning. It is also important that all WGs proceed at approximately the same pace for the first 5-6 levels of the Dictionary so that assumptions related to tasks and their dependencies can be validated by relevant WGs before going too far.

Note: When you have completed the WBS Outline, you are asked to send it to the Project Management Team, which will review it and integrate it with components of the overall WBS Outline being prepared by other WGs.

4.2 WBS Dictionary Preparation

The WBS Dictionary includes several parts. These are described below, together with suggestions for completing them. Refer to the WBS Document Release 1.0 for examples of the WBS Element pages that make up the WBS Dictionary.

WBS Element Definition: This is the first text on the WBS Element page. It states clearly and succinctly what the particular element is about – and, therefore, what is to be funded. Keep this brief; 3-4 lines of text are usually enough.

Deliverable Statements: Next is the statement of deliverables associated with the WBS Element. Decide first on a set of major deliverables for the Element. Probably the number of deliverables will vary from Element to Element, but six or so seems about right. These are the *products* of the WBS Element and are at the top of the WBS hierarchy. They reflect what it is that will be delivered in order to fulfill the objectives of the WBS Element [*Later on we'll talk about milestones, which will include deliverables from multiple parts of the Dictionary. See Appendix B for an explanation of milestones relative to deliverables.*]

Component Subtasks: The component subtasks are the subtasks required to complete the highest level tasks. They are the next level down of WBS deliverables and flow directly from the major task deliverables. This process of defining deliverables, then subtasks with their own sub-deliverables, etc., will occur several times as you work your way down in the WBS hierarchy. Ultimately, you'll reach a point where it is impractical to subdivide tasks further; at this point you will have arrived at what is referred to as a "work package". Generally, this subtask level is an *activity* that can be carried out in a well-defined period of time – usually just a few weeks – by engaging a well-specified set of resources over a short period of time. At this level of granularity, it should be relatively easy to associate a cost with the work package. This is the basis of the "bottom-up" budgeting process.

Dependencies: The scheduling and completion of the deliverables, tasks, subtasks, activities, etc., for any given WBS Element will probably depend in some way on the completion of tasks, deliverables, etc., in WBS Elements that will be completed by someone else. We need to start identifying these "dependencies" as early as possible; ultimately, they will become an integral part of the project schedule. At this point, you are asked to start the process of identifying dependencies. *Simply list the assumptions that you are making related to other WBS Elements that will affect the completion of your WBS Element.* Do not include the dependencies that are entirely within your control; these should be factored into your own scheduling of your WBS Element.

Resources: Here you will need to decide on the level-of-effort (i.e., man-hours, man-weeks, etc.) required to complete a task or subtask. Your first attempt should probably be based on your own experience with a similar task – i.e., a top-down approach. As you develop a better sense of the details of your task, you will have a more quantitative sense of the resources and time required to complete tasks. These staff resources should be considered carefully; they will be budgeted and contribute significantly to the cost of completing a task (see below).

Construction Cost Breakdown: The next component of the WBS Element pages involves estimating the cost of completing the WBS Element tasks. The WBS template includes a table for the Cost Breakdown Structure. It includes wages, non-wage expenses, as well as capital costs. You will probably have to use more than one method to get at cost. If you understand the resource requirements for labor, then use the guideline loaded wages provided to you in the attached Basis of Cost charts [Do not to expand the labor categories at this point]. In addition to wages, there will be non-wage expenses. Try to call these out specifically; several examples of non-wage expenses (taken from the PEP) have been included, but these may need to be expanded by the unique requirements of your own WG task. Add lines to the table as necessary. Finally, if you are building hardware or software that will ultimately be capitalized, you will need to account for this separately from other expenses.

In order to complete the Construction Cost Breakdown section of the WBS Elements, you'll need to do some homework on cost numbers (e.g., with vendors, catalogs, etc.) *Please keep good records as to how you get cost figures; we'll need to report these sources later.* No need to get competitive pricing at this point, although it is best to obtain information from more than one vendor if several vendors offer the same item.

Basis of Cost: This is provided to you for loaded wages. At this stage, “loaded” means salary plus benefits (e.g., vacation, health), but not travel, office space, etc. Please use the loaded wages that are listed at this point; we'll decide later if this needs to be modified. Add lines to the two tables as necessary; what has provided is from the PEP. *Except for loaded wages, you should develop your own line items in the Basis of Cost charts.*

Schedule: The task schedule diagram has not been included for each task item in the WBS Dictionary template provided. It is included in the Wireless Subnets component, so you can use the wireless subnets section as an example. The PMT intends to use MicroSoft Project during the planning period; you are asked to use this program as well for scheduling. Ultimately, the owner of the GPO will select a more comprehensive Project Management Control System tool.

5 WBS Budgeting

One of the principal purposes of the WBS is to be able to construct a budget from the bottom up – that is, starting at the lowest level of cost (associated with a work package) and building the budget from that point by rolling it up through all higher levels of the task hierarchy.

There are three major components to the budget. The first is the *cost estimate* budget; the second is a *contingency budget* component that accounts for the risk associated with each task of the project; the third is a *mitigation element* that is used to lower the contingency component by actively managing risk.

5.1 Constructing the Cost Estimate Budget

The *cost estimate* budget is constructed first. The process starts by identifying the basic costs associated with each *work package* included in the subtasks of a WBS Element page. These costs are then rolled up through all subtask levels of the WBS Element until the top level is reached. This rolled up cost then becomes the bottom-up cost for the WBS Element.

Do not pad the cost estimate budget. We will account for budget uncertainties in the contingency budget (Section 5.2). You will probably have to use multiple methods to arrive at the cost estimate budget for each WBS Element – and the methods you use for one subtask may not be appropriate for another. This is the purpose of the Basis of Cost table [WBS01] that you will also complete. This table should include sufficient information for you to be able to estimate work package costs based on labor rates, catalog prices, vendor “budgetary quotes”, etc. In some instances, it will be necessary for you to use your personal expertise with a similar task, or perhaps the experience of someone else who has completed a similar task. Whichever method you use to arrive at a cost element, *you need to document your sources.*

The importance of developing a good cost estimate budget – as early as possible – is to see how your reference designs and requirements hold up against cost. If costs are too high, it may be necessary to go back to a design and change it in order to achieve a lower, more acceptable cost.

Once you have arrived at an acceptable initial cost estimate, please submit this to the PMT for roll-up with costs received from other Working Groups. This is necessary in order to develop an overall project budget. Once an initial rolled-up budget is developed, we’ll see how close we are to our original estimate of the budget for GENI. It may be necessary to then look at the overall GENI design to lower project cost. Also, we’ll need to consider scheduling within the 5-year period of construction (scheduling will be addressed in a future release of these WBS Guidelines).

5.2 Constructing the Contingency Budget

In order to account for risk and uncertainty in the GENI project, we will develop a *contingency budget*. The cost estimate budget, plus the contingency budget, minus the mitigation correction to these two budget components, makes up the GENI Project budget.

The contingency budget development follows from the GENI Risk Management Plan [GDD03], which, like the WBS, is also a part of the Project Execution Plan [PEP01]. The details of the Risk Management Plan (RMP) are not yet complete, however, the overall structure of the RMP is complete and we present information here as a “heads up” as to what is coming related to preparation of the contingency budget.

The contingency budget will be developed using a *Risk Factor (RF)* – a fraction between 0.05 and 0.99 – that will be an operator on the cost estimate budget to calculate contingency budget numbers. Risk Factors are organized into four top-level risk categories: 1) technical risk, 2) cost risk, 3) schedule risk, and 4) programmatic risk. Further, they are characterized as being associated with High, Medium, or Low risk. The PMT will develop a matrix of RFs based on feedback from the Working Groups on the risks associated with specific tasks or activities of each WBS Element (i.e., backbone, control software, services software, wireless subnets, etc.).

The PMT will supply to the Working Groups the Risk Factor grid (together with a description as to how it was derived). It will then only be necessary for the WGs to calculate the contingency budget elements using the Risk Factor matrix and the baseline budget numbers. Contingency budget numbers will be rolled up in the same way as cost estimate budget numbers to arrive at a contingency budget for each WBS Element.

The final step to creating the contingency budget will involve selecting one or more (of several possible) risk mitigation strategies. The risk mitigation correction to the cost estimate + contingency budget is applied just at the highest level of the WBS Element budget hierarchy. Risk mitigation corrections factors are still being worked out (they are largely based on experience with prior use of similar strategies) and will be supplied to the Working Groups. These factors will be used by the PMT to calculate the final project budget.

References

- [PEP01] GENI Planning Group, "Project Execution Plan", January 10, 2006.
- [GDD03] D. Casey and T. Benzel, "GENI Risk Management Plan," Draft Version 0.2, (in preparation).
- [WBS01] D. Casey, "Work Breakdown Structure: Construction Stage", GENI Project, Release 1.0, June 6, 2006.

Appendix A: WBS Outline at CDR

- 1.1 Project Management
 - 1.1.1 Administration
 - 1.1.1.1. Payroll Administration
 - 1.1.1.2. Administrative Services
 - 1.1.1.3. Human Resources
 - 1.1.1.4. Publications and Publicity
 - 1.1.2 Financial Management and Control
 - 1.1.2.1. Financial Planning, Budgeting, and Reporting
 - 1.1.2.2. Purchasing and Procurements
 - 1.1.2.3. Accounting and Records
 - 1.1.3 Legal Affairs
 - 1.1.3.1. Contracts & Agreements
 - 1.1.3.2. Intellectual Property
 - 1.1.3.3. Government Legal Liaison
 - 1.1.4 Operations and Planning
 - 1.1.4.1. PMCS Processes
 - 1.1.4.2. Contractor Supervision and Liaison
 - 1.1.4.3. Facilities Management
 - 1.1.4.4. Prototyping Operations
 - 1.1.5 Management Systems
 - 1.1.5.1 Risk Management
 - 1.1.5.2 Change Control Management
 - 1.1.5.3 Contingency Management
 - 1.1.6 External Liaison
 - 1.1.6.1 Industry Relationships
 - 1.1.6.2 Government Relationships
 - 1.1.6.3 Academic and Research Institutions Relationships
 - 1.1.6.4 International Relationships
- 1.2 GENI Facility Construction
 - 1.2.1 Facility Node Devices
 - 1.2.1.1 Flexible Edge Devices
 - 1.2.1.1.1 Device Engineering and Assembly
 - 1.2.1.1.2 Component Manager Software
 - 1.2.1.1.3 Subsystems Integration and Testing
 - 1.2.1.1.4 Distribution, Installation and On-Site Testing
 - 1.2.1.2 Customizable High-Speed Routers
 - 1.2.1.2.1 Platform Engineering and Construction
 - 1.2.1.2.2 Component Manager Software
 - 1.2.1.2.3 Subsystems Integration and Testing
 - 1.2.1.2.4 Distribution, Installation and On-Site Testing of Routers
 - 1.2.1.3 Optical Switches (ROADM and D-OS)
 - 1.2.1.3.1 Type-1 and Type-2 D-OS Devices
 - 1.2.1.3.2 Component Manager Software
 - 1.2.1.3.3 D-OS Device Type Selection
 - 1.2.1.3.4 D-OS Construction and Testing

- 1.2.1.3.5 Optical Switch Distribution, Installation, and On-Site Testing
- 1.2.2 Facility Management Software
 - 1.2.2.1 GENI Management Core (GMC) Software
 - 1.2.2.1.1 Slice Manager
 - 1.2.2.1.2 Resource Controller
 - 1.2.2.1.3 Auditing Archive
 - 1.2.2.1.4 Web Front End
 - 1.2.2.1.5 GMC Subsystems Integration and Testing
 - 1.2.2.2 Infrastructure Services Software
 - 1.2.2.2.1 Provisioning Services
 - 1.2.2.2.2 Information Plane
 - 1.2.2.2.3 Resource Broker
 - 1.2.2.2.4 Development Tools
 - 1.2.2.2.5 Other Infrastructure Services
 - 1.2.2.3 Underlay Services Software
 - 1.2.2.3.1 Security Service
 - 1.2.2.3.2 Topology Service
 - 1.2.2.3.3 File Naming Service
 - 1.2.2.3.4 Legacy Internet Service
 - 1.2.2.3.5 Other User Services
 - 1.2.2.4 Instrumentation Software
 - 1.2.2.4.1 Data Collection Software
 - 1.2.2.4.2 Data Archiving Software
 - 1.2.2.4.3 Data Analysis Software
 - 1.2.2.4.4 Other Instrumentation Software
- 1.2.3 Network Assembly and Management
 - 1.2.3.1 National Backbone Assembly
 - 1.2.3.1.1 National Fiber & Core Bandwidth Implementation
 - 1.2.3.1.2 Additional Core Bandwidth (Wavelengths)
 - 1.2.3.1.3 Network Facilities Preparation
 - 1.2.3.1.4 Backbone Node Deployment
 - 1.2.3.1.5 Network Integration and Testing
 - 1.2.3.2 Tail Circuits / Edge Site Assembly
 - 1.2.3.2.1 Dark Fiber Lease with 155Mb/s Service
 - 1.2.3.2.2 Connection of Existing Fiber with 45Mb/s Service
 - 1.2.3.2.3 Pulled Fiber Deployment and 1-10 Gb/s Service
 - 1.2.3.2.4 Connection of Existing Fiber with IP Service
 - 1.2.3.2.5 New Connection Technologies Deployment (TBD)
 - 1.2.3.3 Internet Exchange Assembly
 - 1.2.3.3.1 Connectivity at 45Mb/s
 - 1.2.3.3.2 Connectivity at 155Mb/s
 - 1.2.3.3.3 Connectivity at 1-10 Gb/s
 - 1.2.3.4 Network Management in Construction
 - 1.2.3.4.1 TBD
 - 1.2.3.4.2 TBD
- 1.2.4 Wireless Subnets
 - 1.2.4.1 Urban *Ad-hoc* Subnets

- 1.2.4.1.1 Urban Ad Hoc Subnet Hardware
- 1.2.4.1.2 Urban Ad Hoc Subnet Software
- 1.2.4.1.3 Urban Ad Hoc Subnet Field Distribution and On-Site Testing
- 1.2.4.2 Suburban Wide Area Subnets
 - 1.2.4.2.1 Suburban Wide Area Subnet Hardware
 - 1.2.4.2.2 Suburban Wide Area Subnet Software
 - 1.2.4.2.3 Suburban Wide Area Deployment
- 1.2.4.3 Cognitive Radio Subnets
 - 1.2.4.3.1 Cognitive Radio Subnet Hardware
 - 1.2.4.3.2 Cognitive Radio Subnet Software
 - 1.2.4.3.3 Cognitive Radio Subnet Field Assembly and Test
- 1.2.4.4 Application-Specific Sensor Subnets
 - 1.2.4.4.1 Application-Specific Sensor Subnet Hardware
 - 1.2.4.4.2 Application-Specific Sensor Subnet Software
 - 1.2.4.4.3 Application-Specific Sensor Subnet Field Assembly and Test
- 1.2.4.5 Wireless Emulation Subnets
 - 1.2.4.5.1 Emulation Subnet Hardware Assembly
 - 1.2.4.5.2 Emulation Subnet Software Development
 - 1.2.4.5.3 Emulation Subnet Field Assembly and Test
- 1.3 Systems Engineering**
 - 1.3.1 Requirements & Specifications Management
 - 1.3.2 Fiber Plant Engineering
 - 1.3.3 Equipment Installation Engineering
 - 1.3.4 Standards, Safety and Environmental Engineering
 - 1.3.5 Network Documentation Operations
- 1.4 Facility Commissioning**
 - 1.4.1 Initial Use Commissioning
 - 1.4.1.1 Initial Research Use Requirements
 - 1.4.1.2 Facility Test Plan for Initial Use
 - 1.4.1.3 Facility Testing
 - 1.4.1.4 Facility Commissioning for Initial Use
 - 1.4.2 Mid-Construction Commissioning
 - 1.4.2.1 Mid-Construction Use Requirements
 - 1.4.2.2 Mid-Construction Test Plan
 - 1.4.2.3 Facility Testing – Mid Construction
 - 1.4.2.4 Facility Commissioning for Mid-Construction Use
 - 1.4.3 Final Facility Commissioning
 - 1.4.3.1 Final Acceptance Criteria
 - 1.4.3.2 Test Plan, Procedures, Exit Reporting
 - 1.4.3.3 Final Facility Testing by GENI Systems Engineering
 - 1.4.3.4 Final Facility Testing by External Testing Group
 - 1.4.3.5 Final Reporting
 - 1.4.3.6 Transition to Operation
- 1.5 Science Support**
 - 1.5.1 Construction Stage Final Research Selection
 - 1.5.2 Research Experiment Plans and Definitions Review
 - 1.5.3 Research Policies and Governance for Research Use During Construction

- 1.5.4 Selection of Research Users during Construction Stages
- 1.5.5 Monitoring of Research Use by GENI Management
- 1.5.6 Research Report Evaluations for Research Users

1.6 Education & Outreach

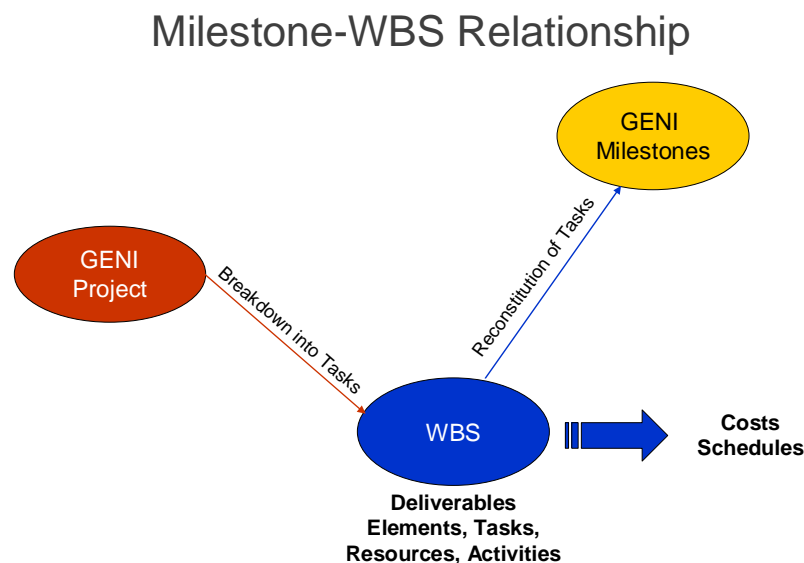
- 1.6.1 Scientific Communities Education
 - 1.6.1.1 Topical Workshops
 - 1.6.1.2 Town Hall Meetings
 - 1.6.1.3 Conference Presentations
- 1.6.2 Public Outreach Education
 - 1.6.2.1 GENI Web Site
 - 1.6.2.2 Broadcast and Newspaper Media
 - 1.6.2.3 Press Releases
- 1.6.3 Classroom Education
 - 1.6.3.1 University Courses & Lectures
 - 1.6.3.2 GENI Laboratory
- 1.6.4 Research User Training
 - 1.6.4.1 User Tutorials

Appendix B: Deliverables and Milestones

Following development of the WBS and the cost estimate budget for GENI – after we have in hand a good idea as to the GENI Facility Reference Design and the Requirements for each of the component parts of that design – we will need to define points in time and Facility features, functions, performance, etc., that we collectively believe will best reflect progress made toward completion of the GENI Facility. These points in time and the associated features to be demonstrated are referred to as *milestones* by the Project Management Team. Milestones differ from the deliverables associated with WBS tasks, subtasks, activities and work packages in that they represent *collections of properties* of the Facility that should be ready simultaneously at selected points in time. Deliverables, on the other hand, are the outputs of the individual WBS Elements.

By definition, milestones will be composed of a collection of deliverables, coordinated so that they are available at particular points of time and so that, collectively, these deliverables enable a certain functionality of the Facility to be demonstrated.

The diagram below illustrates this process. From the collection of deliverables in the WBS, there will be a decomposition and reassembly of the deliverables to enable a milestone. It will be necessary to incorporate in contracts awarded to the future builders of GENI that they have certain platforms, software, services, etc., available at particular times. We will also have to develop test plans by which the GENI Facility can be tested and then commissioned for the next stage of operation and research.



Appendix C: Risk and Contingency Formality

The Risk Management Plan [GDD03] is being developed by the Project Management Team to account for potential risk associated with construction of the GENI Facility. From the Risk Management Plan, the PMT will derive the methodology for calculation of the contingency budget. Basically, this involves identification of risks likely to be associated with the tasks and subtasks of the WBS Elements, assessment of the potential impact (technical, budget, and schedule) that risk events might have on the project, estimation of the likelihood of such risk events, and development of a Risk Factor that can be used in conjunction with elements of the WBS baseline budget to calculate a contingency budget.

Using lists of categorized risks from the WGs, the PMT will design a Risk Rating Matrix that will allow the identification of risks in various categories, potential impact on GENI, and likelihood of occurrence to build an Integrated Risk Factor Matrix such as is shown on the next page. This matrix will then be used by WGs to assemble contingency budgets for individual tasks in a WBS Element, and to roll up such task contingency budget numbers to produce an overall contingency for a WBS Element.

The first step is to identify risk elements and estimate their impact (consequence) and likelihood. The PMT will solicit expert advice related to the appropriate risk elements from the Working Groups using a format similar to that illustrated in the figure below.

| Risk Category | Risk Description | Impact (C) (1 to 5) | Likelihood (1-5)* | RFs |
|---------------|--|------------------------------|--------------------------------------|-----|
| Technical | | | | |
| BBWG 1 | Short description of the specific risk. Identify 5-6 of these for each Risk Category | Rate Impact (5 = highest) | Rate the Likelihood (5 = highest) | TBD |
| Cost | | | | |
| BBWG1-N | | | | |
| Schedule | | | | |
| BBWG 1-N | | | | |
| Programmatic | | | | |
| BBWG 1 | | | | |
| BBWG 2, etc. | | | | |

*Likelihood weighting factors: 1 (p < 0.1); 2 (p = 0.1-0.4); 3 (p = 0.4-0.7); 4 (p = 0.7-0.9); 5 (p > 0.9)