NLC Installation
2001 Configuration

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1. Requirements

The requirements for Installation come in several different forms. The principal document is the NLC Project Schedule, indicating the dates that installable hardware will be available, when the Conventional Facilities will be available, and when commissioning will occur. The second key document is the inventory of all installable items in the project, and associated with that the specific alignment, connection, and handling requirements for each item. Other peripheral information needed is the number of installation crews that can be trained and accommodated concurrently in the tunnel along with their productivity for all of the different installation tasks required.

Conventional Facilities will provide housings ready for beneficial occupancy prior to installation. Details of what this includes will be well defined early in the project. Other information needed from Conventional Facilities is the site map including building locations, storage facilities size and distance from the install site, tunnel and gallery configuration, access point size and location.

2. Technical Description:

2.1 Overall Description

All of the components that make up the operational NLC must be installed into the site prepared by Conventional Facilities. Installation includes all preparation for installation, management during the install process, hardware installation, all equipment and material required, alignment, and system checkout.

Installation must take the requirements information that shows when everything arrives and when it needs to be in place, and come up with a plan that will accomplish this while at the same time not requiring unrealistic staffing levels or fluctuations in these levels.

2.2 Informational Tools

In order to accomplish what is summarized in Requirements above, a comprehensive and integrated logistics system must be established. The goal of this logistics system is to ensure the equipment arrives, well marked, at the right destination, in the right quantity, on schedule (not too soon to avoid long storage and not too late to avoid planning delays), undamaged, without disturbing other equipment in situ and as inexpensively as possible.

The following information tools will be necessary for this logistics system:

2.2.1 Scheduling Database:

This contains the receipt dates and commissioning dates for all components and assemblies for the machine. It begins with the requirements shown in Requirements above, and then is filled in with the detailed plans made by each or sub-area of the machine (for example Electron Sources).

2.2.2 Dictionary Database:

A set of dictionaries of installation details, including a dictionary of components, a dictionary of buildings and locations and a dictionary of handling means. Each one should contain a list of official codes, descriptions, people responsible and specific characteristics such as size and weight for components and dimensions and position for buildings. Dictionaries should be accessible to the public, so everyone and each application has access to the most recent and valid data. The establishment of naming conventions early in the project is important.
2.2.3 Logistics Database:
Data stored here includes definition of the equipment to be installed, the final position of the component in the tunnel, its date of installation, and the access shaft where it has to be lowered, installation sequences and the grouping of components for transport. This database should provide information on availability and location of equipment to be installed, the loads on access points, the travel distance of the components, time required to perform installation activities for the component. Prior to installation this program will be used to simulate installation conditions so that planning can be optimized. During the actual installation phase this database will track progress.

2.2.4 Transport List:
This is generated from the databases used above. It will be issued each week from the data inserted or calculated by the logistics database. It will provide information to people responsible for transport and installation coordination, system managers, site managers, installation coordinators, installation crews, and transport teams. It will show all equipment to be installed during a given week through a given access shaft. The equipment is grouped according to the system to which it belongs.

2.3 Notes/Comments
• An “installable unit” is the component or set of components assembled to their most complete stage prior to installation.
• A “transportable unit” is the largest number of installable units that can be conveyed together.
• These units must be defined by the other TSET’s or Area Managers in terms of what they consist of (including supports and hardware), parts count for all areas, the size and weight of each unit, what equipment is required to install the unit, a unique name for each unit and a location of installation.
• Components will first pass through the Installation Facility for kit assembly into installable and transportable units and the establishment of installation tracking. The assumption is that Installation is not responsible for tracking or storing components until after they enter this facility.

2.4 Cost Issues
• The cost drivers for transportation from the surface to the tunnel are the number of trips made and the handling time (frequency and duration), not the distance between access shafts or speed of transit.
• Since the major costs of installation are labor, use of a Project labor rate table is important.
• For scheduling purposes, the workday is assumed to be two, consecutive eight-hour shifts. The third shift may be used to schedule transportation of components and equipment if required.
• The Installation cost estimate for May, 1999 and April, 2000 was done as a percentage (20%) of the hardware costs for each area. This was assumed to include all preparation for installation, management during the install process, hardware installation, all equipment and material required, alignment, and system checkout.
• Space for the Installation Assembly Facility is being accounted for in the Manufacturing Facilities. Long-term storage has also been planned for in the Manufacturing Facilities. Storage space local to the install site has not yet been determined.

3. Technical Issues
The key technical issues are:
• the degree to which work can be performed on the surface prior to transfer of the assembly to the tunnel, since the tunnel is a very inefficient place to perform work
• the ease of moving pre-assembled items into the tunnel, depending on the access point frequency, the size of objects movable through the access points, the ability to perform concurrent work in the tunnel, and the ability to install and commission simultaneously in the tunnel

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derivation of the Installation Plan will need to be an iterative process between the Installation Group, Conventional Facilities, and all those having items to install. Since the initial requirements will not have been resource-tested by the Installation Group, some of the timing assumptions will most likely have to be modified (due to either impossible or uneconomic installation conditions) resulting in an overall change to the schedule and a new set of installation requirements. The process will repeat until the most cost-effective balance among all stakeholders is reached. As a consequence of all this, the procurement, commissioning, and global project schedules may have to be revised.

4. Discussion of Configuration Choices

One major choice involves the relative amount of work done prior to locating the item in the tunnel; see the discussion in Technical Issues above. Work done in the tunnel is assumed to be of low productivity, but the ability to move large and complex assemblies through the tunnel choke points and the tunnel itself is also problematical.

A second choice involves the site-specific factors. The site topography will most likely influence the number of tunnel access points and the size of objects they can handle. The more tunnel there is and the deeper it is, the more important the tunnel portion of the installation planning becomes. Installation costs are perceived to be the lowest in a shallow cut and cover site, and highest in a deep tunnel site.