Cables Database Development Requirements Document

7.8.61.1, Revision 1

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1.0 INTRODUCTION

This document has been prepared by QCC Communications Corp. to specify the requirements for the Canadian Light Source Inc. (CLS) Cable Management Database System (CMDS). The CLS requires a database to support planning, operational and maintenance processes related to the management of cabling and cable plant within the CLS facility.

1.1 BACKGROUND AND OVERVIEW

The CLS is a national facility under construction on the University of Saskatchewan campus in Saskatoon, Saskatchewan. This facility is a third-generation synchrotron light source, which will produce high intensity infrared, visible, ultraviolet, and x-ray radiation.

The Saskatchewan Accelerator Laboratory, the predecessor of the CLS, developed and utilized a legacy cable management database. The legacy cable management database was developed in Postgres and Sun OpenWindows. This legacy system continues to be in use. The legacy cable management database is used to electronically track, reserve, and document installed cables throughout the Saskatchewan Accelerator Laboratory facility, as well as providing a history of changes made to the legacy cable management database system by users. It is used to retrieve information regarding a particular cable or equipment that is installed using the cable number or equipment identifier as a search argument. Access to the legacy cable management database system is limited to users with access to the workstation on which it is installed.

Access to the legacy cable management database system is currently restricted to the control room of the CLS due to a lack of X11 displays in the CLS facility. A single user account is used as a convenience to the users of the system. The use of the single user account, however, limits the functionality of the history of changes made to cables and equipment within the legacy cable management database system. Currently, until the CMDS is available, paper records are maintained of all new cable additions, modifications, and removals.

The CMDS is intended to provide the same core functionality as the legacy cable management database system, while removing some features from the legacy cable management database system that were never used and adding some enhanced functionality. The CMDS will provide the same capability to manage cables and equipment installed at the CLS facility. The CMDS will restore the full capabilities of the legacy cable management system's authentication and history functions. Some legacy cable management database system functions such as recording cable coloration will not be included in the CMDS, as they were never used. The CMDS will also provide new functionality such as determining relationships between certain data stored within the system, e.g. list of all cables that are attached to a specific piece of equipment. From a user's perspective the CMDS will be web based and will allow access from an authorized, web enabled computer.

2.0 CONCEPTUAL SYSTEM MODEL

The CMDS conceptual system model is shown below in Figure 1. Users login to their workstation. Clients access the CMDS by requesting the Uniform Resource Locator (URL) for the CMDS website via a web browser. The web server will authenticate the user that is requesting access to the CMDS using Network Information System (NIS) on UNIX. When the user is authenticated successfully, the user has access to the CMDS via the web server. Two levels of access will be available to the CMDS web interface. All users in NIS will be permitted read access to the CMDS web interface. A selected group of users will be permitted write access to the CMDS web interface. On authentication failure, the user is prompted to re-enter their username and password and informed that an authentication failure has occurred.

The web server will accept valid HyperText Transport Protocol (HTTP) requests to the CMDS URL, after authentication is successful. If an invalid HTTP request is provided, the web server will return an error message to the user. All valid HTTP requests are passed to the CMDS via the CMDS Interface.

The CMDS will then perform a query to a datastore based upon the requested operation from the user's HTTP request. The results of the query are passed back to the CMDS, formatted as HyperText Markup Language (HTML), and forwarded to the web server. The web server then delivers the formatted results to the user's web browser via HTTP.

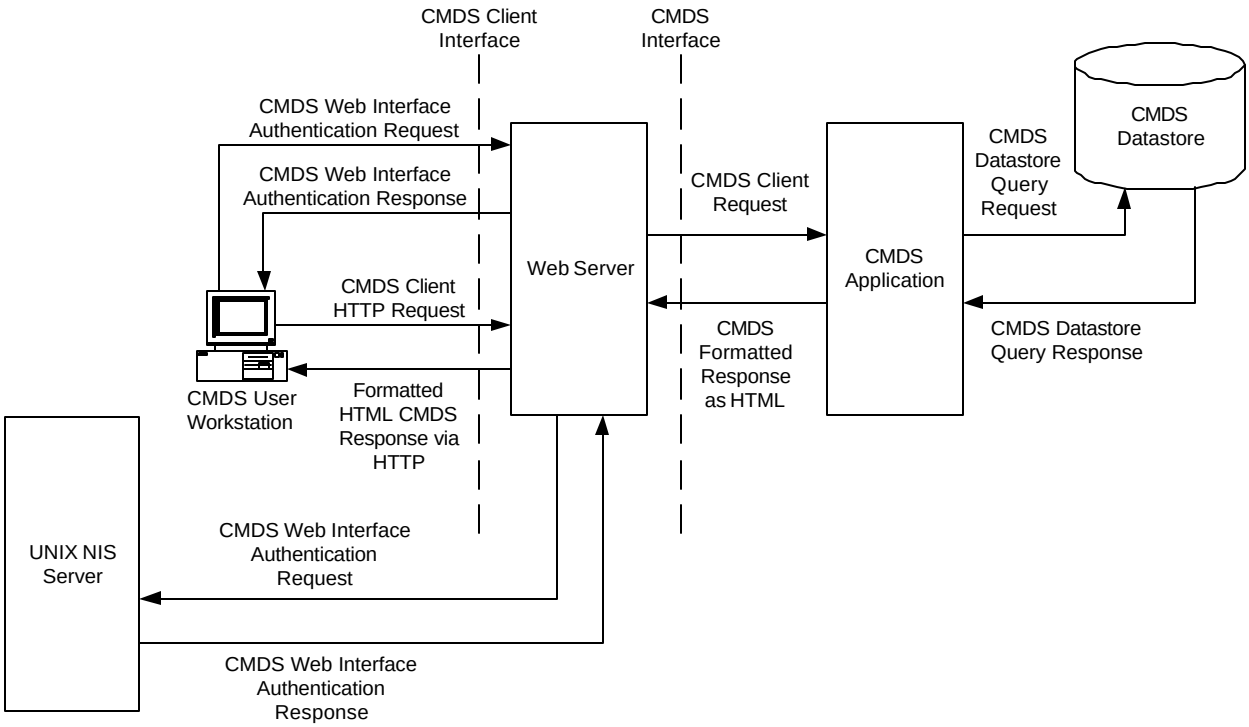

Figure 1: Cable Management Database System (CMDS) Conceptual System Model Diagram

3.0 REQUIREMENTS

The following provides the high level functional requirements of the CMDS.

The CMDS has requirements for the following aspects of the system:

- Information Model Requirements
- Querying and Reporting Requirements
- System Level Operations and Process Requirements
- User Level Operations and Process Requirements
- User Interface Requirements
- Technology Requirements
- System Maintenance
- Performance
- IT Considerations

3.1 INFORMATION MODEL REQUIREMENTS

The CMDS is required to represent cable, equipment, and equipment type attributes. The following is a list of the cable, equipment, and equipment type attributes that the CMDS will include.

3.1.1 Cable Attributes

The CMDS will be able to track cables deployed in the CLS facility. The attributes of a cable include:

- A unique integer cable number (e.g. 23444)
- Although the cable naming convention uses a leading 'C' for cable numbers, internally the system will deal with these as integer values. The leading 'C' may be added on the input and output forms as a hint to the user.
- Only a single cable may be associated with a single cable number
- Each cable has 2 end points
- Each end point is identified by an equipment identifier. Cable end points may not be connected to a piece of equipment. In such cases, the endpoint will be represented by a NULL equipment identifier value (i.e. not terminated).
- First equipment identifier (e.g. P2400-1.01) or if not connected to a piece of equipment, a NULL value

- Second equipment identifier (e.g. P2400-1.01) or if not connected to a piece of equipment, a NULL value
- Cables that do not have a connection to a piece of equipment for both their first and second end points are displayed in the CMDS, however, they do not have a relationship between any piece of equipment
- Generic cable type (e.g. 5c18)
- State of cable. Additional states can be manually added after deployment. States include:
    - installed (cable is installed in the CLS facility and is terminated by one or two pieces of equipment)
    - spare (cable is installed in the CLS facility but is not terminated by equipment)
    - reserved (cable number is reserved for a particular user and the cable is not yet installed in the CLS facility)
- A cable can only exist in a single state. A cable cannot have multiple states (e.g. 'installed' and 'reserved').
- Notes
    - a text field for entry of free form text describing any special attributes/qualities regarding cable, e.g., run type, channel/separation, etc.
- Related cable diagram number
- Last modified by user
- Reserved for identifier
    - a cable may be reserved for either a contractor, project, or user
- Last modified timestamp
- Deleted flag to indicate that the cable record has been marked as deleted

3.1.2 Equipment Attributes

The CMDS will be able to track deployed equipment in the field. Equipment includes such items as panels, power supplies, etc. The attributes of a piece of equipment includes:

- A unique equipment identifier (e.g. P2400-1.01)
    - the equipment identifier denotes the equipment type (e.g. P for panel), room number, room area, and rack slot number
    - if there is a specific format for equipment identifiers, the equipment identifier format can be enforced by the CMDS (CLS would be required to provide QCC with the equipment identifier format standard)
- Only a single piece of equipment may be associated with a single equipment identifier
- Notes
    - a text field for entry of free form text describing any special attributes/qualities regarding the equipment including system type, etc.
- Related diagram number

- Last modified by user ID
- Last modified timestamp
- Deleted flag to indicate that the equipment record has been marked as deleted

3.1.3 Equipment Type

The CMDS will be able to track types of equipment in the field. The attributes of a type of equipment includes:

- Unique character string used to identify the type of equipment as used in the equipment identifier
- Integer ID for equipment type
- Text description of the equipment type string

Equipment types will be used as part of the equipment identifier.

3.1.4 Importing and Converting Existing Data

Relevant portions of the legacy cable management database system's database schema are shown in Section 4.1, Figure 2. Some tables within the legacy cable management database system's database schema will be imported and converted to the CMDS' datastore. Other tables within the legacy cable management database system's database schema will not be imported.

The data from the legacy cable management database system's database will be imported from the data submitted by CLS to QCC. A freeze will be required on the legacy cable management database system's database when the final database export is provided to QCC. The freeze will require a halt on all additions, modifications, and deletions to the legacy cable management database system's database. All changes made to the legacy cable management database system's database after the final export is provided to QCC, will be lost after the freeze is declared. Paper records maintained at the CLS will not be imported to the CMDS database by QCC.

The following tables will be imported from the legacy cable management database system's database schema and converted to the new CMDS datastore:

- cables
- equipment
- types

The types tables will be imported to the CMDS datastore. The cables and equipment tables will have additional attributes added to the converted datastore.

The CMDS cable datastore representation will map to some fields from the existing legacy cable management database system's cables table. The mapping given below in Table 1 is an example of a possible mapping. The CMDS cable datastore representation is for illustration purposes only. The actual CMDS cable datastore representation will be determined during the design phase of the project.

Table 1: cables Table Imported Fields

Legacy cables Table	CMDS cable Datastore Representation
cablenum	cable_number
cabletype	cable_type
uid	last_mod_user
frompanel	equipment_1
topanel	equipment_2
desc	notes
refer	related_diagram_number
datechanged	last_mod_time

The CMDS equipment datastore representation will map to some fields from the existing legacy cable management database system's equipment table. The mapping given below in Table 2 is an example of a possible mapping. The CMDS equipment datastore representation is for illustration purposes only. The actual CMDS equipment datastore representation will be determined during the design phase of the project.

Table 2: equipment table Imported Fields

Legacy panels Table	CMDS equipment Datastore Representation
panelkey	equipment_identifier
numblocks	
name	
location	
description	description
refer	related_diagram_number

The Abbreviations database will be imported from a Microsoft Access database. This database will provide the equipment type list used for the first four characters of the equipment identifier. The entire contents of the existing Abbreviations database will be imported to the same datastore used by the CMDS, but as a separate database. A freeze will be required on the legacy Abbreviations database when the final Abbreviations database export is provided to QCC. The freeze will require a halt on all additions, modifications, and deletions to the legacy Abbreviations database. All changes made to the Abbreviations database after the final export is provided to QCC, will be lost after the freeze is declared.

The Abbreviations database has a table that includes three fields: unique id, abbreviation, and a text description of the abbreviation's meaning. This table will be used as the equipment type table.

3.2 QUERYING AND REPORTING REQUIREMENTS

The CMDS will support querying based on:

- A given cable number
- A given equipment identifier
- Cables terminating at a given equipment identifier
- Cables of a given state
- All cables and equipment that refer to a given diagram number
- A given deleted cable number
- A given deleted equipment identifier
- All deleted cable numbers
- All deleted equipment identifiers

3.2.1 Presentation of Reports

The CMDS will present reports in a sorted logical fashion. Users will not be able to re-sort the query results.

3.3 SYSTEM LEVEL OPERATIONS AND PROCESS REQUIREMENTS

The CMDS will provide the following system level operations and processes:

- Cable Entity Operations
- Equipment Entity Operations
- Equipment Type Entity Operations
- System Change History
- Input Validation

3.3.1 Cable Entity Operations

Cable entities will be subject to the following operations:

- Cable numbers will be assigned automatically by the CMDS
    - o new individual cables that have been added to the CMDS datastore will use the lowest available cable number that is not in use by another cable record
    - o new individual cables will fill gaps in the cable numbering sequence

- Cables will be reserved in a contiguous block of cable numbers
    - new cable reservations will fill gaps in the cable numbering sequence, if possible
- Reserved cable numbers can be unreserved and returned to become available for future use
- Adding a cable entry creates a new cable record in the CMDS datastore. A record of the addition of the new entry is recorded in the CMDS history.
- Modifying a cable record will modify the given record. Information regarding the modification will be stored in the history. The specific modification information stored in the history for the modification of a cable is discussed in Section 3.3.4.
- Deleting a cable record does not remove the entry from the CMDS datastore. The cable record is marked as deleted and retained in the CMDS datastore.
- Cable history is displayed only at the request of the user. The history will not be displayed initially on the cable view.

3.3.2 Equipment Entity Operations

Equipment entities will be subject to the following operations:

- If a standard format for equipment identifiers exists, that format will be enforced by the CMDS.
    - CLS will provide documentation on the equipment identifier format, if such a standard exists.
- Adding an equipment entity creates a new equipment record in the CMDS datastore. A record of the addition of the new entry is recorded in the CMDS history.
- Deleting an equipment record does not remove the entry from the CMDS datastore. The equipment record is marked as deleted and retained in the CMDS datastore.
    - if any cables have a connection relation to the equipment record to be deleted, the user is warned that deleting the equipment will force all cables connected to the equipment to reset the connection value to NULL prior to marking the equipment record as deleted.
        - if the user permits the equipment to be marked as deleted, the cable records that indicate a connection to the equipment will have their associated connection to the equipment set to NULL and the equipment record is marked as deleted
        - if the user chooses to not delete the equipment record, no change occurs to the CMDS equipment record
- Modifying an equipment record will modify the given record. Information regarding the modification will be stored in the history. The specific modification information stored in the history for the modification of equipment is discussed in Section 3.3.4.
- Equipment history is displayed only at the request of the user. The history will not be displayed initially on the equipment view.
- Equipment must be entered into the CMDS prior to cables being associated with the equipment

3.3.3 Equipment Type Entity Operations

Equipment type entities will be subject to the following operations:

- Equipment type must exist prior to it being associated with equipment
- Equipment types cannot be added, modified, or deleted via the CMDS web interface

3.3.4 System Change History

The CMDS will provide a change history that records additions, modifications, or deletions to individual cable and equipment records. Information recorded includes:

- User
- Type of operation
- Timestamp of modification
- On addition: record of creation event recorded to history
- On modification: only the changed information for modified cable or equipment information is recorded to history prior to change.
    - modification of a cable record will record if changes were made to one or more of the following:
        - first equipment identifier
        - second equipment identifier
        - generic cable type
        - cable state
        - related diagram number
        - reserved for user ID
    - modification of an equipment record will record if changes were made to one or more of the following:
        - related diagram number
- On delete: record of deletion event recorded to history

3.3.5 Input Validation

Validation of the equipment identifier will be performed by the CMDS prior to storing or using the identifier for queries. The CMDS will enforce a standard format for the equipment identifier to ensure that the equipment identifier is represented by a single format within the CMDS database to avoid duplication of a single piece of equipment. For example, two users may enter the equipment identifiers p2400-01.12 and P2400-1.12. Both equipment identifiers refer to the same equipment. The CMDS database, however, will treat them as two unique pieces of equipment. The CMDS will force both equipment identifiers to be of a common format, such as P2400.01-12.

3.4 USER LEVEL OPERATIONS AND PROCESS REQUIREMENTS

The CMDS will provide the following types of operations via the web interface:

- User Authentication
- User Level Access
- Additions, Modifications, and Deletions
- Cable Number Block Reservations
- Equipment Type Operations
- Querying and Reporting Requirements as Described in Section 3.2
- Viewing History of Cables and Equipment

3.4.1 User Authentication

The CMDS will authenticate individual users.

- CMDS users login to their workstation
- Authentication with the CMDS web interface will be facilitated by NIS on UNIX
- CLS will ensure all users with read and read/write permissions for the CMDS web interface are defined in NIS on UNIX
    - users in the 'cables' group will be permitted write access to the CMDS web interface (i.e. add, modify, and delete cables and equipment)
    - all other users that do not belong to the 'cables' group will have read access (i.e. cannot add, modify, and delete cables and equipment but could view information for cable or equipment)
- Users not defined in NIS on UNIX will not be granted access to the CMDS web interface
- The username of the user currently logged into the workstation will be used initially for authentication with the CMDS web interface
- If the user currently logged into the workstation accessing the CMDS web interface is defined in NIS on UNIX, the user is prompted for their password
- If the user currently logged into the workstation accessing the CMDS web interface is not defined in NIS on UNIX, the user is prompted for their username and password
- The CMDS authentication prompt will allow users to enter a username and password that the user wants to login with
    - the username of the user currently logged into the workstation will be displayed on the login screen for the CMDS web interface
    - the user will be able to modify the username and password field if the username is incorrect
    - provides a mechanism to login to the CMDS web interface on a common shared workstation used by many users and which may be logged into via a common user account (e.g. 'control' account)

- The CMDS will provide a fixed allowable idle time for each user session. If the user's HTTP session is idle for greater than or equal to the allowable idle time, the user will be logged out by the CMDS and will be required to login again to the CMDS web interface. Idle time is defined as a period of time in which the authenticated user does not:
    - request web pages from the CMDS web interface
    - add new cable, equipment, or equipment type entries
    - modify cable, equipment, or equipment type entries
    - delete cable or equipment
    - conduct searches
    - request reports
- The user authentication process will provide a means to identify who performed changes in the history during the length of the browser session
    - sessions begin when a user enters their authentication information and continues until the web browser is shutdown and restarted or the session idle time is surpassed

A significant security risk exists when using HTTP authentication with system account credentials for the following reasons:

- HTTP does not rate-limit the number of authentication attempts, leaving it open to dictionary attacks
- If not using HyperText Transport Protocol (Secure) (HTTPS), system account credentials can be sniffed off the wire

Failed authentication attempts are only logged to the web server log. Attempts to get in via the above methods may not be noticed.

The system model for the CMDS is shown in Section 2.0, Figure 1. The diagram illustrates how authentication occurs between the CMDS user, web server, and NIS service on UNIX.

3.4.2 User Level Access

There will be two types of CMDS user level access for users defined in NIS on UNIX:

- Read only
- Read/Write

Users with read only access will be able to perform queries via the CMDS web interface and to view the resulting reports. Additions, modifications, and deletions cannot be performed by read only level access.

Users with read/write access will be able to perform queries via the CMDS web interface and to view the resulting reports. Additions, modifications, and deletions can be performed by these

users. CLS will define a group of users defined in NIS on UNIX that will have read/write level access.

3.4.3 Additions, Modifications, and Deletions

The web interface will permit the addition, modification, and deletion of cable and equipment entities. The web interface will allow a subset of the users with read/write level access to add or modify equipment type entities.

3.4.4 Cable Number Block Reservations

The CMDS will allow reservation of blocks of contiguous cable numbers for a contractor, individual technician, or project. A user can reserve a block of cable numbers for another user of the CMDS.

3.4.5 Equipment Type Operations

The Abbreviations database that contains the equipment type data will be migrated to the same datastore that is used by the CMDS. The Abbreviations database will be separate from the CMDS database. Maintenance operations (i.e. add, modify, and delete) will be performed through a separate user interface.

3.4.6 Viewing History of Cables and Equipment

The history of a given cable or equipment will be displayed when requested by the user. The history information will provide information regarding the operations performed on the cable or equipment record.

3.5 USER INTERFACE REQUIREMENTS

QCC will develop a graphical user interface for the CMDS. The graphical user interface will be web based.

3.5.1 Client Access

Client access to the CMDS will be via a web browser that supports:

- Cascading Style Sheets (CSS) Level 1
- HTML 4.01

A diagram of CMDS client access is provided in Section 2.0, Figure 1.

3.5.2 Client Interface

The web interface will conform to HTML 4.01 and CSS Level 1 standards. The web interface will be designed to be compatible with most modern web browsers (i.e. Microsoft Internet Explorer 5, Netscape 4.79 and up). Presentation may differ slightly between modern web browsers due to their various level of support for the CSS Level 1 standard.

3.5.3 User Interface Presentation

Details regarding the web interface such as:

- Content and organization of forms
- Search and results display
- Color schemes
- Use of decorations (e.g. borders, graphics, CLS logo)

will be subjective. QCC will elicit feedback from CLS on the user interface presentation. The web interface may conform to standard CLS intranet appearance standards, if such a standard exists. The use of a standard CLS intranet appearance will be dependent upon its feasibility to implement the CMDS web interface. The font type for the CMDS web interface will not be defined using CSS or HTML. The font type will only be specified by the user's browser settings.

3.5.4 Operational Processes and Workflows

A key expectation of the CMDS is the ability to request and produce various searches and results. The search and results generation activity occur within the context of operational workflows at CLS. A key risk associated with the development and use of a system such as the CMDS, is to ensure that the operational processes supported by the system are understood sufficiently so that the system functions optimally in support of these functions.

QCC will provide a 'mockup' of the user interface, either on paper or as simplified HTML forms, in order to illustrate the dynamic operation of the system and to provide an initial view of the proposed variety of:

- Interfaces
- Data-entry mechanisms
- Reports and search results

The 'mockups' are intended to prompt feedback from CLS regarding the expected interactive requirements for the CMDS. The 'mockups' will not be representative of the final user interface appearance for the CMDS.

3.6 TECHNOLOGY REQUIREMENTS

The CMDS will operate as a client/server system. The list of requirements include:

- Datastore
- Server hardware
- Server operating system
- Software development tools
- Web server

Technology requirements will be chosen with respect to identified CMDS requirements. The primary means to select technology for each of the above requirements will be:

- Technology's satisfaction of functional CMDS requirements
- Support required data representations
- Level of effort required to implement

Secondary concerns for technological requirements include:

- Cost of technology (e.g. licensing)
- Extensibility of technology
- Maintainability of technology
- Usage of tools
- Reliability of technology
- Security of technology

The technology to be used to implement the CMDS will be determined during the design phase of the project.

3.7 SYSTEM MAINTENANCE

There are several modes of maintenance that occur during the life cycle of any system such as the CMDS i.e.:

- Addition of new operations
    - new query and report operations
- Extension of the database schema
- Hardware updates

- Software updates
- User interface presentation changes

3.8 PERFORMANCE

The CMDS will:

- Be an interactive application
- Support the expected maximum of three concurrent users
- Not require frequent restarts due to normal operations (e.g. adding a new cable record will not require a restart of the CMDS)
- Other factors, not directly related to the CMDS, that may affect the observable delay of the CMDS include, but are not limited to:
    - available network bandwidth
    - content generation methods of datastore
    - interference in wireless data link
    - number of records stored in the CMDS datastore
    - platform
    - server load
    - user desktop or laptop load
- Designed first for functional operation, optimizations to the CMDS will be secondary and subject to schedule and budgetary constraints
- Store on the close order of hundreds of thousands of cable and equipment records, along with their relations
- Enable the contemplated modes of maintenance listed in Section 3.7 to occur, if required

3.9 IT CONSIDERATIONS

The CMDS will work with established CLS IT procedures, pertaining to:

- Addition of new users authorized to access the CMDS
- Archiving of current CMDS data
- System backup and restoration

CLS will provide QCC with the relevant IT procedure documentation, information, and/or procedures.

4.0 APPENDIX

4.1 SCHEMA FOR LEGACY CABLE MANAGEMENT DATABASE SYSTEM

A view of the legacy cable management database system's database schema was reverse engineered by QCC from a data dump. The reverse engineered schema is shown below in Figure 2. The schema shown is limited to only those tables that will be imported to the CMDS datastore.

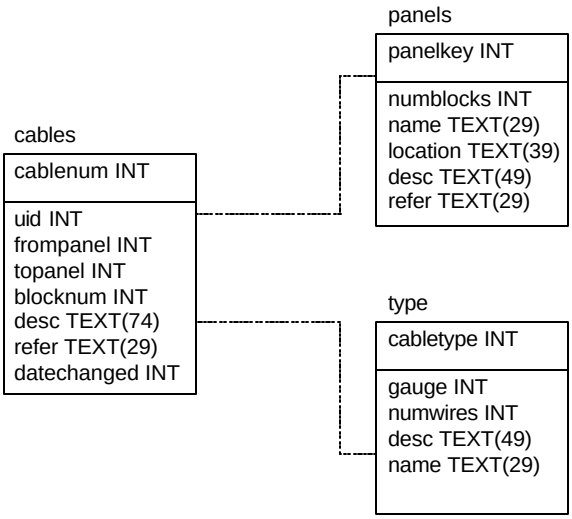

Figure 2: Reverse Engineered Schema for Legacy Cable Management Database System

4.2 GLOSSARY

Authentication: Process to confidently trust the identity of a user. May be handled via a username and password combination.

Cable Management Database System (CMDS): A client/server system to support planning, operational and maintenance processes related to the management of cabling and cable plant within the CLS facility.

Canadian Light Source Inc. (CLS): A national facility under construction on the University of Saskatchewan campus in Saskatoon, Saskatchewan. This facility is a third-generation synchrotron light source, which will produce high intensity infrared, visible, ultraviolet, and x-ray radiation.

Cascading Style Sheets (CSS): A standard language to specify layout and presentation of HTML based content.

HyperText Markup Language (HTML): The standard publishing language of the World Wide Web.

HyperText Transfer Protocol (HTTP): HTTP is an application-level protocol with the lightness and speed necessary for distributed, collaborative, hypermedia information systems. It is a generic, stateless, object-oriented protocol which can be used for many tasks, such as name servers and distributed object management systems, through extension of its request methods (commands). A feature of HTTP is the typing of data representation, allowing systems to be built independently of the data being transferred. HTTP has been in use by the World-Wide Web global information initiative since 1990.

HyperText Transport Protocol (Secure) (HTTPS): HTTPS, the standard encrypted communication mechanism on the World Wide Web. This is actually just HTTP over SSL.

Network Information System (NIS): Network Information Service provides a simple network lookup service consisting of databases and processes that has to be known throughout the network, to all machines on the network.

Schema: A diagrammatic presentation of a database design.

Secure Sockets Layer (SSL): A protocol created by Netscape Communications Corporation for general communication authentication and encryption over TCP/IP networks. The most popular usage is HTTPS, i.e. the HyperText Transfer Protocol (HTTP) over SSL.

Uniform Resource Locator (URL): Global address of documents and other resources on the World Wide Web. The first part of the address indicates what protocol to use, and the

second part specifies the IP address or the domain name where the resource is located. For example, http://foo.com/index.html specifies a Web page that should be fetched using the HTTP protocol.

X11: Graphical user interface primarily used for UNIX operating systems.

4.3 REFERENCES

- Cascading Style Sheets, Level 1 (http://www.w3.org/TR/REC-CSS1)
- CLS Cables Database Development: Technical Specification 7.8.61.1 Rev. 0 (April 2, 2002)
- CLS Legacy cable management database application
- CLS Legacy cable management database schema
- HyperText Markup Language 4.01 (http://www.w3.org/TR/html4/)
- QCC Communications Corp. Cables Database Development: Requirements Analysis Proposal v1.1 (May 28, 2002)