

C3-TREK NUMAC Interface (NI) – PRNM Data Services

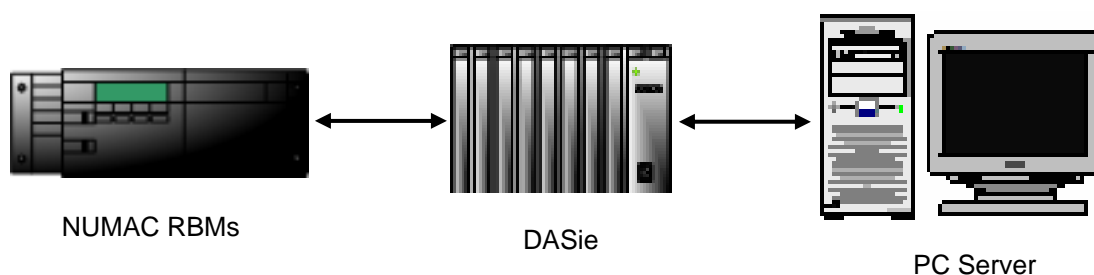
INTRODUCTION

For Nuclear Utilities using General Electric NUMAC devices, C3-ilex has developed replacement software for legacy Core Monitoring System (CMS) data interface applications. The C3-TREK-NI functions consist of Windows Services and Windows Client user-interface applications. The NUMAC Interface (NI) Services will usually run on the Plant Process Computer (PPC) or alternatively on a separate PC. Operators will communicate with the NI Services across the network using one or more NI Client applications. Replacement applications are available for plants using NUMAC RWM, ATIP and/or PRNM devices. The specific NUMAC Services accessible via the C3-TREK NI replacement software are independent of each other, and a customer can implement any combination of RWM, ATIP and/or PRNM Services.

This Product Description discusses Power Range Neutron Monitor (PRNM) data services application, which communicates with the GE PRNM system via the NUMAC Rod Block Monitor (RBM) devices for the downloading of LPRM GAFs and %CTP and the uploading of PRNM data.

The design approach used for the replacement software was to:

- Design the software packages to run under Microsoft Windows in C-based code developed under Visual Studio .NET
- Retain the same PRNM service actions and reports, thereby minimizing user retraining
- Provide a data acquisition interface to the Plant Process Computer and/or Core Monitoring System Computer for PRNM data messaging
- Modernize the user interfaces to standard Windows look and feel
- Implement the serial data interface to the NUMAC using C3-ilex DASie (Data Acquisition System importer/exporter) devices as the data interface between the NUMAC and the host computer running ATIP software applications.
- Run on standard servers and PCs that support the Microsoft XP Professional or 2000/3 server



DASIE/NUMAC DATA INTERFACE

The DASie provides the data interface between NUMAC devices and the C3-TREK Servers performing the NUMAC data processing and application services. The DASie consists of one or more Serial Input/Output (SIO) cards installed in a rack-mountable chassis. Each card is capable of handling several fiber optic data streams from the NUMAC devices. The DASie provides the output (i.e., message downloads) and data retrieval communication paths between the C3-TREK NI software applications (e.g., RWM, ATIP, and/or PRNM) and the NUMAC devices. The DASie translates the NUMAC proprietary protocol data streams into ones that can be accessed by network addressable computers using TCP/IP protocols.

PRNM SERVICES

The PRNM Service communicates with the PRNM hardware (i.e., the NUMAC RBMs) via the DASie, which handles the protocol translation. The messages sent and received by the PRNM Service are TCP/IP versions of the messages defined in the GE NUMAC protocol documents. PRNM Service actions include the collection of PRNM data (e.g., LPRM, APRM, OPRM) and the downloading of LPRM Gain Adjustment Factors (GAFTs) and percent Core Thermal Power (%CTP).

Figure 1 provides a functional overview of the PRNM data services application

PRNM CLIENT

The PRNM Client is a user interface that provides access to the PRNM Service. It is a Windows application providing a single screen view of actions, options and user information for PRNM Data Processing.

Figure 2 represents a screen shot of the PRNM Client Window that is displayed following launch of the PRNM Function from the C3-TREK-NI Client application. This display allows the user to initiate downloads and/or uploads of selected data to/from the PRNM Rod Block Monitors (RBMA and RBMB). It consists of three user interface regions, 1) Operational Parameters Region (Core Map), 2) Demandable Functions Region and 3) Informational/Status Region.

Operational Parameters Region (Core Map)

The Core Map region is a graphical view of the reactor core for representation of LPRM information and user action monitoring. The Core Map consists of the following components and behaviors:

- Core Map Label (dynamic) - *Core Map label changes depending on what the user is currently doing or viewing.*
- NUMAC RBM connection status (dynamic)
- Matrix representation of control rod assemblies (static)
- LPRM locations (location static, icon color dynamic)
- Cursor Location Core Map coordinates – depending on the mouse cursor position within the Core Map, a momentary graphic is displayed

PRNM Demandable Functions Region

The PRNM demandable functions region of the PRNM window is where all possible user requests that can be performed with the NUMAC PRNM System are initiated. The following user actions are accommodated:

- Download to PRNM
 - Send GAFTs + %CTP

Selecting this option changes the title of the Core Map to “Download GAFTs and %CTP”, whereby the user has options for selection of LPRM GAFTs to be downloaded. The GAFTs are retrieved from the C3-TREK NI database and are the result of data obtained from the most recent ATIP analysis, or input by other means. Figure 3 illustrates the Core Map configuration for selection of LPRM GAFTs to be downloaded. The %CTP is also transmitted to the PRNM system whenever LPRM GAFTs are downloaded.

- Send %CTP
Selecting this option initiates transmission of %CTP only to the PRNM.
 - Upload from PRNM
 - APRM / LPRM Gains
This action causes the APRM and LPRM gains to be uploaded from the PRNM.
 - Setpoint Data
This action causes the fixed Setpoint Data to be uploaded from the PRNM.
 - Detector Plateau Data
This action causes the title of the Core Map to change to “Upload Detector Plateau Data” wherein the user selects the LPRMs associated with the data being requested.
 - LPRM Assignments
This action causes the LPRM Assignment information to be uploaded from the PRNM where it is saved in the C3-TREK NI database and must be uploaded before the “Send GAF’s and CTP” download option can be enabled.
 - Stability Cell Assignments
This action causes the Stability Cell Assignments to be uploaded from the PRNM.
- Initiating any of the “Upload from PRNM” buttons results in request messages being sent to both RBMA and RBMB. The data returned in these messages are written to the corresponding C3-TREK-NI database and formatted reports specific to the message type.

Information / Status region

This region provides responses back to the user of errors detected and displays information related to PRNM actions and results. The following is a sample list of informational / status messages.

- PRNM response to C3-TREK data transfer request denied by NUMAC
- Communication errors – C3-Trek in wrong mode
- Communication errors – If RBM is in Operate mode, distinguish error
- User entry errors

PRNM PERIODIC REAL-TIME DATA

In addition to the demandable PRNM processing functions identified above, the C3-TREK-NI PRNM functionality includes the collection of the following real-time data (25 – 50 msec) from the RBM’s.

- LPRM, APRM and RBM Data
- Stability Data & Status
- Diagnostic Messages

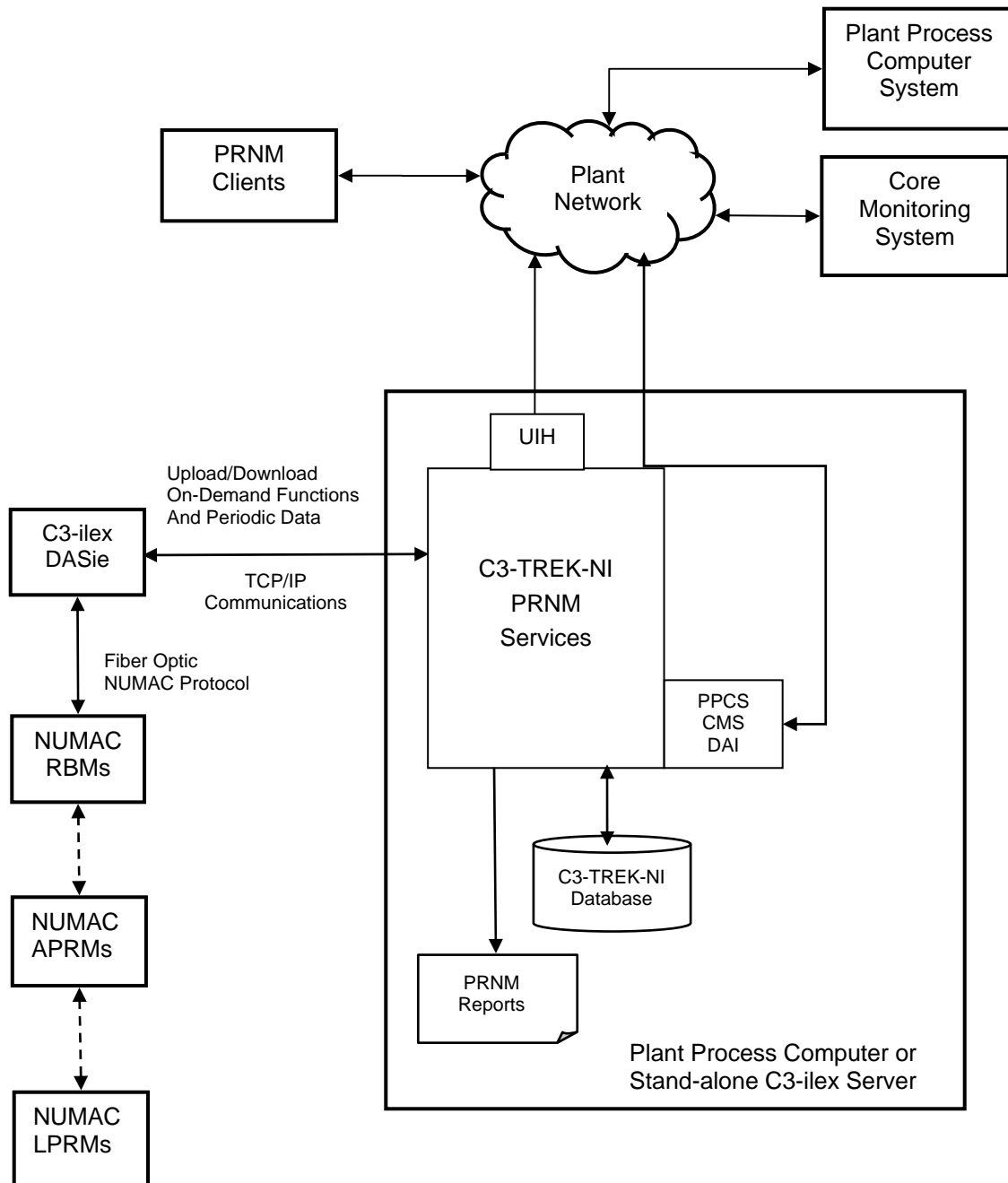


Figure 1. PRNM Data Services Overview Diagram

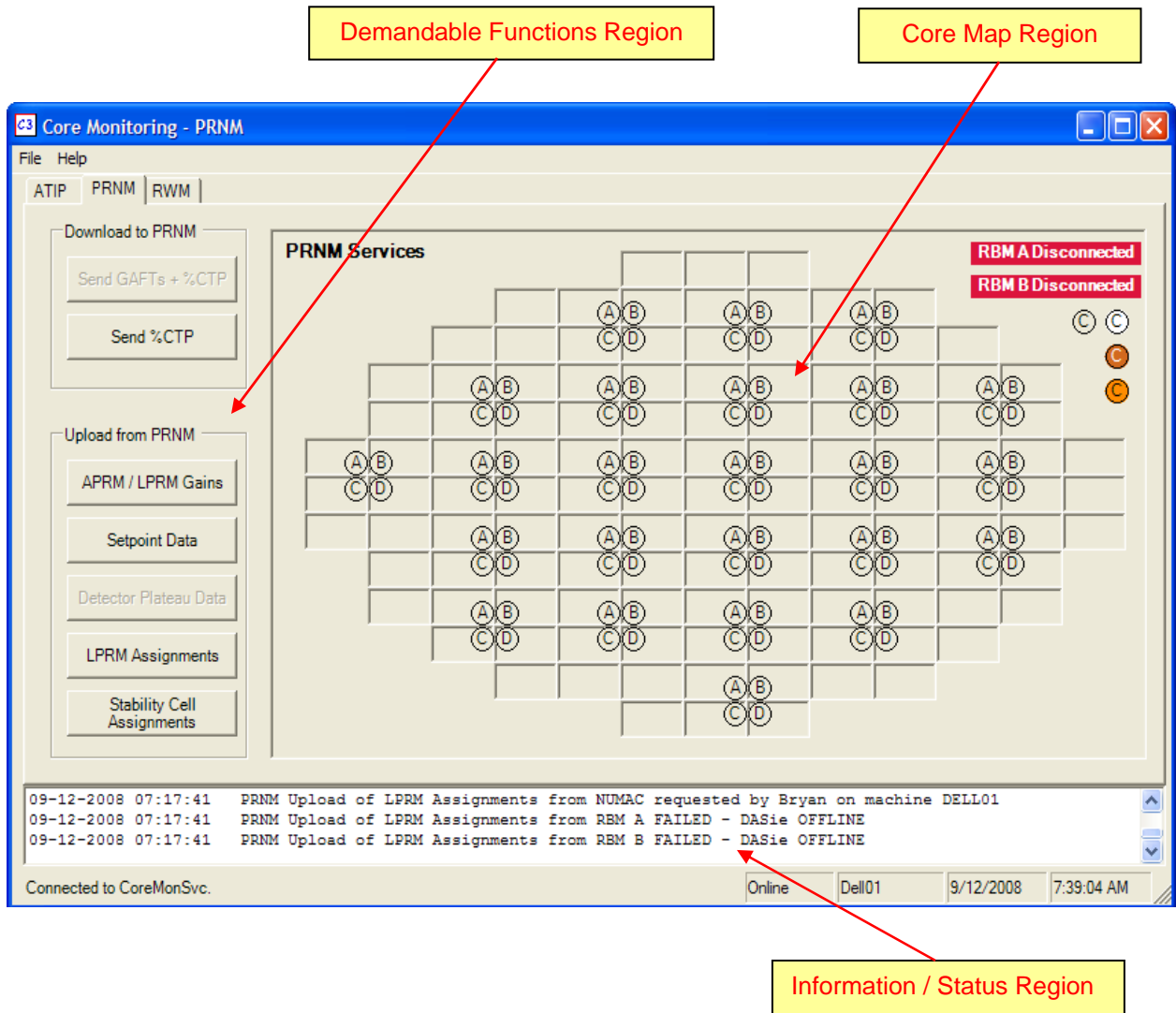
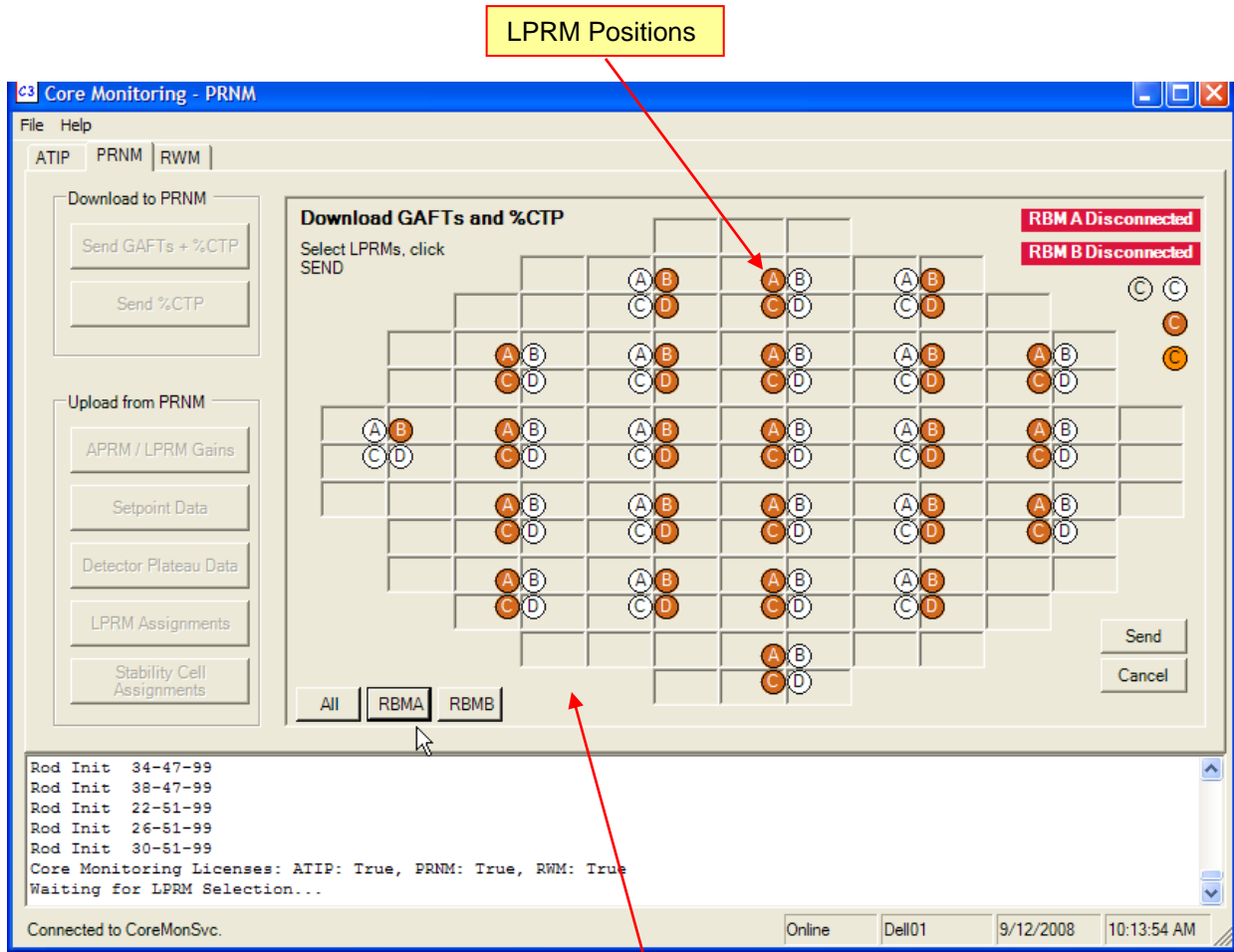


Figure 2

PRNM Function User Interface Window

- Three User Interface Regions:
- Operational Parameters Display - Core Map
- PRNM Demandable Functions
- PRNM Service Actions Information/Status



Core Map screen used to select the LPRMS for which GAFs will be downloaded. LPRMs selected for download are sent the value read from the LPRM_GAF table in the C3-TREK-NI database

Figure 3

PRNM - Download GAFs and %CTP