C3-TREK NUMAC Interface (NI) – ATIP 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 the Automated Traversing In-core Probe (ATIP) data services application, which has two distinct functions. The first interfaces with the NUMAC Automated TIP Control Unit (ATCU) to control TIP scans and to gather the necessary plant data as the TIP traverses proceed. The second function performs the processing necessary to populate the ATIP databases, generate reports and calibrate the LPRM detectors.

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 ATIP 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 ATIP data messaging
- Modernize the user interfaces to standard Windows look and feel
- Implement the serial data interface to the NUMAC ATCU using C3-ilex DASie (Data Acquisition System importer/exporter) devices as the data interface between the NUMAC ATCU and the host computer running ATIP software applications.
- Run on standard servers and PCs that support the Microsoft XP Professional or 2000/3 server

NUMAC ATCU DASie PC 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.

ATIP SERVICES

The ATIP Service communicates with the NUMAC ATCU hardware via the DASie, which handles the protocol translation. The messages sent and received by ATIP Service are TCP/IP versions of the messages defined in the GE NUMAC protocol documents. ATIP Service actions include:

- TIP scan executions
- TIP data collection
- Cross calibration and normalization of TIP Data
- LPRM Gain Adjustment Factor (GAFT) calculations
- ATIP and LPRM Calibration Current database maintenance
- Report generation

Figure 1 provides a functional overview of the ATIP data services application.

ATIP CLIENT

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

Figure 2 represents a screen shot of the ATIP Client Window that is displayed following launch of the ATIP Function from the C3-TREK NI Client application. 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 TIP information and user action monitoring. It consists of the following components:

- Core Map label (dynamic) - The Core Map label changes depending on what the user is currently doing or viewing.
- Matrix representation of control assemblies (static).
- TIP machine/channel locations (location static, icon dynamic) - The icons are either circular selection buttons or rectangular status labels at the LPRM string location, depending on the function being displayed.
- ATIP Auxiliary Information - Selectable features that when enabled display supplementary information in the lower informational/message area.
- Cursor location Core Map coordinates – Depending the mouse cursor position within the Core Map, a momentary graphic is displayed.

Demandable Functions Region

The ATIP demandable functions region of the ATIP window is where all possible user requests that can be performed with the NUMAC ATCU are initiated. These are all of the TIP features that transmit or receive data to/from the NUMAC ATCU, and features that perform processing of TIP data. It consists of the following components:

- Scan Type Selection - Provides capability to select TIP machine(s)/channel(s) to scan. Provides visual verification of the users TIP scan selection. Supports the following scan options:
  - All TIPS Scan (selects all TIP machine/channels to be scanned with a single mouse-click)
  - Some TIPS Scan (allows user to select any combination of TIP machine/channels for scan)
  - Rescan Any TIPS (allows the user to initiate a rescan of selected TIP machine/channels)
  - Start Scan (initiates a TIP scan of the selected TIP machine/channels)
  - Abort Scan (aborts a current TIP scan in progress)
- TIP Data Action Selection - Provides the capability to perform several actions with the NUMAC ATCU data that has been read from the TIPs as a result of the latest scan(s). Supports the following options:
  - Reread from ATCU (re-reads currently stored scan data in the NUMAC ATCU)
  - Export/Validate (exports current TIP data to a CSV format data file)
  - Select for Processing (selects current TIP Scan session data for further processing)
  - Normal Termination/Save Data (closes scan session and saves data)
  - Quit/Don't Save (stops any TIP data function)
- ATIP Processing Selection – Provides capability to process TIP data whether or not a current TIP scan has been performed since TIP processing is based on available input data files. Consists of the following components:
  - Set-up File I/O – This tab allows the user to set up the input and output files that are required for TIP processing. ATIP processing uses input data from the following sources:
    - √ ATIP database (TIP probe data as captured by the NUMAC ATCU and core parameters captured by the ATIP function during the scan session).
    - √ Core Monitoring System Process Data File
    - √ Accountability System Base Data File (LPRM loading identifications)
    - √ LPRM Calibration Current Database (historic LPRM calibration current data

    ATIP processing generates data for:

    - √ Sessions Log (TIP Processing Summary Report)
    - √ Core Monitoring System (TIP Data File)
    - √ LPRM Gain Worksheet (LPRM Calibration Worksheet for I&C personnel)
    - √ LPRM Calibration Current Database (update)
    - √ Miscellaneous logs and report

    Selecting the Set-up File I/O button automatically opens an I/O File Selection browse window. See Figure 2 for a post file set-up example.

  - Run Processing - This tab allows the user to select a single TIP processing task for the previously identified input and output files. Also, a single Axial Alignment option may be chosen by the user for making adjustments to LPRM axial alignments based on TIP common channel data. Once the Analysis and Axial Alignment options are selected, the Run button is selected to initiate the TIP analysis selected.

    Selecting the Run Processing button automatically opens the ATIP Processing Selection window as shown in Figure 3.

Information / Status Region

This region provides responses back to the user of errors detected and displays information related to ATIP actions and results. If selected in the Core Map region, TIP Scan Progress Logs and TIP Machine Status information is also available in this viewing area.

- TIP Scan Progress Logs - Provides feedback on the progress and final status of requested TIP scans. Consists of the following tabs for selecting different categories of information:
  - Cautionary Msgs Tab (displays unsuccessful or low confidence information upon completion of a TIP scan)
  - Scan Error Log Tab (displays information related to any type of TIP Scan errors detected during recent TIP scans
  - Rod Movement tab (displays a summary of control rod activity during the current TIP scan)
  - Unsucess Log Tab (displays information related to the current TIP scan traverse that resulted in unsuccessful TIP scans
  - LowCon Log Tab (displays information related to the current TIP scan traverse that resulted in low confidence TIP data)
  - LPRM GAFs (displays information related to the LPRM Gain Adjustment Factors resulting from the just completed ATIP Processing function. This information may also be printed as an ASCII file)
  - Calibration Currents (displays information related to the LPRM calibration currents resulting from the just completed ATIP Processing 'Produce LPRM Calibration Worksheet" function. This information may also be printed as an ASCII file)
  - LPRM EOL (displays information related to the LPRM End of Life projection resulting from the just completed ATIP Processing 'Produce LPRM Calibration Worksheet' function. This information may also be printed as an ASCII file.

  Selection of the Unsuccess Log or LowCon Log tabs will result in the Core Map Region changing to a Low Successful Scans or Low Confidence Scans view that will display information consistent with messages contained in the Information/Status region. See Figure 5 for examples of the Unsuccess Log and LowCon tabs.

- TIP Machine Status – Provides TIP Machine status updates on an interval basis during the scan process. The TIP machine status table is presented to the user in the right side of Information/Status Region when selected in the Core Map area. See Figure 6 for an example of the displayed TIP Machine status information

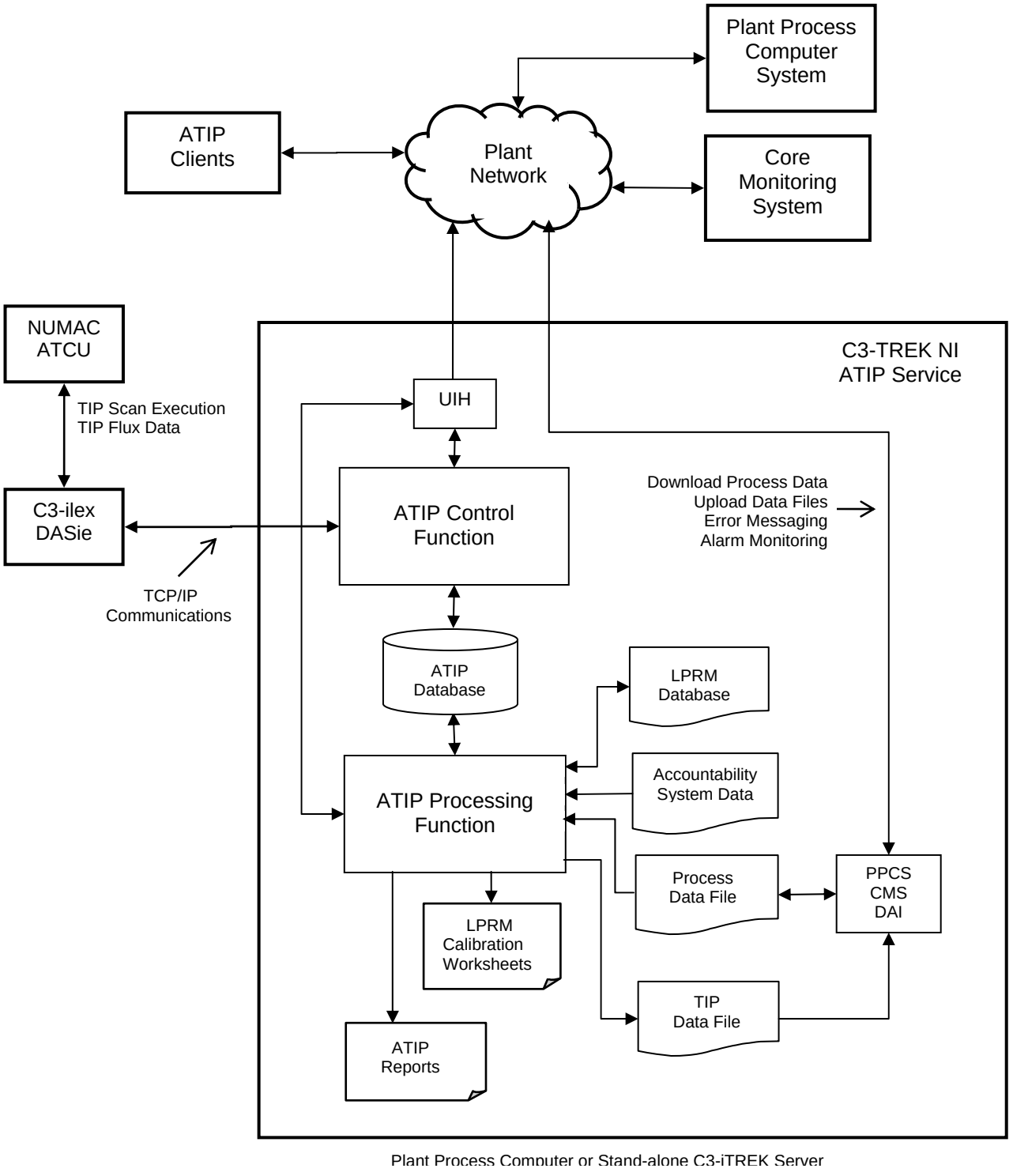


Figure 1. ATIP Data Services Overview Diagram

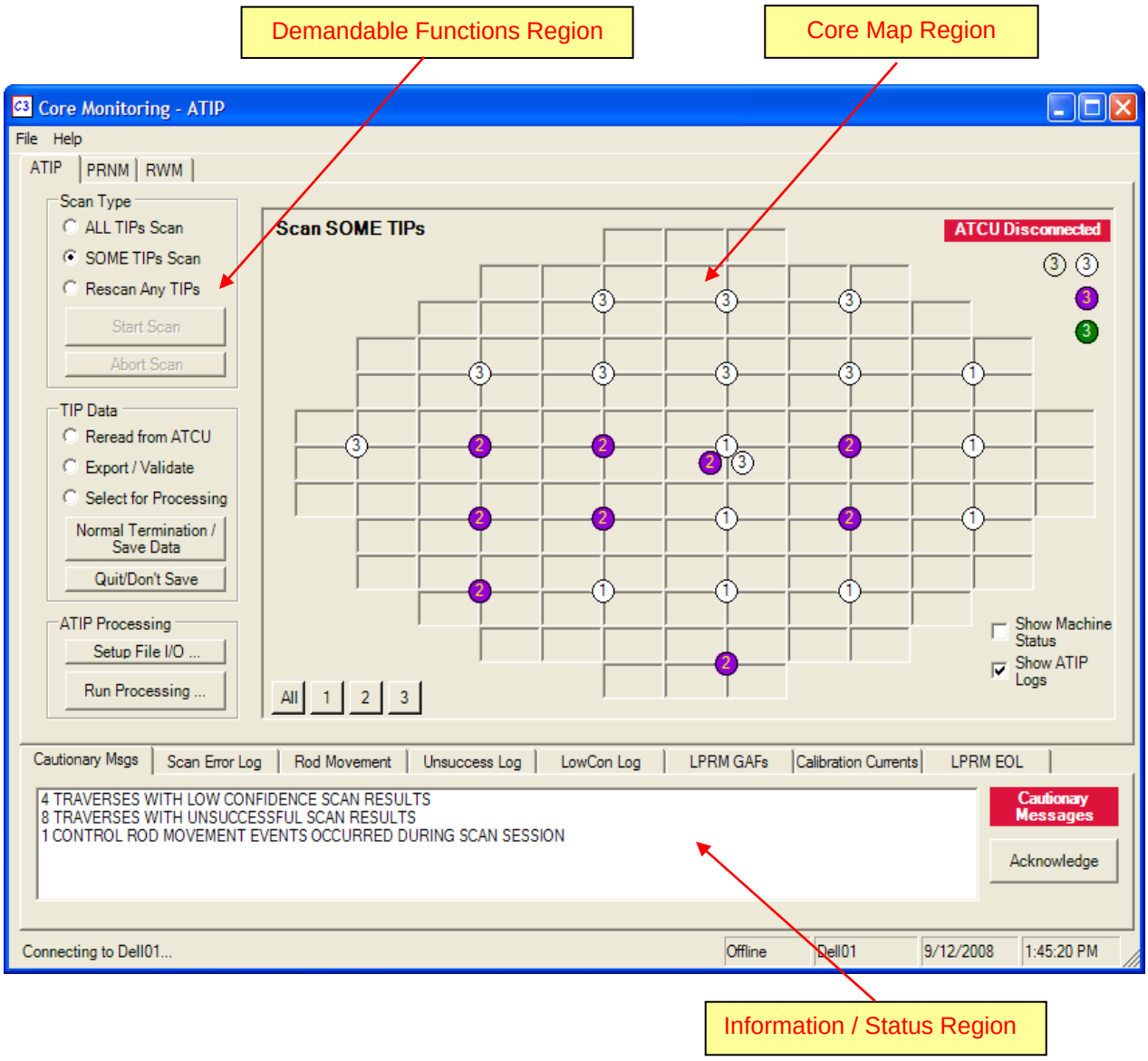


Figure 2

ATIP Function User Interface Window

Three User Interface Regions

Operational Parameters Display - Core Map
TIP Control & Analysis Demandable Functions
TIP Scan Progress Information/Status

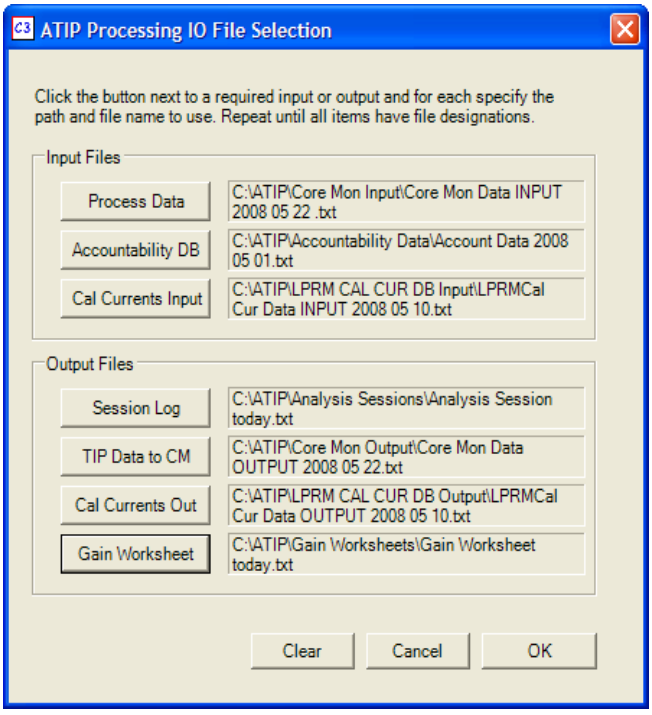


Figure 3

ATIP Processing File Selection Window

Used to set up the input and output files that are required for TIP processing. It should noted that the TIP Scan data file is not required as input because the scan data is already part of the ATIP database and will be read directly out of it when required.

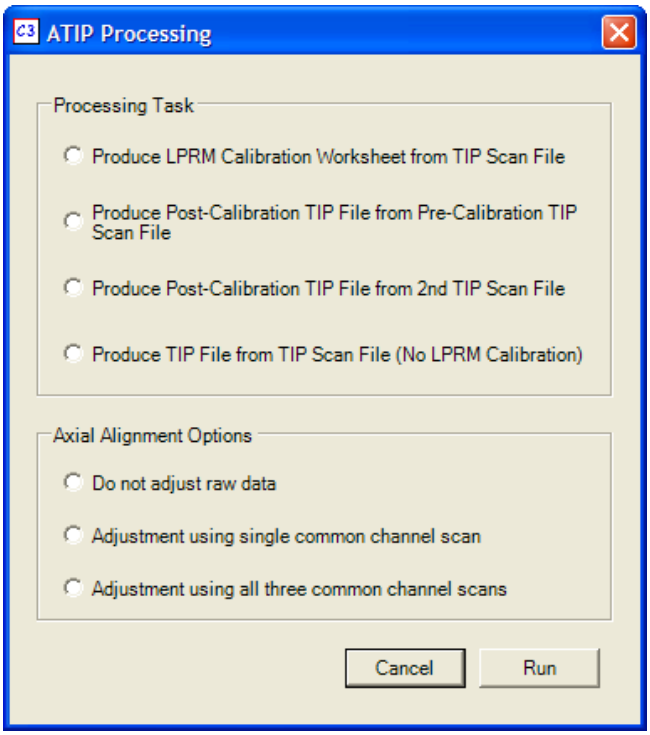


Figure 4

ATIP Processing Selection Window

Used to select a TIP processing tasks for previously identified input and output files. Primary purpose of the various analysis tasks is to produce a TIP file for use by the Core Monitoring System. Also, LPRM calibration current information from the LPRM database is accessed and updated for use in processing information to make the TIP file.

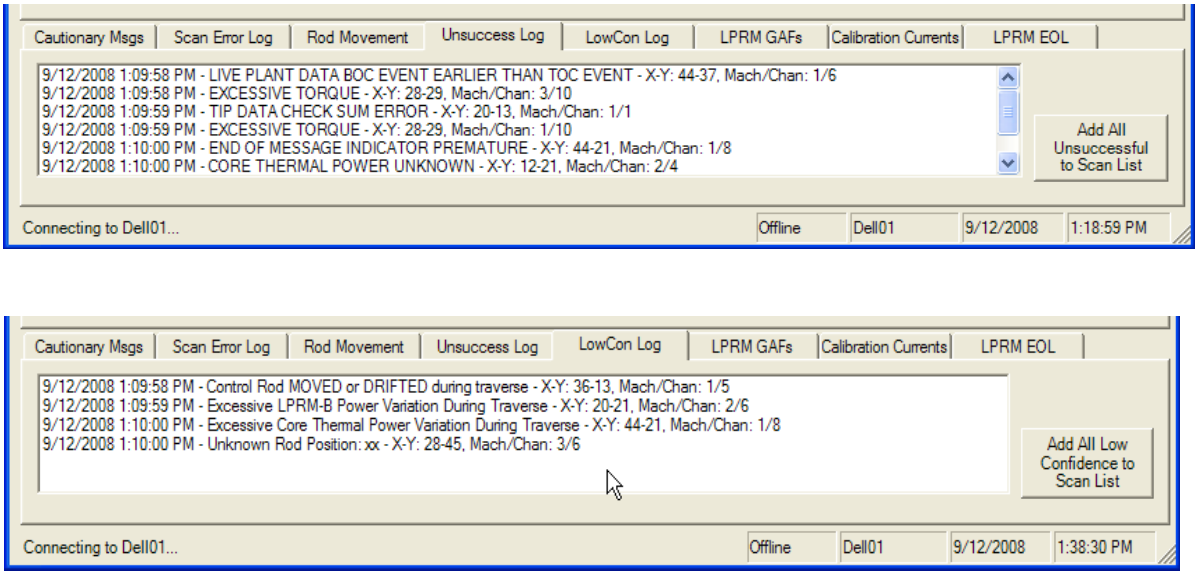
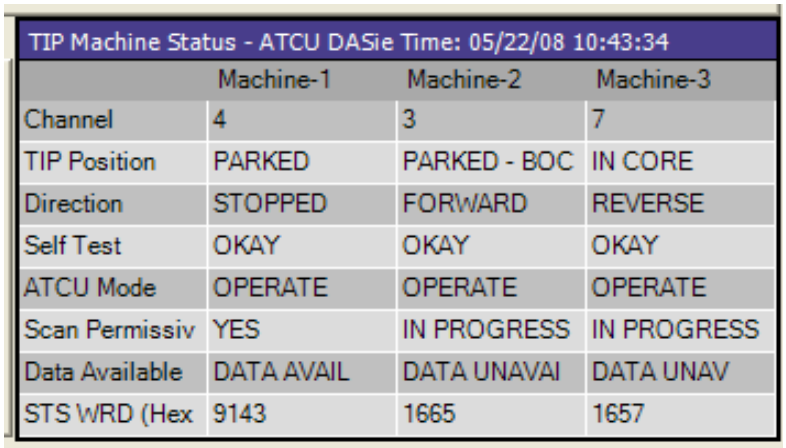


Figure 5.

TIP Scan Progress Information / Status Region
Unsuccessful Log and Low Confidence Log Tabs Illustrated



TIP Machine Status - ATCU DASie Time: 05/22/08 10:43:34

	Machine-1	Machine-2	Machine-3
Channel	4	3	7
TIP Position	PARKED	PARKED - BOC	IN CORE
Direction	STOPPED	FORWARD	REVERSE
Self Test	OKAY	OKAY	OKAY
ATCU Mode	OPERATE	OPERATE	OPERATE
Scan Permissiv	YES	IN PROGRESS	IN PROGRESS
Data Available	DATA AVAIL	DATA UNAVAI	DATA UNAV
STS WRD (Hex	9143	1665	1657

Figure 6.

TIP Machine Status Information Box