General Specifications

Model NTPC021
Exaquantum Production Accounting

GS 36J40C20-01EN

■ GENERAL

Exaquantum Production Accounting (Exaquantum/mPower) is a set of cooperating software modules that provide management reports based on mass and energy flows and inventories within and around industrial plants. These reports are fed automatically by data gathered from contributing systems such as data historians/PIMS (e.g. Exaquantum) and laboratory systems/LIMS (e.g. LabWare, etc.), augmented by calculations carried out within Exaquantum/mPower itself.

Exaquantum/mPower models the physical plant with a software object structure that understands the key concepts of material location, plant connectivity and containment. It uses this structure to provide built-in mass and energy balancing using data reconciliation so as to extract the maximum amount of reliable information from the available measurements.

Reporting simply requires the user to define any desired physical or time boundaries. Once this is done the reports themselves are self- configuring, since they also make use of the underlying model structure,

Exaquantum/mPower contains model elements and thermodynamic data which support the calculations required to produce energy balances, including the effects of combustion and other chemical reactions.

Exaquantum/mPower normally reports over intervals of hours, days or years on the basis of data extracted at periods of minutes or hours. To ensure data availability for longer periods, it maintains its own history repository.

For the Exaquantum/mPower's Model-based Movement Monitoring General Specification, please read document 'GS 36J40C12-01EN'.

■ KEY FEATURES

Key features include the following:

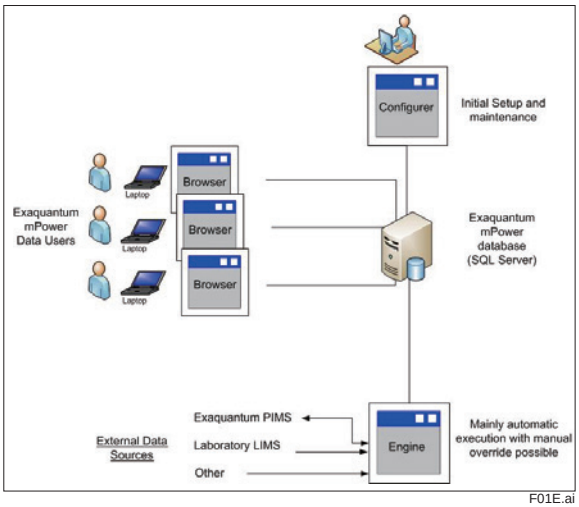
- Easy to use client Browser
- Ability to run both in real time and retrospectively, which means that late arriving or historically corrected data can be retrieved and used to overwrite Exaquantum/mPower's previous calculations and history
- Manual data inputs accepted
- Simple Report Selection files let users save and reuse report criteria for all report types
- Powerful History Browser including easy to use built-in correlation and regression functions
- Mass and energy balancing at run time to infer missing values
- Automatic mass and energy balance reports available
- Reconciled macro-scale balancing reports using data reconciliation with no additional configuration
- Automatic Production Accounting reports including data closure functionality

■ BENEFITS

Key benefits include the following:

- Reliable, flexible and timely management reports
- Simultaneous mass and energy balancing extracts maximum information from available measurements
- Data reconciliation improves reporting accuracy
- Mass balancing with data reconciliation highlights process or instrument problems
- Mass balancing with data reconciliation highlights gross errors or omissions prior to data closure and production of Production Accounting reports
- Choice of Production Accounting areas and materials enables standard Production Accounting reports to be used for Feed/Yield/Consumption/Stock, etc.

■ ARCHITECTURE



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A single Configurer can be used to define the Exaquantum/mPower Production Model, which is held in a relational database. Many users may have a copy of the Browser software, which is used for analysis and reporting.

The Exaquantum/mPower calculation engine runs at regular intervals. It takes relevant data from the subsidiary systems, including manual inputs, and updates the histories in the Exaquantum/mPower database. If it encounters problems, for example if LIMS data has been changed for a period where production accounting has already been declared 'closed', then automatic recalculation with revised values can be arranged.

YOKOGAWA

Yokogawa Electric Corporation
2-9-32, Nakacho, Musashino-shi, Tokyo, 180-8750 Japan

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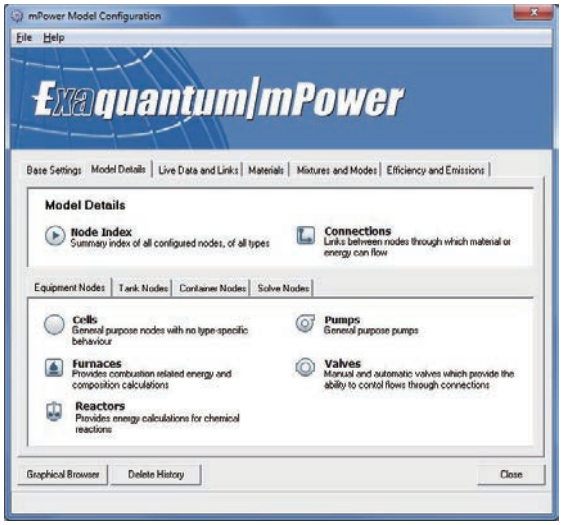
■ FUNCTIONAL OVERVIEW

● Configurer

Configuration is a specialized engineering function that normally occurs only at the start of the project.



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The Production Model is defined at a basic level in terms of a network of nodes (which represent plant equipment) joined together by connections. This model will normally follow the physical layout of the plant but it is important to note that it is sensible to model only those items that are necessary to give the final reports required, and that it is possible to create non-physical items to assist with this if convenient. This normally results in great simplification when compared with typical P&ID diagrams.

The simplest node to which a connection may be attached is the cell which acts mainly as a simple junction of flows, but a variety of other nodes types are available to build up a model of the plant with much more sophistication and knowledge than would be inherent in a basic cell-and-connection structure. Specialized nodes include tanks, furnaces, reactors, valves, etc.

The model can be configured using forms accessed from the screen illustrated above, or the configuration can be imported from and manipulated in Excel spreadsheets where bulk additions and changes are simple to apply.

When the model is completed it will have an understanding of:

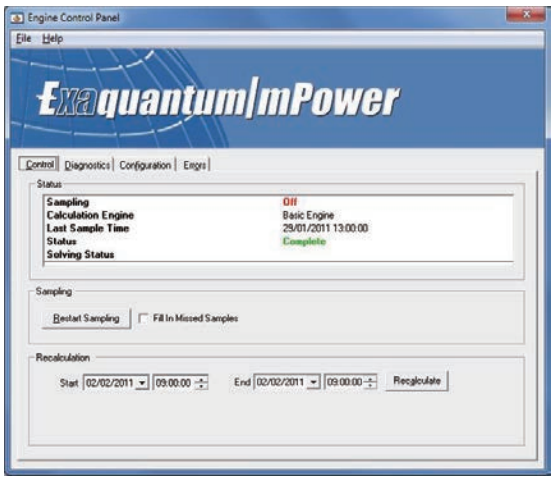
- Which nodes are linked to which nodes by which connections
- Which nodes are contained by other nodes
- Which sub-areas should be used for mass and energy balance calculations
- What materials will be found in any node or connection in any operational mode
- How to find the measurement data that relates to the model.

● Engine

The Exaquantum/mPower Engine is usually run in an unattended mode, scanning the contributory data systems at regular intervals. Typically this might be every hour, but the interval can be longer or shorter (within limits) if required. The Engine transfers the data it gathers into the Exaquantum/mPower histories, adding in the results of any calculations and data reconciliation carried out en route.

The Engine contains intelligence to recalculate its own data if incoming information (especially from laboratory systems) corrects previous data assumptions. This happens automatically unless the new data would cause a recalculation of dependent data that had already been declared as ‘closed’ for Production Accounting.

An engine control screen is provided as shown below.



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An authorized engineer may start and stop the Engine and may request a manual recalculation (including data gathering from contributory systems) over any period of time. The engineer also has the authority to instruct the Engine to remove any closed statuses and overwrite the previous data. The Engine should only be manipulated by a skilled plant engineer.

● Exaquantum/mPower Client Interface

This interface is the day-to-day tool accessed by most users.

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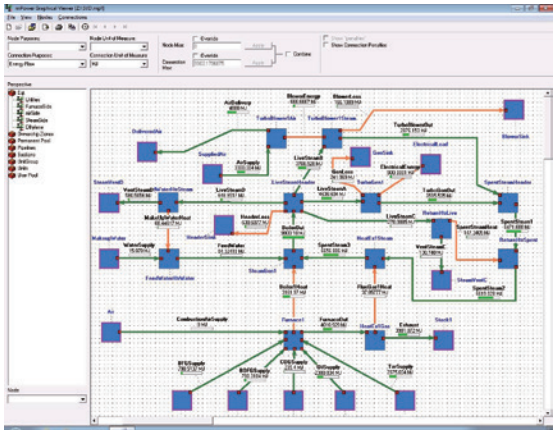
Most of the forms available in the Configurer are also available in the Browser (in read-only form) for reference purposes, but the most important part of the Browser are the powerful Historical Data Browsing functions, which can be seen in the ‘History Data’ tab (above).

● History Browser

The History Browser gives users access to the historical values either as simple listings or as graphical plots, or as displays, such as shown below:



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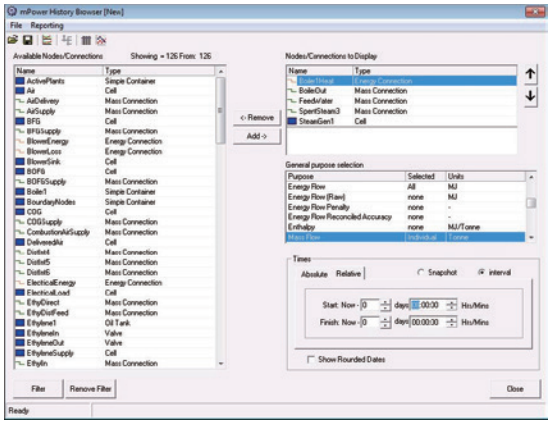
General data access is available via a selection screen:



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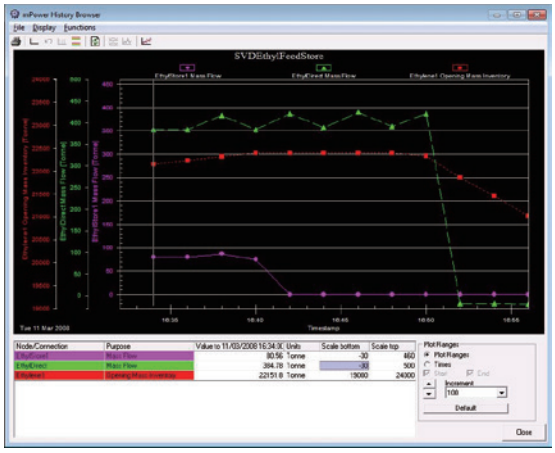
Having chosen the time period and the desired parameters (which are defined in plain language such as ‘Tank1.waterlevel.’), the user then chooses the form of display – data listings, or single or stacked trend graphs. The graphs are highly configurable providing capabilities such as pan, zoom, hide axes, common or separate axes, etc.



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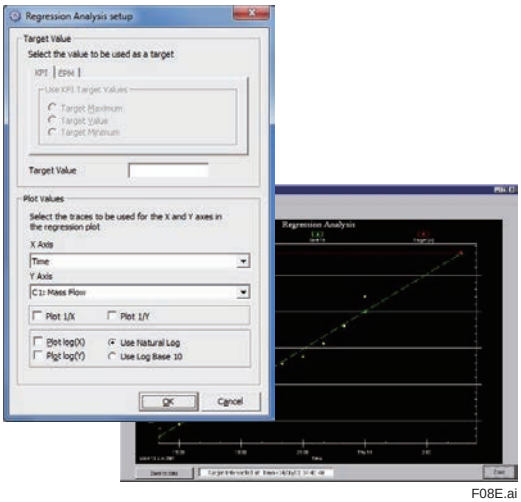
From a single graph screen it is possible to request a regression of the points plotted (via a subsidiary screen) so that the approach to targets may be predicted.



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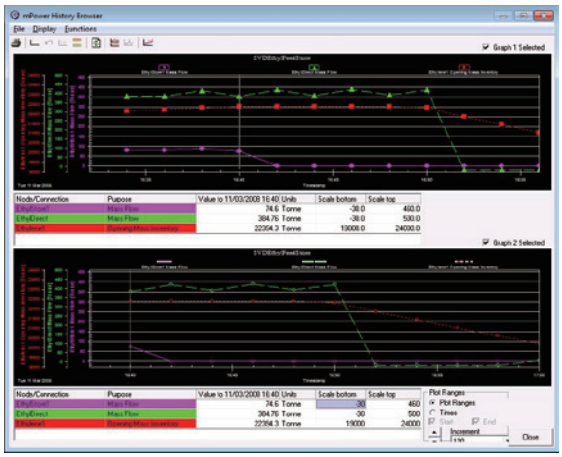
The stacked graph plot (see below) gives users an opportunity compare similar events from different time periods. A tool is provided to snap the traces into the best horizontal alignment, on the basis of the correlation function (below).



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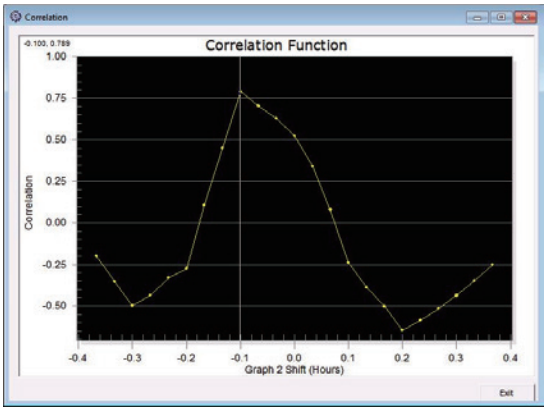

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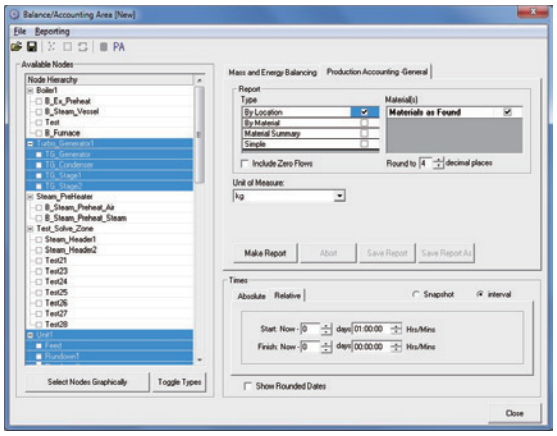
● Production Accounting Reports

There are several varieties of Production Accounting Report whose detail can be changed by picking appropriately from the Production Accounting – General tab as shown below.



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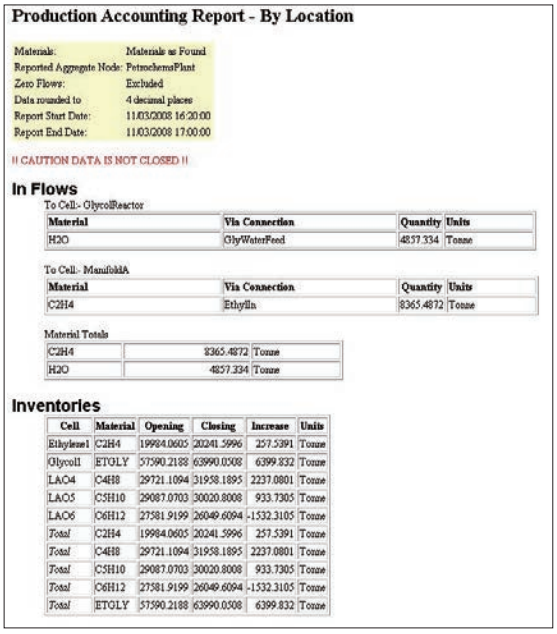
The reports show the inventories of material present in each tank in the selected part of the plant, and also the changes of inventory and the total flows of these materials in and out of the selected part of the plant during the chosen report period. They are presented in a web-style report similar to that shown next.



Production Accounting Report - By Location

Materials:	Materials as Found
Reported Aggregate Node:	PetrochemsPlant
Zero Flows:	Excluded
Data rounded to	4 decimal places
Report Start Date:	11/03/2008 16:20:00
Report End Date:	11/03/2008 17:00:00

!! CAUTION DATA IS NOT CLOSED !!

In Flows

To Cell:- GlycolReactor

Material	Via Connection	Quantity	Units
H2O	GlyWaterFeed	4857.334	Tonne

To Cell:- ManifoldA

Material	Via Connection	Quantity	Units
C2H4	Ethylln	8365.4872	Tonne

Material Totals

C2H4	8365.4872	Tonne
H2O	4857.334	Tonne

Inventories

Cell	Material	Opening	Closing	Increase	Units
Ethylene1	C2H4	19984.0605	20241.5996	257.5391	Tonne
Glycol1	ETGLY	57590.2188	63990.0508	6399.832	Tonne
LAO4	C4H8	29721.1094	31958.1895	2237.0801	Tonne
LAO5	C5H10	29087.0703	30020.8008	933.7305	Tonne
LAO6	C6H12	27581.9199	26049.6094	-1532.3105	Tonne
Total	C2H4	19984.0605	20241.5996	257.5391	Tonne
Total	C4H8	29721.1094	31958.1895	2237.0801	Tonne
Total	C5H10	29087.0703	30020.8008	933.7305	Tonne
Total	C6H12	27581.9199	26049.6094	-1532.3105	Tonne
Total	ETGLY	57590.2188	63990.0508	6399.832	Tonne

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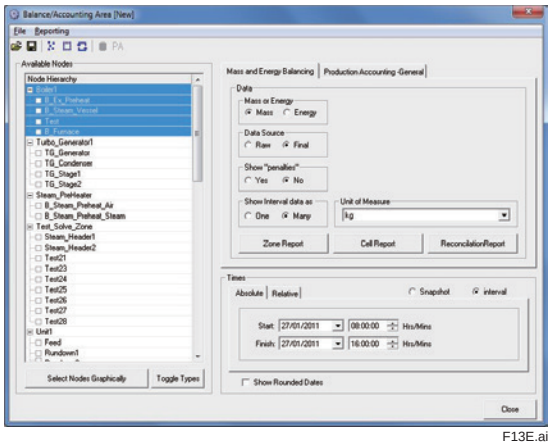
● Balance Reports

Many Balance Report options may be chosen from the Mass and Energy Balancing tab as shown below



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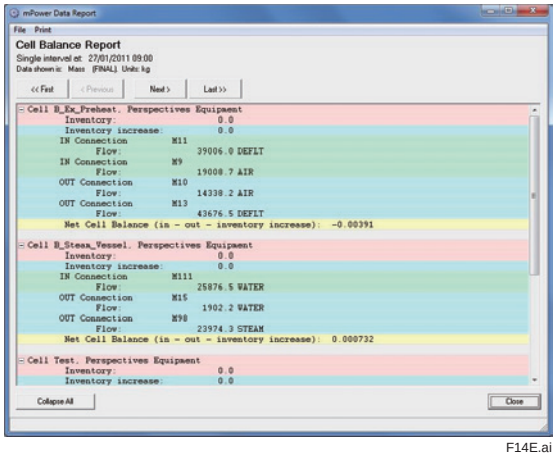
Options exist to select the time period covered by the report, the part or parts of the plant to be covered by the report, and whether to show mass or energy data, raw or final data, and subdivided or accumulated data. The resulting Balance Reports have formats similar to the following.



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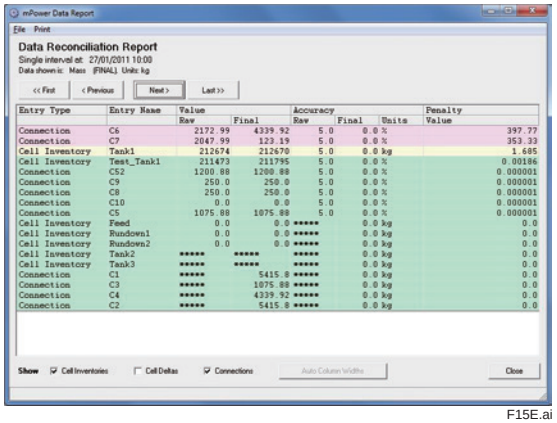
Evidence of poor measurements is displayed in the reconciliation report in which individual balance data are ordered by the size of adjustments required to obtain the overall balance.



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■ GLOSSARY OF TERMS

Term	Definition
Data Reconciliation	Statistically-based adjustment of measured data values in situations in which more than one source of measurement for the same quantity exists and disagreements between the sensors are present.
Energy Balancing	Calculation of energy flows and inventories entering, leaving and being stored in different parts of a plant, including the release and consumption of energy as a result of chemical reactions. Application of the laws of conservation of energy to derive unmeasured energy flows.
Loss Accounting	Presentation of mass and energy balancing results so as to highlight losses (or gains) caused by physical losses or by instrumentation errors.
Mass Balancing	Calculation of mass flows and inventories entering, leaving and being stored in different parts of a plant. Application of the laws of conservation of mass to derive unmeasured mass flows.
Movement Monitoring	Full quantitative monitoring of the intermittent flows which typically take place between such things as storage tanks and material receipt/ dispatch locations.
Node	A junction between connections in a topological model of an industrial plant. Nodes may represent physical equipment such as a tank, a valve or a pipe junction, or they may represent parts of equipment such as the run down outlets from a processing unit, of they may represent virtual equipment such as the boundary of an industrial plant.
Production Accounting	Tabulation of the receipts, inventories and dispatches of individual (or summed) materials processed in an industrial plant over selected periods of time.

■ HARDWARE AND SOFTWARE REQUIREMENTS

Table: Minimum Hardware Specification

Component	Hardware Specifications
Exaquantum/mPower Server	2.8 GHz multi-core processor 4 Gbytes RAM 600 Gbytes disk
Exaquantum/mPower Clients	2.2 GHz Pentium processor 2 Gbytes RAM 4 Gbytes disk CRT resolution: 1024 × 768

Table: Minimum Software Specification

Component	Software Specifications
Exaquantum/mPower Server	Exaquantum R2.50 Windows Server 2003 Standard Edition R2 with SP2 or Windows Server 2003 Standard Edition with SP2 or Windows Server 2008 Standard Edition, optionally with SP2 (32- bit version only) Internet Explorer 7 or 8 Internet Information Services (IIS)
User PCs	Windows XP Professional (SP3) or Windows Vista (Business Edition) (SP1, SP2) or Windows 7 Internet Explorer 7 or 8

Exaquantum/mPower can be installed on a fully functional Exaquantum PIMS (Plant Information Management System) server or installed on its own dedicated server.

If mPower will be installed on a different version of Exaquantum, please contact Yokogawa for assistance.

■ MODELS AND SUFFIX CODES

Exaquantum/mPower Product

		Description
Model	NTPC021	Exaquantum/mPower Productt
Suffix Codes	-S	Basic Software License
	1	New Order (with Media)
	1	Always 1
	-0020	Twenty Nodes License
	-0050	Fifty Nodes License
	-0100	One Hundred Nodes License
	-0200	Two Hundred Nodes License
	-0300	Three Hundred Nodes License
	-0500	Five Hundred Nodes License
	-YYYY	Select an Option Code
Option Codes	/DR	Data Reconciliation License
	/PA	Production Accounting License
	/N□□	Enter the number of additional groups of 100 nodes (1 - 99)
	/P□□	Enter number of additional Exaquantum/mPower per-seat Client Licenses (01 - 99)
	/C□□	Enter number of Exaquantum/mPower 2:1 concurrent Client Licenses (01 - 99)

Maintenance Service for Exaquantum/mPower

		Description
Model	SV3NTMC021	Maintenance Service for Exaquantum/mPower
Suffix Codes	-S	Basic Software License
	1	New Order (with Media)
	1	Always 1
	-0020	Twenty Nodes License
	-0050	Fifty Nodes License
	-0100	One Hundred Nodes License
	-0200	Two Hundred Nodes License
	-0300	Three Hundred Nodes License
	-0500	Five Hundred Nodes License
	-YYYY	Select an Option Code
	-N	New
	-R	Renewal
Option Codes	/DR	Data Reconciliation License
	/PA	Production Accounting License
	/N□□	Enter the number of additional groups of 100 nodes (01 - 99)
	/P□□	Enter number of Exaquantum/mPower per-seat Client Licenses (01 - 99)
	/C□□	Enter number of Exaquantum/mPower 2:1 Concurrent Client Licenses (01 - 99)

■ ORDERING INFORMATION

Specify model and suffix codes.

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