TERMINAL AUTOMATION SYSTEM

Past, Present & Future Trends in BPCL Terminals

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A FINAL DISSERTATION REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTER OF TECHNOLOGY (PETRO INFORMATICS) OF UNIVERSITY OF PETROLEUM AND ENERGY STUDIES, INDIA

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CERTIFICATE OF ORIGINALITY

This is to certify that the dissertation report on

"TERMINAL AUTOMATION SYSTEM"

submitted to the University of Petroleum & Energy studies, Delhi, by **Puneet Singh**, in partial fulfillment of the requirement for the award of the degree of **Masters of Technology (Petro Informatics)**, is a bonafide work carried out by him under my supervision and guidance. This original work was carried during 15/02/2006 to 7/05/2006 at **UPES**, New Delhi.

Date: 8/05/2006

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ABSTRACT

Terminal Automation System provides safe and efficient monitoring & control of all aspects of marketing terminal operations including loading, invoicing and reporting. It adopts a client-server architecture interfaced with hardware devices in the field. The server system manages the complete ordering procedure from assignment of order for loading to monitoring and control of loading procedure.The client system facilitates the operator and graphical interfaces and allows for manual data input and display of the field event in real-time.

TAS will operators to view the loading process and quickly be alerted to any abnormal conditions. Alarms are time-stamped and logged for further analysis. Daily reports can also be generated to provide information to the management.TAS include the following modules:

- Order Management
- Inventory Management
- Tank Farm Control
- Loading Operations
- System Management
- Report Generation
- Internet Access Capability
- Security access
- Product Return
- Company Own Consumption
- Document Management systems
- Accounting systems

SCOPE OF THE PROJECT

The Terminal visited for Dissertation Study was Mathura Terminal, BPCL. It's an Inland automated terminal. The main operations performed at the terminal were Receipt, Storage & Dispatch. The main departments in the terminal were Operations, Finance, Health.& Safety Environment, & Human Resource Management.

Dissertation Study was done for the past, present & future trends that were followed at the Terminal. Detailed study was done in the following areas:

1. Working of the terminal in the past & how operations were performed manually

2. The Terminal Automation System presently installed at the terminal helps in :

    - Better inventory control & management
    - Improved Reliability
    - Simplified controls
    - Safety improvement
    - Increased accuracy
    - Report generations

3. Detail Study of available Automation system
4. Digital Terminal Automation System
    - Acquisition and processing of information about the process and equipment at the terminal;
    - Emergencies, process deviation, equipment failures detection and alarm;

- Controlled and design variables and events registration (including operator's actions) and their automatic archiving in the database;

5. Future plans were regarding On- line Terminal Audit & Certification System. This TACSYS System will equip the managers of the terminals to audit the terminals on-line & issue the certifications to the terminals. These on-line audits & certifications issued will be directly available to the Head-Quarters of BPCL.

About BPCL

History

In 1860, an important player in the South Asian market was Burmah Oil Company. Though incorporated in Scotland in 1886, the company grew out of the enterprises of the Rangoon Oil Company, which had been formed in 1871 to refine crude oil produced from primitive hand dug wells in Upper Burma.

In 1928, Asiatic Petroleum (India) joined hands with Burmah Oil Company - an active producer, refiner and distributor of petroleum products, particularly in Indian and Burmese markets. This alliance led to the formation of Burmah-Shell Oil Storage and Distributing Company of India Limited.

On 15th October 1932, when civil aviation arrived in India, the company had the honour of fuelling J.R.D. Tata's historic solo flight in a single engined de Havillian Puss Moth from Karachi to Bombay (Juhu) via Ahmedabad. Thirty years later, i.e. in 1962, Burmah Shell again had the privilege to fuel JRD Tata's re-enactment of the original flight. Burmah Shell also fuelled flying boats, which carried airmail at slightly higher rates than sea transport, at several locations.

An agreement to build a modern refinery at Trombay, Bombay was signed between the Burmah Shell group of companies and the Government of India on 15th December 1951.

Burmah Shell Refineries Limited was incorporated as a private limited company under the Indian Companies Act on 3rd November 1952, and work began on the marshland of Trombay at Bombay. Man and machine worked relentlessly, and soon the swamps gave way to towers and tanks of steel, and miles of pipeline.

The refinery on 454 acres of land at village Mahul went on-stream on 30th January 1955, one year ahead of schedule. Dr. S. Radakrishnan, Vice President of India, declared the

2.2 MMTPA (Million Metric Tonnes Per Annum) Refinery open on 17th March 1955. It was then the largest refinery in India then.

On 24th January 1976, the Burmah Shell Group of Companies was taken over by the Government of India to form Bharat Refineries Limited. On 1st August 1977, it was renamed Bharat Petroleum Corporation Limited. It was also the first refinery to process newly found indigenous crude (Bombay High), in the country.

In 1996, Bharat Petroleum went through a process of visioning, involving people at all levels, which evolved a shared vision and a set of shared values. Based on this, the company restructured itself, in a proactive move to adapt to the emerging competitive scenario. The function-based structure was carefully dismantled and replaced with a process-based one. This made the company more responsive to its customer needs.

Bharat Petroleum realises that, in the long run, success can only come with a total reorientation and change in approach with the customer as the focal point. Today, Bharat Petroleum is restructured into a Corporate Centre, Strategic Business Units (SBUs) and Shared Services and Entities. The organisational design comprising of five customer facing SBUs, viz. Aviation, Industrial & Commercial, LPG, Lubricants and Retail and one asset based SBU, viz. Refinery, is based on the philosophy of greater customer focus.

Technological Edge

Bharat Petroleum is the first Public Sector Oil Company to implement Enterprisewide Resource Planning (ERP) solutions - SAP. The implementation project known as ENTRANS (Enterprisewide Transformation) has been awarded the 'SAP Star Implementation Award', with Bharat Petroleum having the distinction of executing the largest and the most ambitious SAP project in India. The challenge of SAP implementation was to ensure that all the integrated elements (of the complex multi-modular integrated solutions that impact the entire workflow of the organisation) work seamlessly across the length and breadth of the country, including the remote locations. Providing online connectivity in these remote locations, given the full-fledged IT network infrastructure, was in itself a daunting task.

Bharat Petroleum is reaping the benefits of the integrated system in many areas of its operations. The early gains of implementation are in the areas of tracking customer-receivables, monitoring credit-management, inventory management, besides easing the operations in a large number of areas.

With SAP as the IT backbone, Bharat Petroleum plans to take advantage of the Internet based capabilities along the entire value chain with a Customer Relationship Management solution. A large data warehouse project has also been implemented, which facilitates access to real-time accurate information on key performance indicators at all Bharat Petroleum locations. This enables the management to take strategic and business decisions, thus ensuring value-added services, better customer satisfaction and enhanced shareholder value.

TERMINAL OVERVIEW

A Terminal/ Depot is an installation of a petroleum marketing company used for storage & distribution of products in a particular region or location.It's a cost centre in a supply chain where its primary function is the receipt of products and their supply to retail outlets in the territory or industrial bulk consumers.

Product receipt/dispatch is done through:

- Pipelines
- Railway wagons
- Tank lorries
- Ships (Coastal locations)

Terminal involves various business processes proceeding to deliver fuel to retail outlet. It involves forecourt management, fuel and non-fuel stock support, support of credit debit fleet/loyalty cards and interface to a wide range of head office applications. Managing all of these elements effectively requires efficient communication with headquarters, financial institutions and company own petrol pump.

A typical location usually comprise of the following installations:

- Pipeline Tap-off Point/ Manifold (depending on mode of product receipt)
- Storage Tanks
- Railway siding (depending on mode of product receipt)
- Jetty & pipeline facilities (coastal locations)
- Tank lorry filling gantry
- Product Quality Lab
- Power Generation Plant
- Fire Fighting facilities
- Administrative Offices etc.

Terminal involves:

- ***Supply chain management*:** Refinery procures the crude depending on demand from terminal, performs processing (refining) and then distributes the products (fuel) to terminals. Terminal receives the fuel, stores it and dispatches it to retail outlets.
- ***Planning and scheduling:*** In order to procure right amount of fuel, terminal must have proper information about sales pattern and demand forecast. After procuring fuel from refinery, terminal needs to dispatch the product depending on invoice raised from retail outlets. For this it requires *network planning* in order to find out the optimum solutions for dispatching its quantity so that to avoid run-out at some retail outlets and retain at others.
- ***Fleet management*:** Logistics manage how and when to move fuel to the locations they are needed.
- ***Inventory management*:** In order to capture real time inventory status of various products such as MS, HSD and other premium brands, inventory management is required.
- ***Accounting*:** Daily consumption data, receipt record, dispatch or sales data and inventory data are recorded to perform accounting.

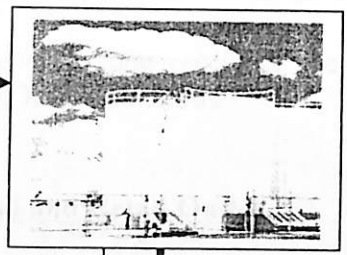
SUPPLY CHAIN PICTORIAL REPRESENTATION

REFINERY

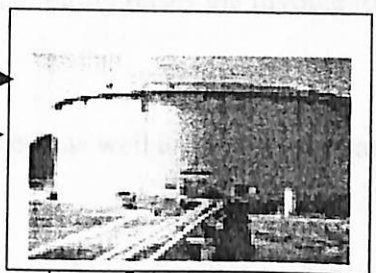


TERMINAL

Logistics



DEPOT

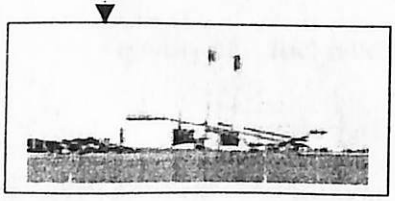


RETAIL OUTLET

Logistics



INDUSTRIES



INTERFACES BETWEEN DIFFERENT ENTITIES

Between Terminal And Refinery

- *Stock information*: Terminal sends its inventory status information to refinery.
- *Demand supply information*: Based on sales data available, terminal forecasts future demand and raises invoice for appropriate quantity.
- *Custody transfer report*: Terminal checks the quantity and quality of the product received and, if appropriate, sends the acknowledgement to the refinery.

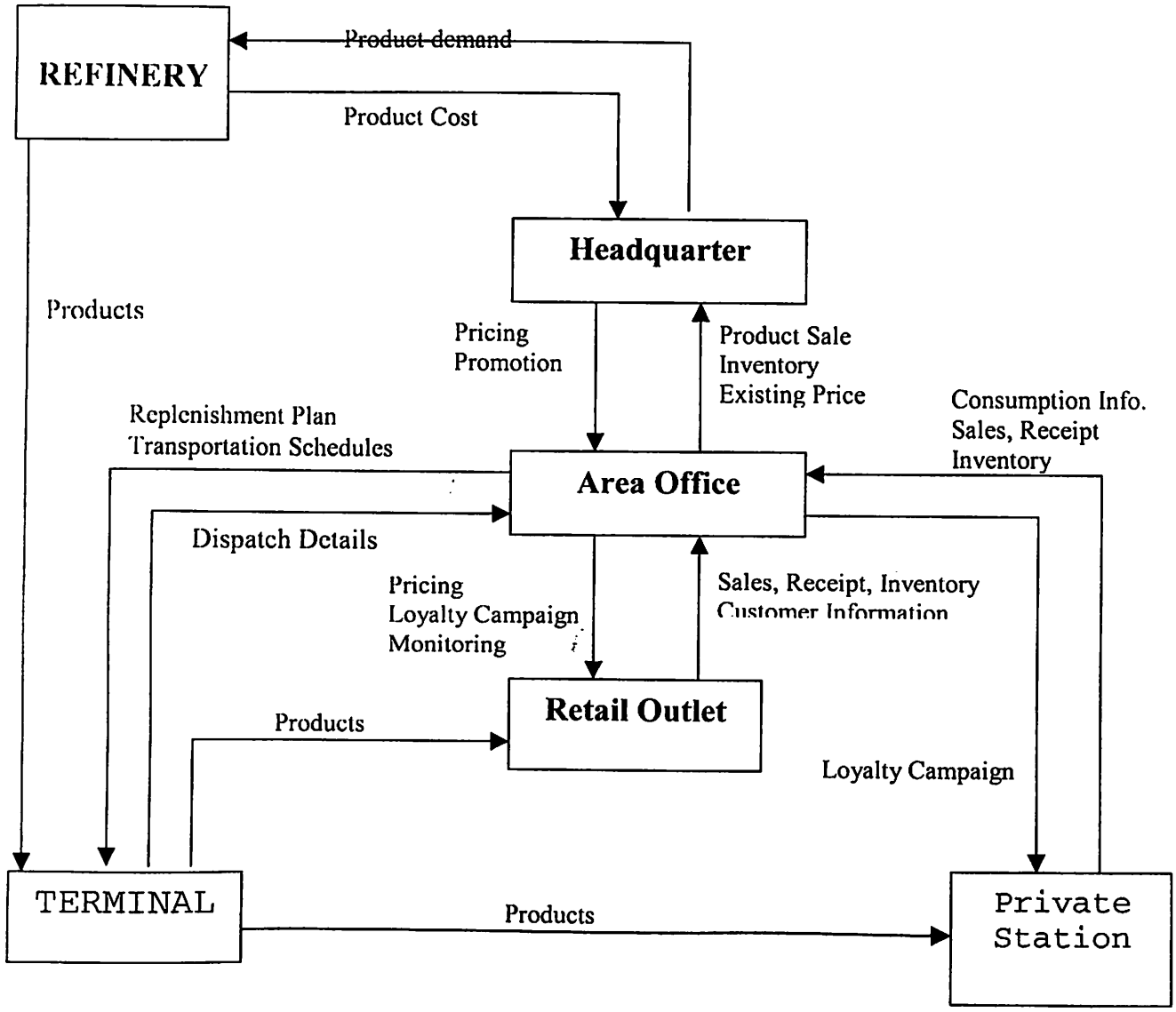
Quality testing report: Upon receiving the products, terminal checks the quality of fuel received and keeps it in the records

Between Terminal and Retail Outlet

- *Stock information*: Retail outlet sends its inventory status to terminal /depot.
- *Demand & supply information*: Retail outlet raises the invoice for procuring fuel.
- *Sales report*: Total sales of a day, week as well as month are sent to depot/terminal.
- *Custody transfer report*: Retail outlet checks the quantity and quality of the fuel received to make sure fuel meets required specifications. It sends the acknowledgement to the depot.
- *Quality testing report*: Upon receiving the products, Retail outlet checks the quality of fuel received and keeps it in the records.

- Products (fuels) are dispatched from the refinery to primary distribution centers; either to terminal or to depot, depending on invoice generated by Headquarter.
- Primary distribution unit receives the fuel and sends back custody transfer. On receiving fuel demand from retail outlet and private station, it dispatches the fuel. It sends the dispatch details to the area office and inventory and sales data to headquarter.
- Headquarter, after receiving the sales data and inventory status, predicts the demand and raises an invoice to refinery.
- Headquarter receives the fuel cost from refinery and conveys the retail selling price to retail outlets through area office.
- Primary distribution receives the transaction from private station and retail outlet.
- Private stations also convey their sales, inventory status and demand to area office.

SUPPLY CHAIN FLOW DIAGRAM



FLOW CHART EXPLANATION

- Products (fuels) are dispatched from the refinery to primary distribution centers; either to terminal or to depot, depending on invoice generated by Headquarter.
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- Headquarter, after receiving the sales data and inventory status, predicts the demand and raises an invoice to refinery.
- Headquarter receives the fuel cost from refinery and conveys the retail selling price to retail outlets through area office.

Primary distribution receives the transaction from private station and retail outlet.

Private stations also convey their sales, inventory status and demand to area office.

Need For Terminal Automation

An automation process is a set of logically related business activities that combine to deliver something of value (e.g. products, goods, services or information) to a customer. In other words, a set of tasks that accomplishes a business goal is a business process. Until the advent of **Automation,** processes were manually implemented.

Automation brings these significant benefits:

- *Reliability*: Automation of business process eliminates the need of human intervention and thus human errors, which brings more consistency in work.
- *Timeliness*: Business process automation also ensures the timely completion of tasks and reduces delay due to absence of operators and human errors.
- *Performance:* Due to timely completion and more consistency in business process, performance improves which brings more revenue.

Supervisory control: This is one of the greatest strengths of Automation. With a manual system, it is almost impossible to find the current status of any business process. It's common that processes are stuck because the person performing a task is on leave. Automation can provide a supervisory control on all the processes and all the tasks in the processes. Then it is easy for managers to identify bottlenecks and fix problems. Managers can also use automation to continually measure the time taken to complete tasks and business process. This kind of information is extremely useful in improving the overall operations of the company.

Terminal Automation System

Storage, receiving and dispatch of petroleum products from terminals is a vital part in which automation systems will play an important role by increasing productivity, reducing risks, improving safety and, saving time and cost.

TAS offer a comprehensive automation solution that empowers users with all the benefits of the latest Open Information System (OIS) architecture and more. It has a reservoir of in-depth expertise and information under its belt that allow a deeper understanding of process requirements as well as specific customer needs. The TAS solution offers smooth integration of business application with real-time process control to give users the competitive edge to meet market demands efficiently.

TAS offers a host of benefits to boost every aspect right from loading bay to the accounting office to offer as much or as little human intervention as you require.

Field-proven, comprehensive solution

TAS is a new-generation system that allows users to seamlessly integrate industry-standard databases like Oracle with corporate host management systems. It offers flexible features that can be easily adapted to meet individual customer requirements. All business, process and engineering features like:

- Terminal security
- Truck entry/exit
- Customer identification and authorization
- Inventory management
- Flow control
- Bill of Loading (BoL)
- Filling advice note (FAN) generation
- Truck status
- Bay queue/status

TAS is designed to automate all processes, and yet give complete fingertip control over any process, at any stage of the operation. Filling and other activities including stock reconciliation are automatic and carried out with a high level of accuracy, security and safety. Even though the system is totally fail-proof through use of redundant architecture; it also offers a high level of diagnostics to facilitate trouble-shooting, if ever required.

TAS uses never-before features like server redundancy based on multi-master replication with automatic changeover in less than 30 seconds for 100% reliability. It is a Windows NT-based real-time, multitasking, fast response, client-server system with three level UTP / fibre optic networking over TCP/IP and 10/100 Mbps connections. It offers optional SAP and web interfaces and OLEDB/ ODBC linkages for easy data exchange even from external modules. It also offers high degree of flexibility for customization as per customer specifications and easy connectivity to other databases. TAS comprises high-end PC/servers called Load Rack Computers (LRC), Tank Truck Entry System (TTES), Tank Farm Management System (TFMS) and Operator Interface Computer (OIC) all linked via highspeed dual 10/100 Mbps TCP/IP Ethernet (typical TAS configuration). This network is linked via high speed 10 MBPS MB Plus lines to the gateway and PLC that controls the gateway. The Tank Farm Management System analyzes level, pressure and temperature data from containers (bullets / spheres) from servo gauge or radar gauge and presents a graphical representation of this data to operator. Once a vehicle enters the facility, time of arrival and vehicle number is recorded in the LRC – which is the heart of the system on which databases are stored for instant access by other computers.

The status of all trucks is displayed on the TTES (Tank Truck Entry System) and accordingly the Filling Advice Note (FAN) is prepared and a card number is allocated to each vehicle. This information automatically gets downloaded onto LRC and a bay number is allocated to each vehicle.

Magnetic / proximity type / touch key smart Card Readers (CR) are used to verify authenticity of driver/vehicle at the gateway. The presence of a vehicle is sensed by

smart infra-red sensors and the opening/closure of gateways is done via PLC. The weight of empty vehicle is taken at the weigh bridge and this data is downloaded onto LRC. The vehicle proceeds to the appropriate bay, where FAN details are downloaded from the LRC onto the Batch Controller (BC). This smart system manages loading of rail tankers, rail cars and barges. It provides total control over all functions at loading gantry including pump and valve control, printing of bill of loading (BoL) etc. The BC features an interactive display which prompts users to take appropriate actions like:

Business requirement:

- Like entering valid card number...

Safety requirement:

- Like connecting earthing clips to ground the vehicle (to eliminate static charges).

Process requirement:

- Like connecting loading arm, etc.

Terminal Automation System (TAS) provides safe and efficient monitoring and control of all aspects of marketing terminal operations, including loading, invoicing and reporting.

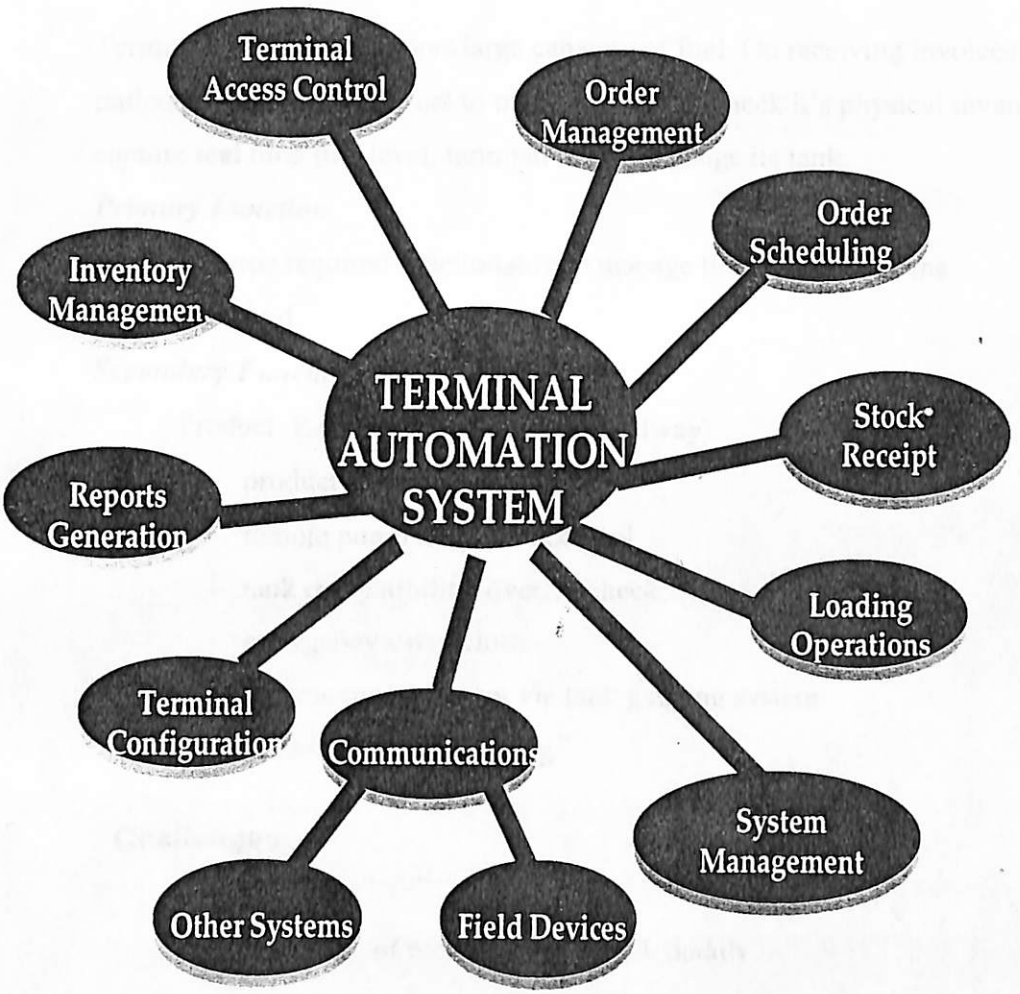
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Alarms are time-stamped and logged for further analysis. In addition, daily reports can be generated to provide information to management. TAS will operators to view the loading process and quickly be alerted to any abnormal conditions. Alarms are time-stamped and logged for further analysis. Daily reports can also be generated to provide information to the management.

TAS system will include the following modules:

- Order Management
- Inventory Management
- Tank Farm Control
- Loading Operations
- System Management
- Report Generation
- Internet Access Capability
- Security access
- Product Return
- Company Own Consumption
- Document Management systems
- Accounting systems

Terminal Automation System Modules



TAS MODULES – DETAILED EXPLANATION

1). Inventory Management at the Terminal

Terminal receives and stores large capacity of fuel. On receiving invoices from retail outlets, it dispatches the fuel to them. In order to check it's physical inventory and to capture real time fuel level, terminal needs to gauge its tank.

Primary Function

Provide required functionality to manage the Inventory of the Terminal.

Secondary Functions

Product Receipt (Ship, Pipeline, Railway)

- product receipt administration
- remote pump and valve control
- tank compatibility, overfill check
- emergency valve close
- volume measurement via tank gauging system
- product receipt reporting

Challenges

- Tracking of receipt and dispatch details
- Accurate and real time inventory data
- Reconciliation of actual inventory and system records
- Safety precautions

IT Enabler

Petro Tag System

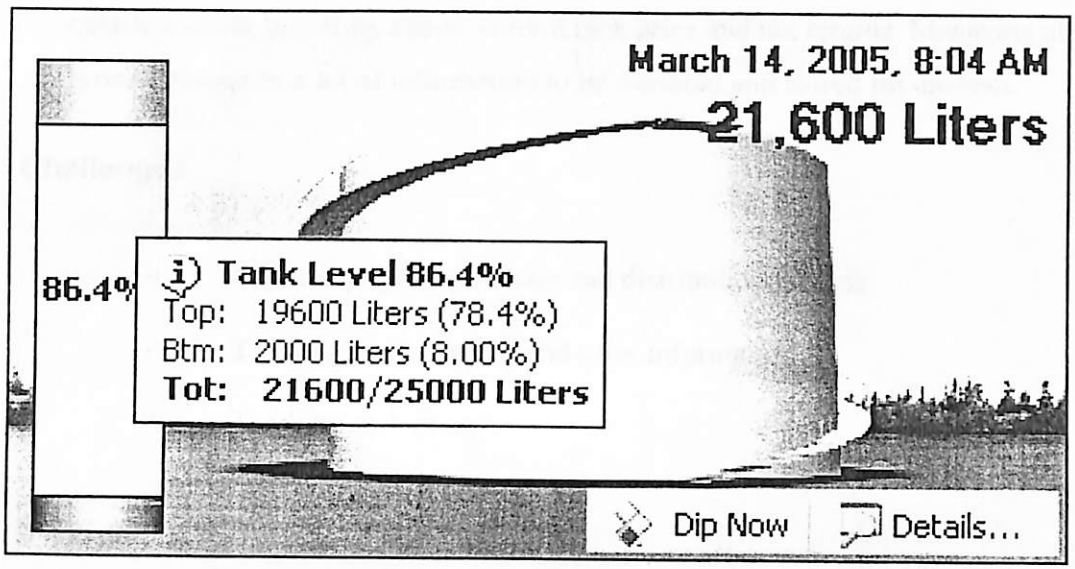
The PetroTag Tank Gauging System is versatile, accurate, easy to install, and very competitively priced. It can measure temperature, corrected height, volume, mass and density with a single sensor probe. It's a stand alone system which can also be connected to a remote computer via a suitable communications channel. It does all measurement and calculation in its own controller. PetroTag sensor is operated by nitrogen gas and the controller is outside the hazardous area it does not require explosion proof cabling and is therefore inexpensive and easy to install.

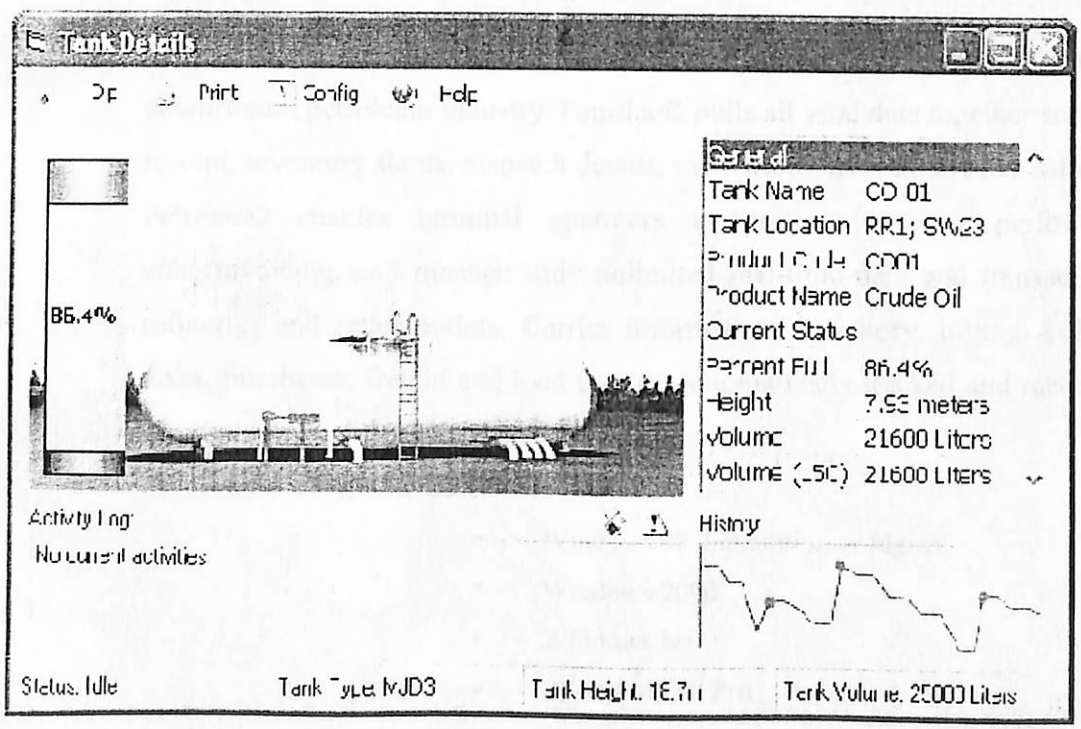
This system helps in:

- Dealing daily with reconciling and accounting for stock levels
- Tracking pipeline receipts and shipments
- Reporting inventory levels across business operations
- Complying with regulatory issues, such as tank overfill protection
- Maintaining safer working environment and reduce personnel exposure

Terminal Inventory data sheet										
Date	Product	Tank 1	Tank 2	Tank 3	Tank 4	Receipt	Stock	Total inventory	Sales	Net Stock
	MS									
	Branded MS									
	HSD									
	SKO									

Petro Tag System





2). Accounting at the Terminal

Terminal has to maintain all the records such as invoice received from RO, dispatch details, current inventory status, current rack price and tax returns. Managing all these processes require a lot of information to be captured and stored for analysis.

Challenges

- Maintaining fuel purchase and distribution records
- Tracking truck loading and sales information
- Tracking rack price

Solution

Petrolac

Petrolac© is a complete accounting and inventory management solution for downstream petroleum industry. Petrolac© pulls all vital data together such as fuel receipt, inventory status, dispatch details, rack prices, as well as sales information. Petrolac© enables terminal operators to produce reports, perform order entry/invoicing, and manage truly unlimited real-time data and transaction with refineries and retail outlets. Carrier information, inventory, billing, collections, taxes, purchases, freight and load fees are automatically tracked and recorded into a system for analysis.

Platforms for Petrolac Software:

- Windows 98 2nd edition or higher
- Windows 2000
- Windows NT
- Windows XP Pro

3). Fleet management

The Hydrocarbon Products Transportation scenario supports planning and execution of bulk shipments and packaged products shipments in a timely and accurate manner at the lowest possible cost.

Challenges

- Delivery date accuracy
- Quantity and Quality integrity

IT Enablers

- *RFID technology*
- *GPS System*

RFID: Radio Frequency identification Device system is used to transmit the identity (in the form of a unique serial number) of an object

Components Of RFID

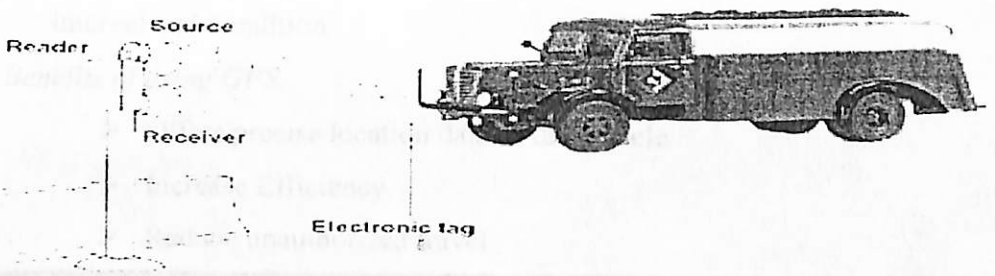
- An Antenna or a coil
- A Transceiver (with decoder)
- Transponder (RF tag)

Solutions

Each tank lorry can be fitted with RFID tag. The **antenna** generates a magnetic field, which activates the magnetic tag and enables communication between the

tag and the transponder. Often the antenna and the transceiver are packaged together as **reader**.

The range of the system can be more than 100 ft depending on the type of transponder tag used and the operating frequency. This technology along with Fiber Optics/GPS will enable proper fleet management since it can send real time data about the tank lorries, their exact positioning.



These reader poles can be connected with terminals through GPS or fiber optics.

Advantage of RFID Systems

- They do not require direct contact or line of sight to operate properly
- Tags can be read in all types of environment such as snow, fog, rain, dirt or other harsh conditions
- They can be read very quickly; in most cases response time is less than 100 milliseconds

GPS (Geographical Positioning system): A system of satellite and receiving devices used to compute positions on the earth. GPS is use in navigation and to track vehicles. GIS can also be used for vehicle tracking.

GPS terminal can:

1. View and monitor position of its fleet, speed at which vehicles are traveling, direction and other information.
2. Establish voice communication with the vehicle at a touch of the button.
3. Company can also set the position of the remote vehicle by sending speed interval and condition.

Benefits of using GPS:

- Offers precise location data of the vehicle
- Increase Efficiency
- Reduce unauthorized travel

Fleet Management Sheet				
	Date	Time	Speed	Average Distance
Location 1				
Location 2				
Location 3				
Location 4				

4). Planning and Scheduling

Planning, scheduling and batching are few of the most important processes in terminals.

From Terminal prospective: Terminal needs to have a proper *planning* about how much fuel to receive from refinery and dispatch to retail outlet so that neither terminal or retail outlet runs out of fuel nor they have to block their capital investment in excess inventory. *Scheduling* involves dispatching of right mix of product to right location at right time. In other words, terminals should have proper information about inventory status of various products at different retail stations as well as their sale/ consumption data. *Batching* is done to send right quantity of fuel mix to the retail outlet so that no retail outlet faces either retains or dry out/run out.

Challenges

- Managing inventory of terminals across the network.
- Fleet management
- Cumulative demand forecasting pattern
- Avoiding Bull-Whip effect

From Retail outlet prospective: Retail outlet needs to develop demand forecasting in order to procure fuel from terminal. Retail outlet planning and scheduling involves procurement planning. It's procurement planning needs to analyze lead-time, sales pattern as well as its current inventory.

Challenges

- Inconsistent demand pattern.
- Delays in receiving product.
- Insufficient or excess supply.

IT Enablers

Aspen Retail™ Supply Chain Solution: Aspen Retail is a web-enabled supply chain software solution which enables petroleum companies to create an automated, real-time system that monitors consumption and fuel stocks across an entire retail network, creates demand forecasts, and, using the latest product and transportation cost data, generates plans to replenish the outlets in the most efficient and profitable way.

Compared with traditional manual methods, benefits include reduced transportation costs by using fewer trucks more efficiently to meet sales demand, a reduction in unnecessary fuel stocks at service stations, and improved customer service by ensuring outlets do not run out of fuel.

Solutions

Aspen Retail™ Supply chain Solution can be integrated with inventory management and fleet management in order to capture real time data. Based on the
data fed, it can then generate reports for consumption / Sales, replenishment plan and demand forecast.

5). *Tank Farm Management*

Tank Farm Management enables oil and gas companies to manage large volumes of refined petroleum products in terminal tank farms. Crucial for the effective management of tank farms is the ability to obtain a quick overview of incoming and outgoing goods movements, and to continuously monitor physical stock levels and optimize the internal processes. In addition, tank farms are often managed by a tank farm operator for several stock-owning companies which requires detailed tracking of the stock for all parties holding stock in a single tank. Sophisticated analytical tools are provided to monitor goods movements and compare book stock levels with physical stock levels on a regular basis.

A TAS interface provides seamless integration between SAP for Oil & Gas and external terminal automation systems. This integration improves business processes involved in terminal management, such as taking orders, managing terminal operations for orders and the corresponding shipments, and managing tank stocks in the terminal.

A flexible quantity conversion interface (QCI) converts volumes, masses, and energy at ambient conditions (temperature, pressure, vapor pressure, calorific value, and density) into volumes, masses, and energy values at standard conditions. The QCI can be configured to comply with any national or international petroleum or natural gas measurement standard.

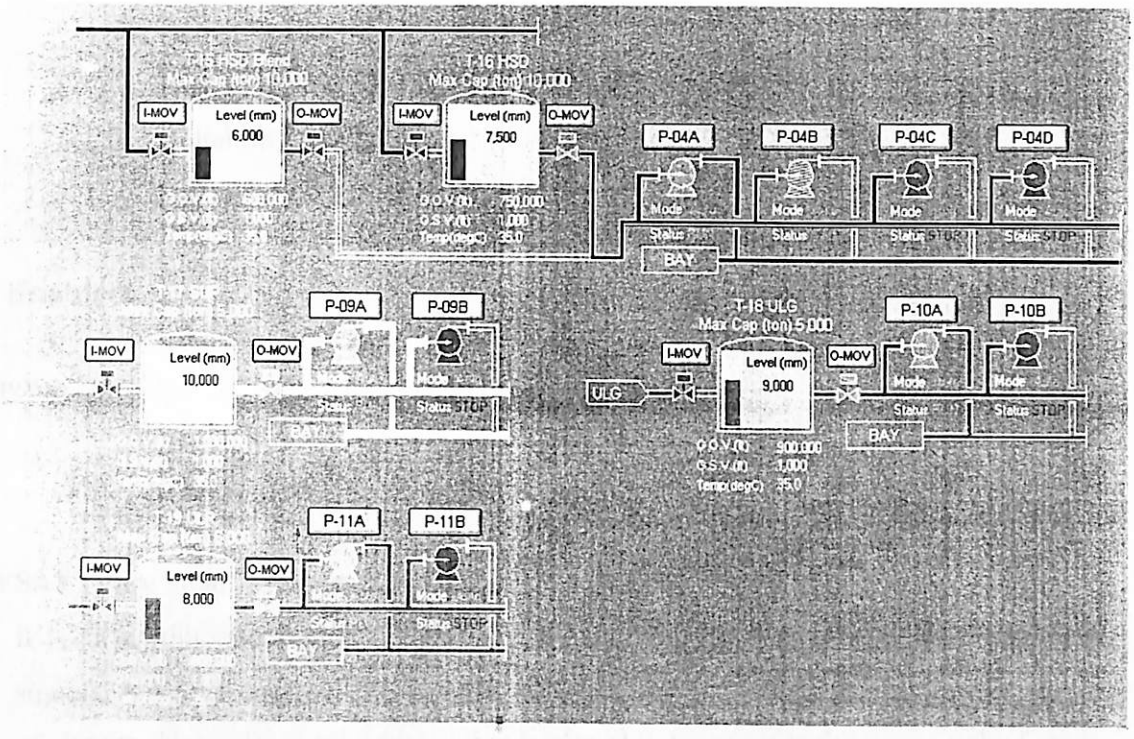
Primary Function

- Monitor and Manage the Tank Farm Operation

Secondary Functions

- Real time product measurement at ambient & standard
- High and high-high level warning and alarm
- Product transfer operations

Tank Farm Display



6). Order Management

For ordering fuel either from terminal or depot, retail outlet needs to have a proper order management system in place. The role of this process is to monitor all orders placed and follow-ups with suppliers. This system must be in line with the inventory so that real time data about inventory, that need to be relayed to terminals, can be sent as per requirement and also every time inventory goes below threshold, a raising invoice can be generated. It should also seamlessly integrate automatic tank gauges and point-of-sale (POS) systems for inventory and sales polling. Apart from that, if RO wants to order products in advance it should have an option for that as well.

Challenges

- Accurate data flow
- Real time data transfer
- Reliability and Security

IT Enablers

Tools:

- Fiber Optics
- Very Small Aperture terminal (VSAT)

VSAT (Very Small Aperture Terminal)

It is an earthbound station used in satellite communications of data, voice and video signals. A VSAT consists of two parts, a *transceiver* that is placed outdoor in direct line of sight to the satellite and a device that is placed indoor to interface the transceiver with the *end user's communications device*, such as a PC. The transceiver receives or sends a signal to a satellite transponder in the sky.

VSAT can handle up to 56 Kbps. It enables fast, secure, and efficient communications to any location. It requires no staff or additional technology to operate it. It simply plugs into existing terminal equipment.

VSAT satellite communications provide virtually error-free digital data communications and better than 99.9% network reliability. VSAT can provide remote diagnostics, remote monitoring, and data streaming services from remote or hazardous sites.

VSAT technology has numerous advantages:

- Centralized administration of networks and logistics.
- Increased capacity for processing high volume of transactions.
- High level of information protection.
- VSAT allows the user to make incremental increases in its network
- It provides global connectivity as well as local compatibility.

Fiber Optics:

- Cost-effective signal transmission
- High signal-to-noise ratio for sharp video resolution, detail, contrast and color
- Multi-protocol data with data translation
- Easier integration with other equipment
- Immunity to Electro-magnetic Interference, Radio Frequency Interference, and other electrical problems
- Lower installation and maintenance costs

A combination of VSAT and fiber optics can be used for effective order management. A fiber optics bus topology can be used to connect those retail outlets, which are in the city location or in the path of bus. Those, which are farther or in remote location, can be connected by VSAT.

Order management				
Date	Products	Quantity	Mode Of Payment	Expected Delivery Date

7). Loading Operations

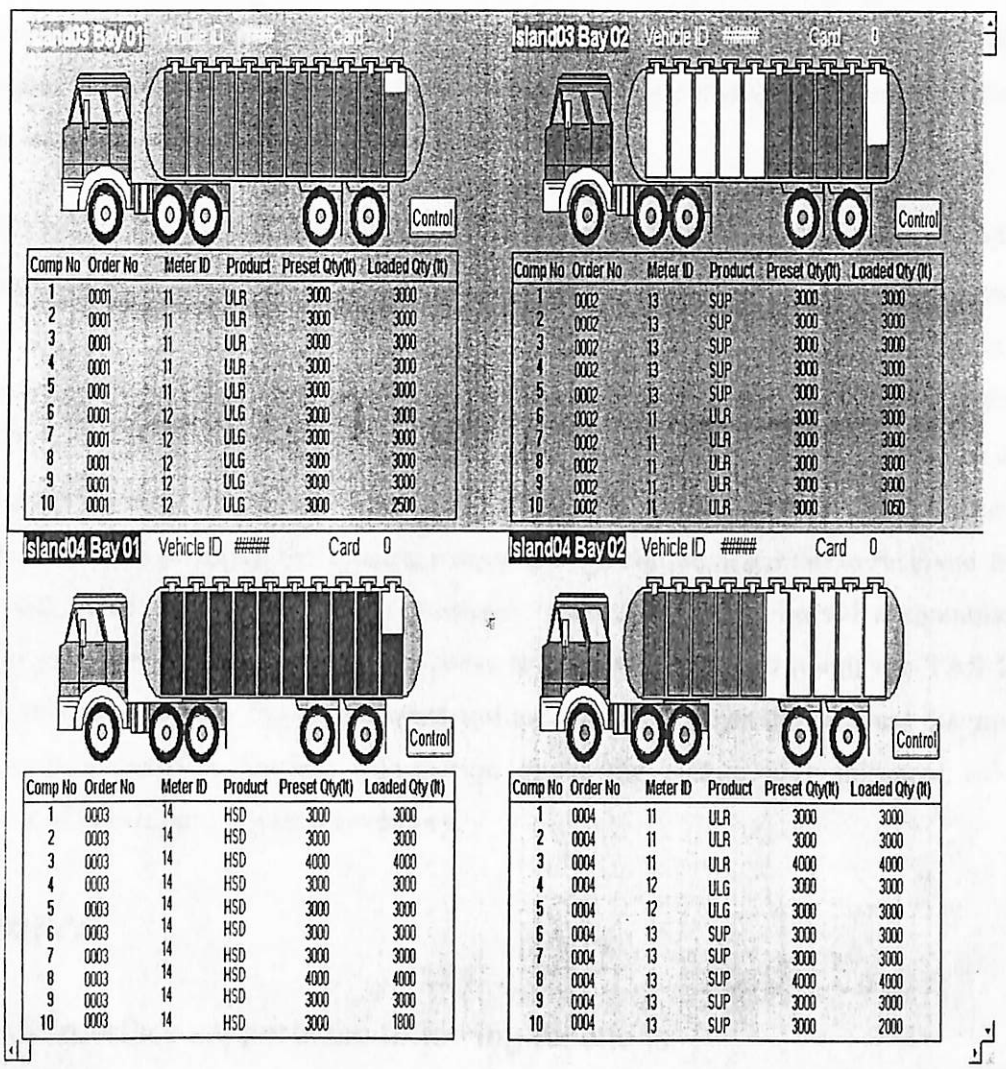
Primary Function

Manage the Loading Procedure to minimize turn around time, minimize wrong product & quantity delivery, contamination, and standardize loading procedure

Secondary Functions

- Dynamic bay allocation
- Loading advice generation
- Permissive monitoring & Control
- Initiate compartment loading
- Real-Time Loading monitoring
- Pumps/ Valve shutdown during emergency
- Product invoicing based on volume or weight

LOADING DISPLAY



Terminal Automation System Interface

BPCL has implement highly automated equipment and control software system, called a Terminal Automation System (TAS), for efficient bulk product handling and inventory management. The terminal automation system improves terminal operations such a slifting and discharging product, moving product between tanks, and managing the inventory of each tank efficiently.

The TAS Interface provides seamless integration between SAP Oil & Gas and external terminal automation systems. The system integration made possible by the TAS Interface improves the business processes involved in terminal management, such as taking orders, managing terminal operations for orders and the corresponding shipments, and managing tank stocks in the terminal. The TAS Interface sends data on loading transactions (such as details on contracts, orders, and shipments) from SAP Oil & Gas to the terminal automation system. The terminal automation system performs the loading transactions using the information received from SAP Oil & Gas. After the loading transactionshave taken place, the terminal automation system sends the information on the loading process to SAP Oil & Gas through the TAS Interface. SAP Oil & Gas processes this information and automatically posts the relevant documents.The TAS Interface transfers loading information about the pickup and shipment of product, movement of goods, and physical inventory.

Features

The TAS Interface supports the following functions:

- Sending loading information to an external terminal automation system

- Receiving loading information from the external terminal automation system and providing that information to SAP Oil & Gas using:
    - Intermediate documents and application linking enabling (ALE)

- An internal table and a remote function call (RFC)

- Manually entering loading information in SAP Oil & Gas
- Processing loading information in SAP Oil & Gas

Loading Operation using TAS Interface

1). Customer Pickup using TAS

This figure illustrates how the TAS Interface works when a customer picks up material from a terminal. As shown in Figure 1, these are the steps in the pickup process:

1. A customer requests to provide the authorization to pick up material at the terminal.
2. The load identification (load ID), Sales and Distribution (SD) document (contract, order, or call-off), are created and assignd the load ID.
3. Load ID sent to the customer.
4. Send the load ID and SD document details to the terminal.
5. The customer comes to the terminal to pick up the material and presents the load ID.
6. The terminal automation system submits the load ID to SAP Oil & Gas through the TAS Interface to validate the information.
7. SAP Oil & Gas sends back confirmation that the information is correct.
8. The terminal automation system performs the loading transaction.

9. The TAS Interface sends the loading details to SAP Oil & Gas.
10. Data is processed in SAP Oil & Gas, and relevant documents are created.

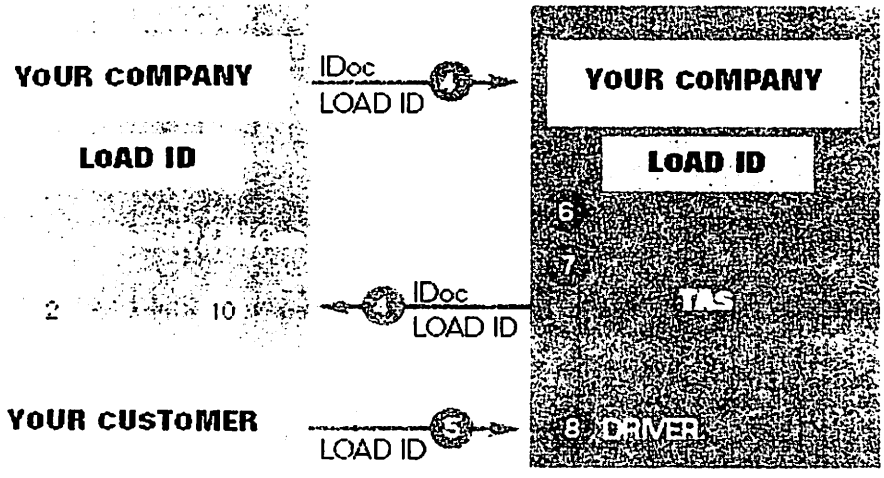


Figure 1: Customer Pickup Using the Terminal Automation System

2). Planned Shippment using TAS

This figure illustrates how the TAS Interface works when you ship material from a terminal using a carrier or driver. As shown in Figure 2, these are the steps in the planned shipment process:

1. Create a load ID in SAP Oil & Gas.
2. Send the load ID to the company or person responsible for loading (for example, the carrier or your own driver).
3. Send the load ID to the terminal.
4. Receive the order from the customer.
5. Create the order and the delivery in SAP Oil & Gas.

6. Assign the delivery to the shipment.
7. Assign the load ID (or IDs) to the shipment.
8. Send the shipment planning details and the load ID to the carrier or driver.
9. Send the shipment planning details and the load ID to your terminal.
10. The carrier arrives at the depot and presents the load ID.
11. The terminal automation system uses the load ID to verify the information and performs the loading transaction.
12. The TAS Interface sends the loading data – such as the load ID, work shift, time of loading at the depot, and the quantity that was loaded – to SAP Oil & Gas.
13. The data received is processed in SAP Oil & Gas for that load ID.

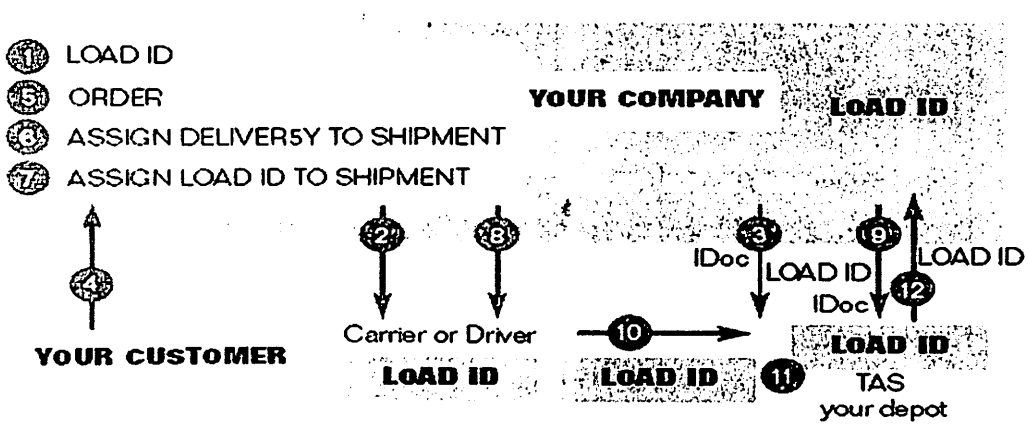


Figure 2: Planned Shipments Using the Terminal Automation System

3). Shipments with Delivery Confirmation using TAS

TAS Interface works when you ship material between various plants with delivery confirmation at each location.

1. Create a load ID in SAP Oil & Gas.
2. Send the load ID to the company or person responsible for loading (the carrier or driver).
3. Send the load ID to the terminal.
4. Create the stock transport order (STO) for the material quantities that are to be transferred.
5. Create a delivery with reference to the STO.
6. Assign the delivery to the Transportation and Distribution (TD) shipment.
7. Assign the load ID (or IDs) to the TD shipment.
8. Send the shipment planning details and the load ID to the carrier or driver.
9. Send the shipment planning details and the load ID to your terminal.
10. The driver arrives at the terminal and presents the load ID.
11. Material is loaded based on the information for that load ID.
12. The TAS Interface sends the loading data – such as the load ID, work shift, time of loading, and the quantity that was loaded – to SAP Oil & Gas, where a load confirmation is created.
13. Inform the receiving plant of the successful loading of the product and of the load ID.
14. The driver takes the material to the receiving plant and presents the load ID.

15. The receiving plant sends the detailed data confirming the delivery – such as the load ID, the material received, and the quantity – to SAP Oil & Gas.
16. The data received is processed in SAP Oil & Gas for the load ID, and a delivery confirmation is created.

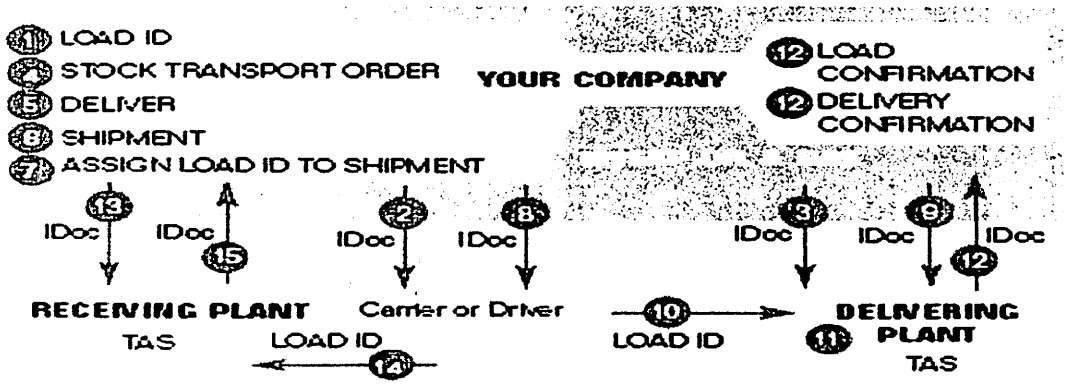


Figure 3: Shipments with Delivery Confirmation Using the Terminal Automation System

4). Goods Movement Using TAS

This figure illustrates how the TAS Interface works for goods movements in terminals where materials are pumped out of one tank and into another. These goods movements are recorded in the terminal automation system and are sent by theTAS Interface to SAP Oil & Gas in the form of IDocs.

The following stock transfers and transfer postings are supported:

- Plant-to-plant transfers
- Transfers from one storage location to another

- Material-to-material transfers

For goods movements involving an oil material, SAP Oil &Gas includes a quantity conversion interface that allows you to calculate quantities in various units of measure.

The steps for goods movement are:

1. Create a load ID in SAP Oil & Gas.
2. The stock transfers and transfer postings are performed in the terminal. The goods movement is saved in the terminal automation system.
3. The detailed data for the stock transfer and transfer posting –such as the load ID, the delivered material, and the quantity –is sent to SAP Oil & Gas.
4. The receiving data is processed in SAP Oil & Gas for the load ID.

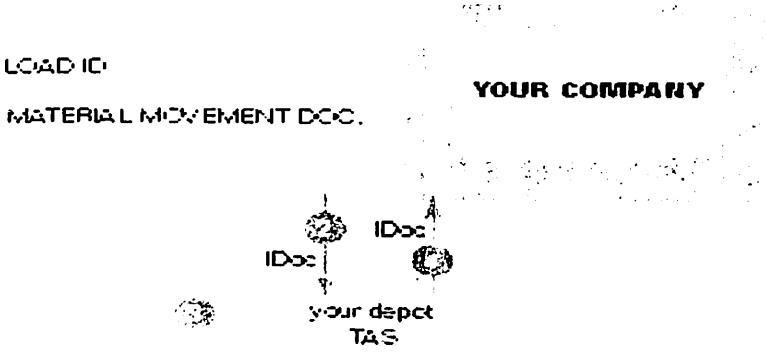


Figure 4: Goods Movements Using the Terminal Automation System

5). Physical Inventory Counts using TAS

This figure describes how the TAS Interface works for physical inventory counts. In terminals, physical inventory is counted at set times, such as the end of the day, to track the quantity of all inventory-relevant stock. The physical inventory count is recorded in the terminal automation system and sent to SAP Oil & Gas using an IDoc. The physical inventory document is created in SAP Oil & Gas, the inventory count is carried out, and the inventory difference is posted.For inventory counts involving an oil material, the calculation of quantities in various units of measure is supported by a quantity conversion interface. This interface is provided with the capabilities for inventory management of hydrocarbon products in SAP Oil & Gas.

As shown in Figure 5, these are the steps in the physical inventory count:

1. Create a load ID in SAP Oil & Gas.
2. Inform your depot of the load ID to be used for the physical inventory count.
3. The physical inventory count is performed in your terminal. The physical inventory count is stored in the terminal automation system.

4. Then receive a detailed list of the physical inventory count from the terminal.
5. The data received is processed in SAP Oil & Gas for the load ID, and the inventory difference is posted.

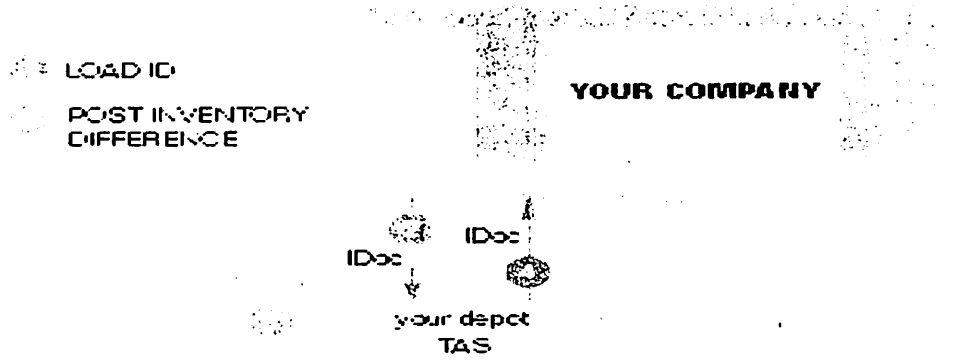


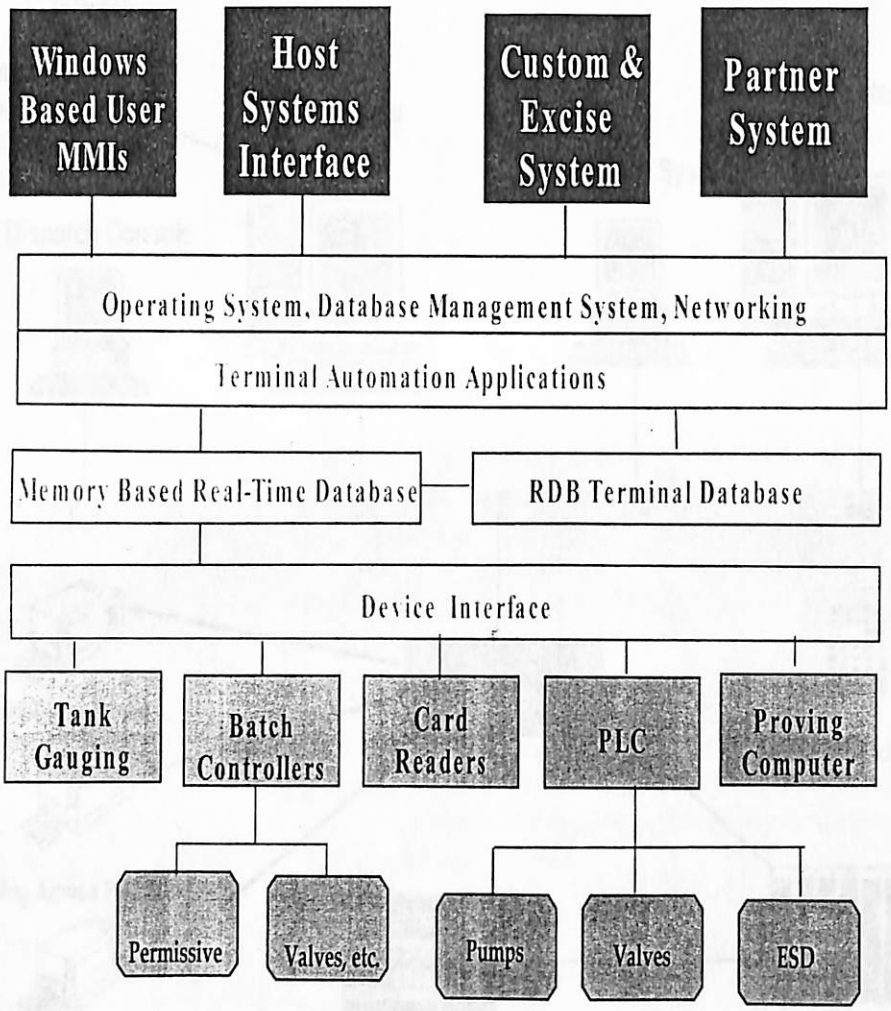
Figure 5: Physical Inventory Counts Using the Terminal Automation System

Benefits of TAS

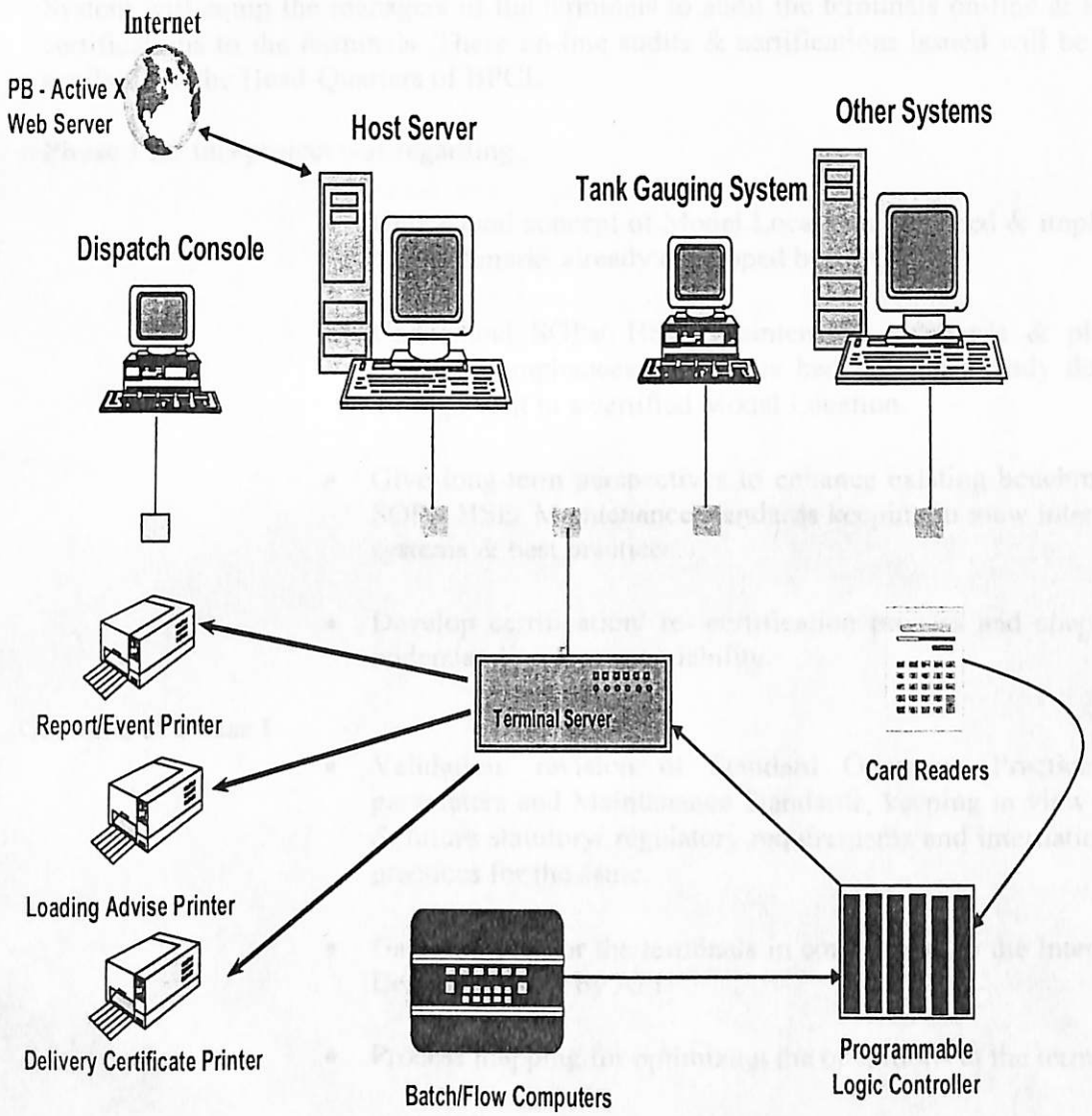
- TAS is based on leading-edge technologies and meets the latest open-system standards. It's a fully scalable, modular solution that can be easily adapted to meet specific needs. When you choose TAS, you are assured of increased throughout, greater efficiency, and higher safety – in addition to never-before control over operations at every level. It offers unmatched capabilities that make a difference – to your balance sheet.
- TAS features a real-time multi-tasking environment geared for fast response that helps increase productivity and throughput by the more efficient use of resources, as well as cutting down on wastage of both material and time.
- TAS is a highly flexible solution that can adapt to meet individual needs right from a single-arm bay to a large terminal with several unloading facilities.
- Oracle database with client-server architecture and advanced replication (Database configuration diagram) provides unlimited capacity and expandability for all conceivable future requirements.
- Multithreaded TDM allows interface with host computers and specific database fields and functionality can be easily incorporated at any stage.
- The GUI-based HMI server module provides customizable screens for easy access and control of every function at your fingertips.
- TAS offers high security and redundancy through unique features like multi-master real-time data replication; system heartbeats; Automatic Database Synchronization on start-up; extremely fast changeover from primary to back-up server; time synchronization across all terminals; status display on remote terminals; and data logging of all events, errors and alarms.
- The system has a modular structure so as to be fully adaptable to different field element interfaces as well as future requirements. It offers unlimited connectivity to field devices / ports, as well as connectivity to Modicon./

- It also offers standard drivers for Smith, Alma, Danload and Contrec Batch Controllers as well as drivers for Smith, Rosemount, E&H Density Meters and Ethernet, TCP/IP, LAN, WAN and PPP connectivity.
- Fully scalable High degree of automation implies high degree of accuracy and reliability
- High level of security of data and movement of authorized personnel
- Automatic data processing and monitoring
- Accurate measurement of plant data thereby preventing discrepancies and fraud
- Dual redundant architecture for fail-safe operation
- Centralized database for easy access from anywhere
- High level of diagnostics for fault-finding
- Easy connectivity to higher level software
- Leading-edge technologies
- Improved safety interlock
- 100% reliability
- Open-ended database
- Optimized performance
- Highly adaptable

TAS Functional Architecture



Typical TAS Configuration



Conclusion & Future Scope

BPCL is planning to implement an On-line Audit & Certification System. This TACSYS System will equip the managers of the terminals to audit the terminals on-line & issue the certifications to the terminals. These on-line audits & certifications issued will be directly available to the Head-Quarters of BPCL.

Phase I for this project was regarding

- Understand concept of Model Locations, the need & implications of benchmarks already developed by BPCL.
- Understand SOPs/ HSE/ Maintenance standards & physically observe compliances to various benchmarks already developed through visit to a certified Model Location.
- Give long-term perspectives to enhance existing benchmarks for SOPs/ HSE/ Maintenance standards keeping in view international systems & best practices.
- Develop certification/ re- certification process and checklist for understanding location viability.

Outcome of **Phase I**

- Validation/ revision of Standard Operating Practices/ HSE parameters and Maintenance Standards, keeping in view existing & future statutory/ regulatory requirements and international best practices for the same.
- Gap Analysis for the terminals in comparison to the International Benchmarks set by API
- Process mapping for optimizing the operations at the terminals
- Auditable procedures for the same.
- Audit formats.

Phase II for the project is to implement an On- line Audit & Certification System which will equip the managers of the terminals to audit the terminals on-line & issue the certifications to the terminals. These on-line audits & certifications issued will be directly available to the Head-Quarters of BPCL. This system will be integrated with SAP Oil & Gas which has already been implemented in the organization. With this implementation the various audits conducted throughout the country in various terminals will be available through the organization.

Need for the Automated Audit System

- Audits are conducted over a period of time at the terminals
- Necessity for concise reporting about the audits
- Value add to clients
- No automated system at present is available in the market
- International dimensions
- Multiple users can log on to the system On-line

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