



User Requirements Specification
For
Enterprise Real Time Historian(EH)

Project ID	IT00231
Revision	0.7
Revision Date	Feb 2014
Group IT	

User Requirements Specification for Enterprise Real Time Historian (EH)

Prepared by
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DOCUMENT APPROVAL

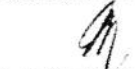
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Ernest Mpshe	SCOT and Tx Systems Operation		
Dharmesh Bhana	Group Customer Service - Top Customers Representation		
Andre van Heerden	Primary Energy Representation		
Derick Opperman	Generation Representation	13/04/14	

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ABBREVIATIONS AND DEFINITIONS

ABBREVIATIONS

ABBREVIATION	DESCRIPTION
AD	Active Directory
BI	Business intelligence
CVM	Current and Voltage Monitor: measure currents and voltages on pole mounted transformers and miniature substations on the Low Voltage (LV) side.
CoE	Center of Excellence
DCS	Distributed Control System
DMS	Distribution Management System
DMZ	De-Militarised Zone
Dx	Distribution
EMS	Energy Management Systems
Enterprise Wide Historian	Enterprise-wide data historian that collects, archives and distributes <u>tremendous volumes of real-time production information</u> at extremely high speeds
Gx	Generation
Historian	Repository of real time and non-real time data. Collect plant, network and other data. Analyze acquired data.
IGCC	Integrated Generation Control Centre
IM	Information Management
ISA	International Society Automation
IPP	Independent Power Producer
KSACS	Key Stakeholder and Customer Service
MWP	Megawatt Park
MI	Management Information
NCC	National Control Centre
OEM	Original Equipment Manufacturer
OMO	Operating, Maintenance and Outages
OT	Operational Technology
PCLF	Planned Capacity Loss Factor
PCM	Process Control Manual
PDS	Plant Data System
PLC	Programmable Logic Controllers
PPC	Project Portfolio Committee
RMDC	Remote Monitoring Diagnostic Centre: The function of the RDMC is to remote monitor, diagnose and provide operator support, based on data gathered from the Enterprise Historian
SAP	Systems, Applications and Products in data processing
SCADA	Supervisory Control And Data Acquisition
SOW	Statement of Work
Tags	Historians include packaged interfaces to most distributed control system (DCS) platforms, supervisory control and data acquisition (SCADA) systems, manufacturing execution systems, and individual electronic devices. The software forms inputs into "data streams" of time-series data (value, quality, time stamp), referred to as tags.
Tx	Transmission
UCLF	Unplanned Capacity Loss Factor

1 INTRODUCTION

Real Time Historians provide reliable real time plant process data in a standard manner to all of the business users that require this data. Real Time historians offer a flexible, powerful grouping of applications and tools that gather, manipulate and make real time data readily available to all these identified users. This data is presented in the proper context for each defined user and is presented in an understandable form. This data must be delivered reliably, in a standardised manner and in a format that allows visualization and easy integration into other standard Eskom IT systems.

Real time historians are used as the repository of real time process data. These systems allow process data to be viewed by all of the corporate users of such data. A real time historian also interfaces data to and from other condition monitoring and decision based systems that use or generate process type data. This project will provide a single, standardised real time historian to be applied Eskom wide.

An Enterprise wide real time Historian (EH) is needed to support the different line groups, Generation, Transmission, Distribution, Group Customer Service and Renewables to achieve (but not exclusively limited to) the Eskom strategic priority: "Keep the lights on".

Eskom has various local historians (containing a variety of data in differing data structures) installed which are part of the turnkey solutions provided by the vendors of the process systems.

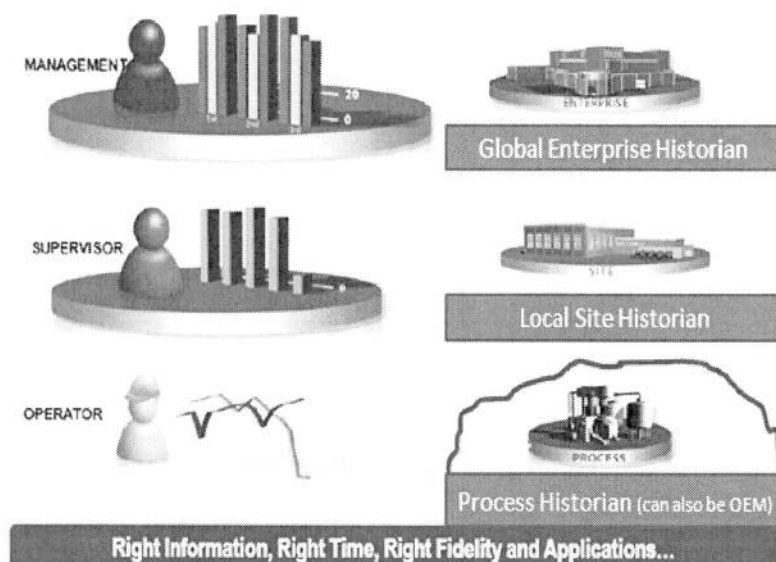
This poses the following challenges to the business:

- ✓ Enterprise plant and network operational data is not readily available to the business.
- ✓ Limitation in the capability of the current historian(s).
 - Only a subset of the process data is being collected by the Historian
 - Storage limitations affecting Historical Data availability
 - Inconsistent data compression techniques across historians thus affecting historical data integrity
 - Incompatible data structures making standardisation impossible

The EH will either replace these local historian's or will provide a uniform interface between the business and these historians.

Eskom is also lacking a historian to which field devices in the wires business, including those in substations, can send data and information for long term archiving and consequent analysis. Visibility of wires infrastructure is currently limited to operational data provided by SCADA and metering systems, both of which only fulfils their respective business needs. The inclusions of dataset that are complimentary to these are required by business to assist the planning, optimisation, plant and various field departments.

This specification provides for the initial core implementation of the Enterprise Historian and will provide the path for a pattern based deployment.



1.1 BUSINESS PROBLEMS AND ISSUES

The world's best practice is for large utilities to move to an operating model that is based around information provided by monitoring centres. These monitoring centres are focused on either divisional or enterprise wide application. Eskom has SCADA in Distribution, National Control, Integrated Generation Control Centre (IGCC), Remote Monitoring Diagnostic Centre(RMDC) and is currently planning a nerve centre. All of these centres require a secure supply of standardised data. This data source is an Enterprise Historian. Eskom currently does not have an EH and hence this places the monitoring centre operating model at risk.

The rapid development of Information Technology (IT) systems has resulted in it being possible for skilled technical staff to be able to perform their functions at remote locations or even beyond the boundaries of the country from both Eskom-internal staff and external support/specialist staff points of view. This however requires that the data can be made available reliably and in an easily accessible fashion. Ready access to data requires an EH to be in place. Eskom's lack of the EH makes it difficult and sometimes impossible to make informed decisions when not located on site.

New process systems that are based around IT produce a vast amount of data. Currently Eskom does not have data warehousing capabilities to store this data. The EH will allow the archiving of all Eskom's data.

Since the power crises in the mid 2000's, Eskom Executives have been requesting dashboards that give a high level overview of the state of the business. This has only been met with limited success because of the lack of an EH. Once the EH is in place it will be simple to develop the requested dashboards.

1.2 BUSINESS NEED ENGAGEMENT

Engagement Date	Invitees	Attendees	Division	Business Need
27/01/2014	Richard Candy	Richard Candy	National Control-Systems Operation	The system operators at NCC, are in desperate need of the following data sources to be available at National Control; • Weather data – from Weather Services • Space weather data from Hermanus • Storm tracking – via lightning data • Phasor Measurements from the PMU data concentrators ➢ (Rosalette Response: WAMS will be available to NCC – but may be required by other users and/or applications.) • Contingency analysis results from TEMSE ➢ (Rosalette Response: CA is already available to NCC – but may be required by other users and/or applications.) • Grass fire data - from the CSIR • Lightning history • IPP energy forecast output – three from external vendors • IPP hourly forecast and available output – • Substation plant health data – from the substation servers All of these data sources need to be combined and made visible in the control room on a Geographic map of South Africa, via the graphics box on the National Control rear projection system. The data quantities will need to be defined for each data source. Primary Energy foresees that the EH will provide benefits to the division by providing data for forecasting and trending. The architect on Primary Energy needs to confirm where exactly on the landscape will the EH collect data.
05/02/2014	Beaudine Hanson, Andre Van Heerden, Nico Singh, Shenaaz Naidoo, Clem Rajah, Sagren Govender, Jacques Erasmus, Herman Brand	Beaudine Hanson, Clem Rajah, Jacques Erasmus, Herman Brand	Primary Energy Department	
10/02/2014	Ernest Mpshe; Tertius Hyman;	Ernest Mpshe; Tertius Hyman;	Systems Operation,	The primary benefit of the EH is to: Have "one version of the truth".

Jason Hector; Rishi Hariram; Rosalette Botha Diane Small	Jason Hector; Rishi Hariram; Rosalette Botha Diane Small	Group Technology, Dx, SCOT, Tx	Diane Small indicated that the Nerve Centre and the APM project is dependent on getting its data from the EH. Rosalette indicated that the NCC requires the EH for forecasting. The lack of environmental awareness in the control room has serious consequences. The physical location of the EH must be indicated as this will affect the access control and governance requirements. Ernest indicated that the EH project must provide the infrastructure, licenses, rules, governances and policies. This will allow the OT to easily integrate to the EH. The following are Group Technology's Business Need: 1. Access to improved and additional information for designers: - DC Load profiles used for substation DC designs to ensure adequate standby supply. This is not currently available. - Better quality data, such as disturbances on the network and capacitor banks being switched, can be useful for forecasting demand in an area and doing both VAR control and load regulation/balancing. - Load growth for critical buildings can be monitored to ensure that backup generators are appropriately sized and system integrity is maintained. Ad-hoc data such as for building standby generators has never before had any real-time monitoring system linked to them. This will assist the Real-Estate departments. 2. Improving maintenance and inspections procedures: - Reliability Centered Maintenance can be applied using historical data. Such as breaker contact wear being determined using the fault current and duration of the fault and used as an indication of pending maintenance. - Transformer aging can be more accurately determined using data on transformer overloading, associated temperature reading, as well as readings from Dissolved Gas Analyzers. All this data would typically reside in different systems (typically proprietary). The EH affords us the opportunity to consolidate this and all other information to provide easy access to data. - Outages can be better planned when data indicates possible wear on certain parts. 3. Improving the reliability of data:
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				a. Models used to simulate the network can be tested using historical data to ensure their validity. This is very important as these models are the main tool used to design and analyze our network for both planning and operational outcomes. b. Data can be stored at much higher resolutions (both time and amplitude), making calculations more accurate and relates to more use-cases for the data. 4. Save 'windscreen' time and improving safety: a. Fault records that are digitized on the EH can be consulted before going to site so the correct equipment can be taken with. 5. Preventing equipment failures: a. Using historical data to identify equipment that is not properly functioning. b. Early warnings can be given for equipment safety. Such as an alarm that is automatically raised by monitoring phase voltages when dead conditions are expected on an open breaker. 6. Improving performance (SAIDI, SAIFI, System Minutes, SAIRI and circuit unavailability): a. Reducing the time to restore faults by consulting fault records before going to site. b. Using historical data to identify problem areas on the network, and determine whether further action is required. c. Provide the business with automated daily reports on the performance levels on various different networks. d. The balancing of loads can be monitored, ensuring the effective use of the primary plant. e. Improved voltage regulation by pro-actively monitoring problem areas and correcting for regulatory limits before they occur. 7. Speeding up investigations a. Using easily accessible event information to identify relay mal-operation. b. Historical data can be used for the comparison of events. c. Access to data such as fault records speeds up the process of fault investigations. 8. All data in one place: a. Data can be made available to all that find it useful, instead of it being only available to the 'owner' of the device that collects it. b. Links to other databases can be made, consolidating data. c. Custom dashboards can be created for groups, eliminating the need
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				for each user to manipulate data. Individual users can also create custom dashboards if need be. 9. Improving operational efficiency: a. Currently, any auxiliary alarms from substations to which users need access to, are being fed into DMS or EMS systems. This is not good practice as such systems are meant to control and manage the power network, not be distracted by non-essential alarms. The use of a Data Server (EH) will divert such messages away from the SCADA systems and deliver them directly to the end user, whilst being available on the system for the interest of anyone else. <u>Rosalette Comments:</u> In support of the above the following data is available from TEMSE for storage in EH: Real-time and applications database snapshots of telemetered, non-telemetered, calculated analogue and accumulated values Quality codes associated with each point Time-tagged status, alarm, and event messages Scheduling and energy accounting information Operator entered data and actions Derived (calculated) information based on real-time values Error logs regarding RTU failures, breaker operations, link operations Event messages It was indicated that the APM tool relies on the success of the EH project. There is a great need to have a single access point to consolidation of data. EH will provide that common user interface. The Customer Service division requires the EH to be able to calculate the loading per customer. This will help prevent loading shedding. The Customer Service division does not have all the data available at one centralised location. The Customer Service division indicated that is important to guarantee the quality of the data. Generation undertook an intensive process of analysis and definition of historians required for successfully establishing a Remote Monitoring and Diagnostic Centre (RMDC), used to monitor power station processes, identify risk and instability in these processes and provide assistance in the operational-, condition monitoring- and thermal performance environments. Detail of this analysis is contained in document "RMC_FWRD_PL123_Current_Capability_Assessment_PDS_30062008_Rev3
12/02/2014	Richard Mccurrach Johan Harmse Colin Smith Carl Wolmarans Andre De La Guerre	Carl Wolmarans Andre De La Guerre Johan Harmse	Group Technology	
12/02/2014	Dharmesh Bhana	Dharmesh Bhana	Group Customer Service – Top Customers	
10/02/2014	Derick Opperman	Email Engagement	Gx	

13/02/2014	John Dean	John Dean	Renewables	0.pdf". A single vendor architecture scheme (described in section 6.3 of this document) conforms to "Leading Practices" requirements, satisfies all user requirements and will enable Generation's future plans to reduce trips & incidents and reduce cost through the deployment of the Remote Monitoring concept. EH can be a useful tool for centralising of weather data. Renewable plants are predominantly weather dependant. The weather data will be useful for the following: 1. Rainfall – flooding alerts, lighting forecasting, etc. (information for small hydro's) 2. Wind data and forecast – for current wind farms and development work. 3. DNI (dynamic nominal irradiation) – for solar and PV applications.
15/04/2014	Rosalette Botha	Email Engagement	Tx	Requirements: ➤ Transfer operational data from EMS to Historian, ➤ Define exchange protocols and ensure that meet all requirements to communicate to systems, ➤ Data to flow from all defined systems into the historian, only when exception is raised will data flow back to operational systems, ➤ Eskom is the owner of the data with each respective business unit controlling the inputs, definitions and analysis of data, ➤ Process to be defined on system support, tag definitions & deployments, data upload and other related elements

1.3 PROJECT GOAL(S)

The following are the project goals:

- ✓ It is required to get the correct real time based data to the identified business users at the right time. This data is sourced from sensors placed on the plant. The need is for this data to be distributed to users who require location information, consolidated information, visualization information and high levels of asset management information.
- ✓ To provide an EH to the Eskom business. This includes budgeting for the system, procuring the licences and the hardware for the system, design and architect the IT domain of the system, deploy the IT domain of the system and support the IT domain of the system.
- ✓ Integration of EH with the SharePoint environment.
- ✓ To assist in the design of the OT domain of the system. It must be emphasised that it is not part of this project scope to actually design the OT domain of the system. Currently approximately 8 real time process data historians from different suppliers are used Eskom wide.
- ✓ The ideal end state is to interface to Eskom in a standard technique:
 - A standard SAP interface will be used to link the data from the historian with the SAP PM module.
 - The project is needed to create a standardized data environment for all process data in Eskom. This will also facilitate, through a standard interface, the seamless transfer into the EH is as important as the transfer of data into SAP from the EH.

1.4 OBJECTIVES

The objectives of this project are in line with the business strategy.

1.4.1 High Performance Organisation

The EH will support Eskom's drive for standardization.

1.4.2 "Keeping the lights on" and "Setting up for Success"

The strategic priorities of keep the lights on and setting up for success will be achieved through the following project objects:

- ✓ Providing data and information that will assist in decreasing Unplanned Capability Loss Factor (UCLF).
- ✓ Providing data and information that will assist in decreasing Planned Capability Loss factor (PCLF)
- ✓ Provide data and information that will facilitate and increase the availability and reliability of the plant through early warning of plant failures.
- ✓ Increasing plant life by making available reliable data to facilitate the accurate calculation of plant remaining life.
- ✓ Either facilitating within its own set of software or providing information to systems that will facilitate the early warning of potential plant failures
- ✓ Providing data and information to asset management systems to enable educated life cycle decisions to be made.
- ✓ Provide data to all levels of Eskom staff that will enhance their decision making capability.
- ✓ Forecast data
- ✓ IPP energy data
- ✓ Weather data
- ✓ Fire data
- ✓ Provide real time data to manage customer demand during system constraints and emergencies.
- ✓ Condition monitoring for the notification of next maintenance cycle based on plant wear.
- ✓ Making event data available for post analysis.

1.4.3 Securing Resources, Mandate and Enabling Environment

The strategic priority of Securing Resources, Mandate and Enabling Environment will be achieved through the following projects objects:

- ✓ Mitigate the skills shortage by facilitating the availability of raw and processed plant data required when accessing and sharing knowledge capital within Eskom.
- ✓ Providing the raw and processed plant data to allow the building an internal capability in plant monitoring, diagnostics and support.
- ✓ Providing real time plant data from various sources without recreating the sources.

1.4.4 "Ensuring Financial Sustainability"

The strategic priority of ensure financial sustainability will be achieved through the following projects objects:

- ✓ Re-use of existing IT capital, infrastructures and programmes where possible and only expanding where necessary.

1.5 BUSINESS PROCESSES

Refer to the document "2013-02-27 Operating and Maintenance Engineering" and "O&M Delivery View Document Signed 20131010".

1.6 RELATED DOCUMENTS

No.	Name/Description	Rev	Unique ID	Publishing Agency
1.	IM Demand Registration Form Enterprise Historian			 Enterprise Historian IM Registration Signe
2.	O&M Delivery View Document Signed 20131010		240-65101136	 O&M DELIVERY VIEW DOCUMENT SIGNED ;
3.	2013-02-27 Operating and Maintenance Engineering	V1.0		 2013-02-27 Operating and Mainte
4.	Statement of Work			
5.	RMC_FWRD_PL123_Current_Capability_Assessment_PDS_30062008_Rev3 0.pdf			 RMC_FWRD_PL123_ Current_Capability_A

1.7 EXISTING PROJECTS AND INITIATIVES IMPACTING ON THIS FUNCTIONAL SPECIFICATION

The following projects are dependent on the EH:

1. Nerve Centre Project
2. Asset Performance Management (APM) Project
3. Smart Grid Strategy Project
4. RMDC Expansion Project
5. National Engineering and Data Server Project
6. Current and Voltage Monitor (CVM)
7. Visualisation Project by Dr Richard Candy

1.8 CONSTRAINTS AND RISKS

Table 1: Constraints

No.	Constraint	Constraint Implication
1.	It is possible that not all stakeholders, whose input is vital to the success of the Real Time Historian, will be consulted during the user requirements gathering phase.	To ensure all critical stakeholders are consulted.
2.	Not all instrumentation, required to monitor the performance of critical equipment, is already in place.	It is not a project objective to supply additional instrumentation. This must be supplied through separate projects. The project can continue, but the information provided by the system is decreased and compromised.
3.	Integration is not possible between the various technical components in Gx that the Real Time Historian needs to interface with.	The implication depends on the criticality of the component that cannot be interfaced.
4.	A comprehensive list of required inputs to a real time historian is not available	The implication will depend on the nature of the input that is not available.
5.	A comprehensive list of required documentation with all associated standards and procedures is not available	The implication will depend on the documentation with all associated standards and procedures that is not available.
6.	All new standards and procedures have not been finalised prior to the commencement of the project	The implication will depend on the standards and procedures that have not been finalised.
7.	Skilled personnel are not available to support the Real Time Historian	The non-availability of skilled support staff could potentially place the project at risk.
8.	Existing structures are not adequate to deploy the Real Time Historian.	The system does not meet expectations.
9.	Not all IT services providing integration to existing programmes on which the Real Time Historian depends, exist and will provide the required performance	Failure of the system to operate.
10.	Resources required for the project are not available timeously to establish the Real Time Historian	Delays in the implementation program.
11.	The accuracy and availability of measurements (Voltage, current, power etc) from the field may be limited.	Insufficient and inaccurate data will be available.

Table 2: Risks

No.	Risk	Risk Implication	Risk Mitigation
1.	Challenges in managing the interfacing between control layer systems and the new data historian.	Not all the data is available.	Each interface layer is rigorously designed.
2.	Migration of history from legacy	No historic data is available	Porting of legacy data to

	systems to the new real time data historian if the legacy data is required in the new system.	on start-up of the new system.	the new system is handled as a separate design function.
3.	Some DCS/ SCADA/ DMS / EMS/MV90 systems have the possibility of having close coupled functionality compromised.	Failure of the DCS/SCADA/DMS system.	All interfacing is designed in such a way that there is no risk to the DCS/SCADA/DMS/EMS/ MV90.
4.	All the required data points are not available or are not mapped to the real time historian.	Compromised functionality of the real time historian.	- Data integration is rigorously designed and there is provision made that points can be added on an ongoing basis. - Communicate dependency on data source to business.
5.	Support structures are not set up for the Real Time Historian.	Low level of adoption of the historian.	Identify the stakeholders. Involve and inform all the parts of the business from an early stage. Work with business to make the required changes in the business structure.
6.	Ineffective Change Management.	The system has low adoption.	Change management needs to be a stand-alone function within the program.
7.	Eskom processes affecting approval.	Delays in all stages of the project.	Map the required processes at the concept phase and ensure that the correct preparation is undertaken prior to submission to the governing authority.

1.9 ESKOM HIGH LEVEL OVERVIEW

1.9.1 Generation Business Overview

Table 3: Generation Power Stations

GENERATION					
No	Station	Units	Capacity (MW)	Type	Location
1	Arnot	6	2352	Coal	Middelburg, Mpumalanga
2	Camden	8	1520	Coal	Ermelo, Mpumalanga
3	Duhva	6	3600	Coal	Witbank, Mpumalanga
4	Grootlvei	6	1200	Coal	Balfour, Mpumalanga
5	Hendrina	10	1965	Coal	Hendrina, Mpumalanga
6	Kendal	6	4116	Coal	Witbank, Mpumalanga

7	Komati	9	940	Coal	Middelburg, Mpumalanga
8	Kriel	6	3000	Coal	Kriel, Mpumalanga
9	Lethabo	6	3708	Coal	Sasolburg, Free State
10	Majuba	6	4110	Coal	Volksrust, Mpumalanga
11	Matimba	6	3990	Coal	Ellisras, Northern Province
12	Matla	6	3600	Coal	Kriel, Mpumalanga
13	Tutuka	6	3654	Coal	Standerton, Mpumalanga
14	Kusile (New)	6	4800	Coal	Witbank, Mpumalanga
15	Medupi (New)	6	4800	Coal	Ellisras, Northern Province
16	Koeberg	2	1930	Nuclear	Melkbosstrand, Western Cape
17	Gariep	4	360	Hydro	Norvalspont, Free State
18	Vanderkloof	2	240	Hydro	Petrusville, Northern Cape
19	Drakensberg	4	1000	Pumped Storage	Bergville, KwaZulu Natal
20	Palmiet	2	400	Pumped Storage	Grabouw, Western Cape
21	Acacia	3	171	Gas	Cape Town, Western Cape
22	Port Rex	3	171	Gas	East London, Eastern Cape
23	Ankerlig	9	1338	OCGT	Atlantis, Western Cape
24	Gourikwa	5	746	OCGT	Mossel Bay, Western Cape
25	Klipheuwel	3	3	Wind	Klipheuwel, Western Cape

Eskom has a number of real time historians installed which were part of the turnkey solutions provided for the installation of the process systems.

The following list outlines the real time historians that are used by the Distributed Control Systems (DCS) controlling the Generation Power Stations:

1. **Arnot, Tutuka** :- ABB PGIM
2. **Matla** :- ABB PGIM/Citect
3. **Duvha** :- Visual Automation 3 (Siemens)
4. **Majuba, Matimba, Hendrina, Camden** :- Visual Automation 4 (Siemens)
5. **Lethabo** :- Wonderware (WW) InSQL 9
6. **Koeberg, Peaking** :- Wonderware InSQL 8 and 9
7. **Kriel, Komati, Kendal** :- OSIsoft PI
8. **Grootvlei** :- Honeywell PHD
9. **Medupi, Kusile** :- Alstom Alspa 6

Wonderware ArchestrA is used as the standard plant data system (PDS) on all Generation power stations. Wonderware is also used at the Integrated Generation Control Centre (IGCC).

OsiSoft PI is used for the same purpose but only at Coal 3 stations and for Generation's Remote Monitoring Diagnostic Centre (RMDC) to provide operational support.

A phased approach to migrate the non-Standard Historians to the Enterprise Historian will be applicable.

Context Diagram: RMDC Solution

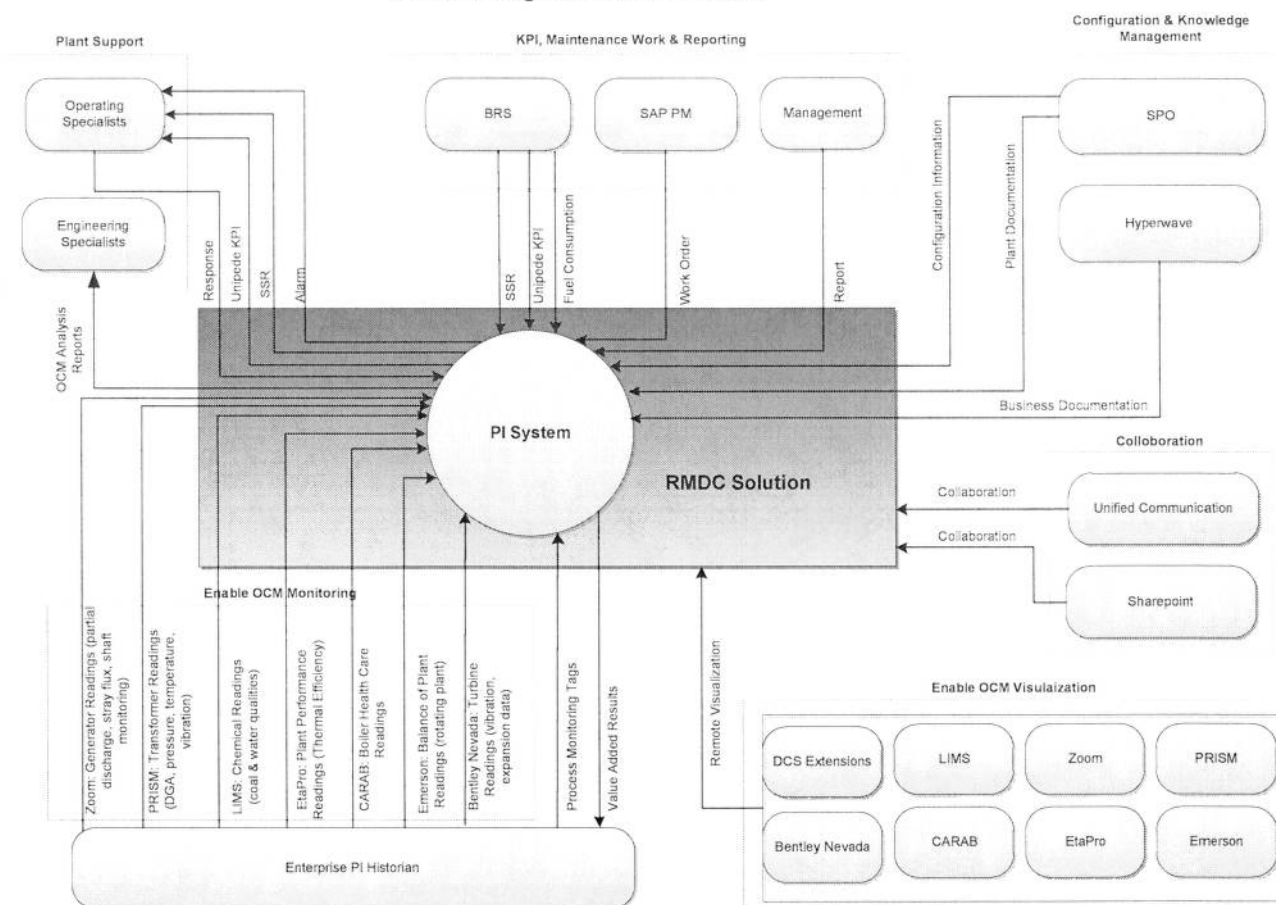


Figure 1: RMDC Solution

1.9.2 Transmission Business Overview

The Transmission Division has 230 Substations. System Operations and Planning uses the Alstom SCADA/EMS (System Control and Data Acquisition/Energy Management System). This system includes a historian called eTerra Archive.

The following data types/tags must be monitored by the EH (NB: All data must be time tagged):

- Real-time and applications database snapshots of telemetered, non-telemetered, calculated analogue and accumulated values
- Quality codes associated with each point
- Time-tagged status, alarm, and event messages
- Scheduling and energy accounting information
- Operator entered data and actions
- Derived (calculated) information based on real-time values
- Error logs regarding RTU failures, breaker operations, link operations
- Event messages

The following data format and data access must be applied:

- The format required to be exported from the EH include KML and KMZ files to be used as input into visualisation tools.

1.9.3 Distribution Business Overview

There is currently an OSI Soft PI historian pilot running in the Western Cape Operating Unit.

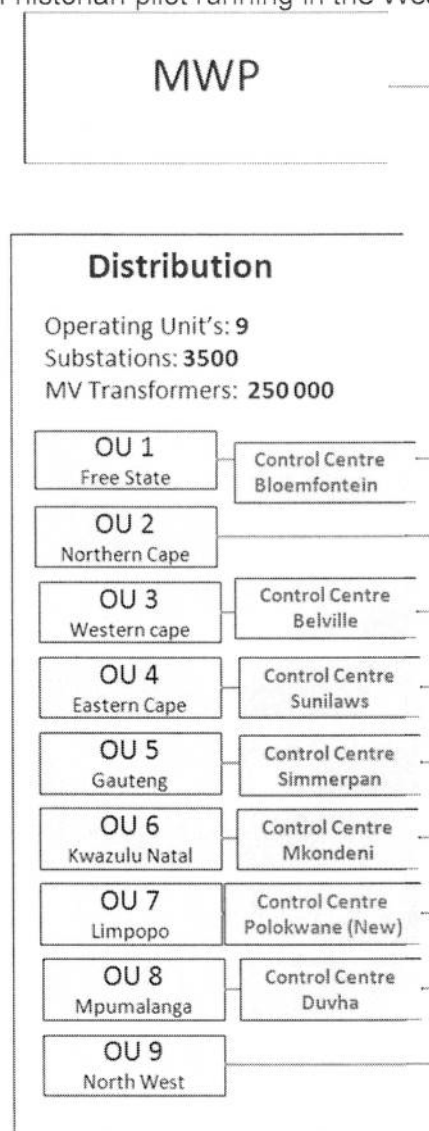


Figure 2: Distribution Network Infrastructure

- Distribution (Dx) Division currently has 9 Operating Units.
- Each Operating Unit does not have a dedicated POP site or Control Centre.
- There is also redundant links between the POP sites for failover.
- It is however evident that each Control Centre is at a High Speed Link.

Table 4: Dx Assets

	Dx
Assets to interface with EH	• Distribution Management System (DMS – SCADA) • MV90 / MDMS (Metering information, decision to be made from which system) • Maximo (Plant asset information & work-orders linked to equipment) • Substation Data Concentrators (Specific for interfacing to the Data Server project) • Field Reclosers (Needs to interface to the Data Server) • Current and Voltage Monitor (CVM) • BEN or equivalent (Notifications to be sent via sms)

	Fault Management System (Most likely to interface to Data Server as source and sink)																																		
Asset Location	- DMS - MV90 - Maximo - Data Concentrators - Field reclosers - BEN - FMS – Each OU (ex. regions) should have these - CVM – New technology of distributed sensors. Each OU should have this																																		
Data Sources	- DMS – SCADA data, operational - MV90 / MDMS – Metering data, both for billing and statistical - Maximo – Work orders - Data Concentrator – All substation engineering data including waveform/disturbance files that needs to be digitised in the Data Server - BEN – Event notifier via SMS - FMS – Stores fault related data for the OU. - Current and Voltage Monitor (CVM)																																		
Number of Users	<table> <tr> <td>ED Netops:</td><td>25</td></tr> <tr> <td>ED Network Services:</td><td>30</td></tr> <tr> <td>NS Planning:</td><td>20</td></tr> <tr> <td>NS Plant:</td><td>30</td></tr> <tr> <td>ED Field Services:</td><td>20</td></tr> <tr> <td>Field Services (Senior supervisors+1):</td><td>26 x 2 = 52</td></tr> <tr> <td>Exec. Management</td><td>20</td></tr> <tr> <td>Customer Exec.</td><td>10</td></tr> <tr> <td>Total Users per OU:</td><td>207</td></tr> </table>	ED Netops:	25	ED Network Services:	30	NS Planning:	20	NS Plant:	30	ED Field Services:	20	Field Services (Senior supervisors+1):	26 x 2 = 52	Exec. Management	20	Customer Exec.	10	Total Users per OU:	207																
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Data Points	<table> <tr> <td>Points per MV feeder (11kV): 68</td><td></td></tr> <tr> <td>Western OU # MV Feeders: 1210</td><td></td></tr> <tr> <td>Western OU Total MV Feeder points:</td><td>68 x 1210 = 82280</td></tr> <tr> <td>Points per HV feeder (up to 132kV): 79</td><td></td></tr> <tr> <td>Western OU # HV Feeders: 479</td><td></td></tr> <tr> <td>Western OU Total HV Feeder points:</td><td>479 x 79 = 37841</td></tr> <tr> <td>Points per Transformer Bay: 55</td><td></td></tr> <tr> <td>Western OU # Transformer Bays: 540</td><td></td></tr> <tr> <td>Western OU Total Transformer points:</td><td>540 x 55 = 29700</td></tr> <tr> <td>Points per Recloser: 25</td><td></td></tr> <tr> <td>Western OU # Reclosers: 300</td><td></td></tr> <tr> <td>Western OU Total Recloser points:</td><td>300 x 25 = 7500</td></tr> <tr> <td>FPI? – Ian Snyders (currently on leave)</td><td></td></tr> <tr> <td>Metering points currently in MV90:</td><td>20000</td></tr> <tr> <td>Subtotal Western OU:</td><td>177 321 + FPI</td></tr> <tr> <td>SCADA Points for Western OU:</td><td>+ 70000</td></tr> <tr> <td>TOTAL WESTERN OU:</td><td>247 321</td></tr> </table>	Points per MV feeder (11kV): 68		Western OU # MV Feeders: 1210		Western OU Total MV Feeder points:	68 x 1210 = 82280	Points per HV feeder (up to 132kV): 79		Western OU # HV Feeders: 479		Western OU Total HV Feeder points:	479 x 79 = 37841	Points per Transformer Bay: 55		Western OU # Transformer Bays: 540		Western OU Total Transformer points:	540 x 55 = 29700	Points per Recloser: 25		Western OU # Reclosers: 300		Western OU Total Recloser points:	300 x 25 = 7500	FPI? – Ian Snyders (currently on leave)		Metering points currently in MV90:	20000	Subtotal Western OU:	177 321 + FPI	SCADA Points for Western OU:	+ 70000	TOTAL WESTERN OU:	247 321
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1.10 STAKEHOLDERS

The following Stakeholders and their interests were identified in Table 5.

Table 5: Project Stakeholders

Stakeholder Division	Stakeholder Classification	Current Understanding	Level of Interest	Current Commitment	Required Commitment	Stakeholder Power	Required Support	Represented by:
Business Stakeholders								
Sponsor	Key Player	High	High	High	High	High	High	Simon Higgins
Executive Requestor	Key Player	High	High	High	High	High	High	Willy Majola
Gx Representation	Key Player	High	High	High	High	High	High	Derick Opperman
Dx Representation	Key Player	High	High	High	High	High	High	Tertius Hyman
Tx Representation and SCOT	Key Player	High	High	High	High	High	High	Ernest Mpshe
Group Technology	Key Player	High	High	High	High	High	High	Jason Hector
KSACS Representation	Key Player	Medium	High	Medium	High	High	High	Dharmesh Bhana
Primary Energy Representation	Key Player	Medium	Medium	Medium	High	Medium	High	Beaudine Hanson / Andre van Heerden
Renewables Representation	Key Player	Low	Low	Low	High	High	High	John Dean
Corporate Specialist National Control-Systems Support	Key Player	High	Medium	High	Medium	High	High	Richard Candy
Group Technology	Key Player	High	High	High	Medium	High	High	Rishi Hariram

Corporate Specialist (Energy Management System)	Key Player	High	Medium	High	Medium	High	High	Rosalette Botha
Plant Engineering	Key Player	Low	High	Low	Medium	High	High	Danie Odendaal
Production Engineering Integration-Coal	Key Player	Low	High	Low	Medium	High	High	Dhiraj Bhimma

2.1 AS-IS AND TO-BE

Figure 3 shows the current situation of the historians. It is noted that there are many different historians serving similar functionalities. The purpose of this project is to have one Enterprise Historian.

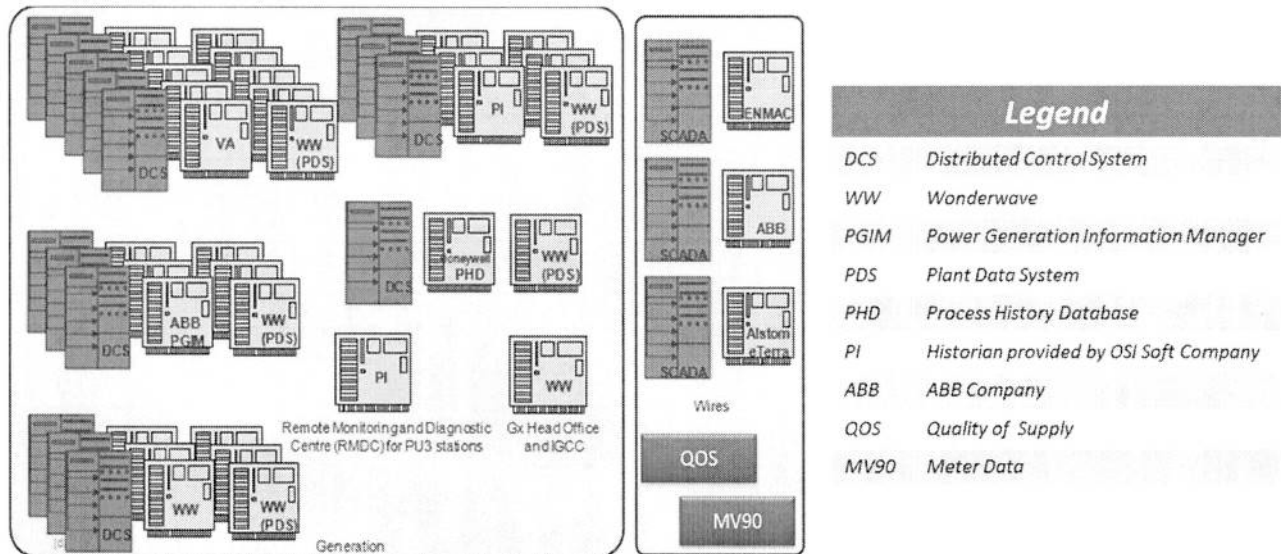


Figure 3: Deployment of Historians in Eskom's Environment (As-Is)

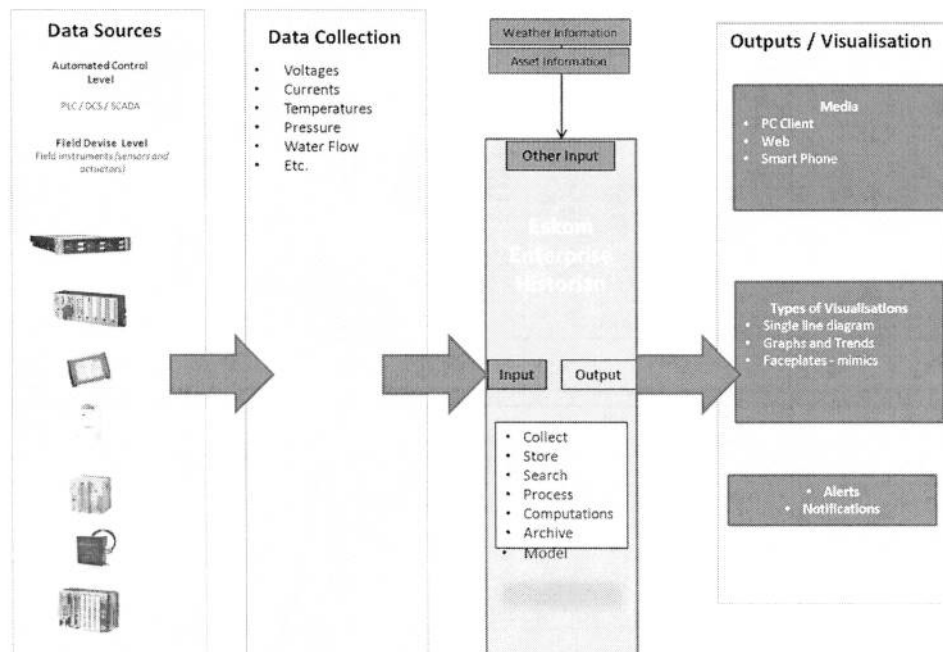


Figure 4: EH - TO-BE

2.2 FUNCTIONAL REQUIREMENTS

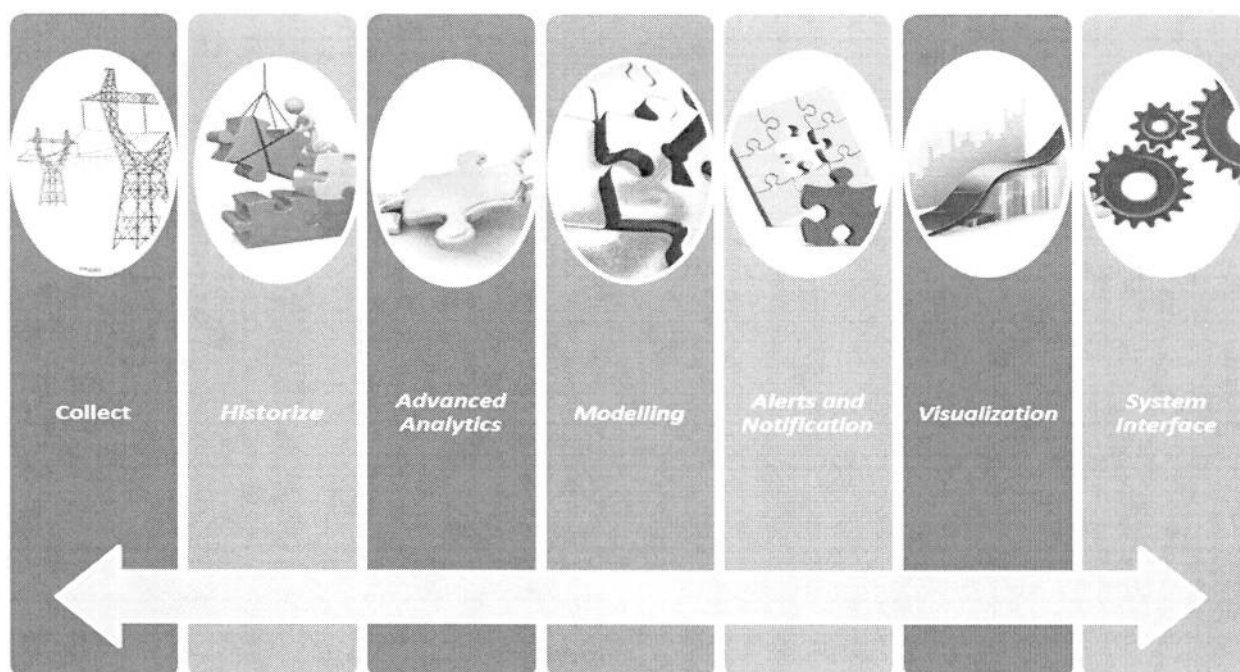


Figure 5: Enterprise Historian Components

The EH must consist of the following components, refer to Figure 5:

1. **Collect:** - The historian through its interfaces will retrieve all the required data as per the business processes and rules. The data sources for the EH are:
 - DCS
 - SCADA
 - PLC's
 - Substation-based Data Concentrators
 - Field Instruments / Remote Sensors
 - Weather data
 - Forecast data from external sources
 - MV90/ Meter data
 - IPP energy data
 - IPP forecast data
 - Closed coupled historians
2. **Historize:** - The data historian routes real-time data throughout the entire information infrastructure. The historian stores all the collected data to make a complete, set of relevant data available to all the users in the required formats need by different stakeholders.
3. **Advanced Analytics:** - A computing engine allows the design of complex process calculations. This allows the applications of complex calculations to multiple units and processes. The Analytics must utilise the model information in the process.
4. **Modelling:** - The historian will provide complex analysis based on the business process, the need and business rules. There must be a connection between the EH and Eskom's BI/MI standardised packages to create and publish reports and perform complex data analysis. A process reporting generator for the production of reports for both real-time and historical data. This has the capability to take data from sources both internal and external to the real time historian. Export data in file format from the EH. Schedule data exports to external systems for visualisation.
4. **Alerts and Notification:** - The capability to create and manage alerts and alarms in response to certain predefined conditions within a process or plant.
5. **Visualization:** - The user interface is critical for visualising real-time process data. Graphics package that enable users to create dynamic, interactive graphical displays. There is a suite of visualisation tools: process book [graphical displays], the excel addin

called datalink, coresight for thin clients and mobile platforms, SharePoint web-parts for portal integration, Activeview for DirectX components.

6. **System Interfaces:-** As defined by the enterprise ISA (International Society Automation) 95 model, the EH will interface with all levels of the business but limited to the project scope.

The system must perform the functional requirements captured in Table 6.

Table 6: Functional Requirements Summary

ID	Category	Description
	<u>Collect</u>	
1.		The original properties and characteristics of the data must be preserved.
2.		The system must be able to collect data from the various SCADA systems, metering and other sensors and field devices used by Eskom.
3.		The system must be capable of time-stamping data using an Eskom provided system time and date value or an Eskom supplied alternative.
4.		The system must be capable of allowing manual data input via Eskom standard operating systems and smart devices.
		The collection and storage for the following data must be provided (analogues could be either 3 phase or per phase):
5.		• Process Data
6.		• Configuration Data (Setting and configuration data of equipment)
7.		• Environmental (Weather) Data.
8.		• Geo location of measurement points
9.		• Asset Meta Data (Such as equipment ratings / nameplate data) – (This will be always a slave copy of the Asset master data)
10.		• Current
11.		• Power
12.		• Voltage
13.		• Distance (to fault)
14.		• Quality of supply data [e.g. total harmonic distortion [%], dip, sag and flicker oscillographic data]
15.		• Pressure
16.		• Volume
17.		• Vibration
18.		• Flow Rate
19.		• Counters
20.		• Waveforms [importing of high resolution COMTRADE files as time-series data represented by tags]
21.		• Temperature
22.		• Polled Numeric
23.		• Profile / Contour
24.		• Alarms
25.		• Protection events (SOE – a collection of tags that can construct an SOE.)
26.		• Operator Comments
27.		• Phase Angles between voltage and current and power factor
28.		• Discrete states [user defined. E.g. Open/Close, Bad/Good]
29.		• Operator entered data and control operations
30.		The system must be able to reference and display data from external

ID	Category	Description
		systems without storing it internally.
31.		Where the interface supports such functionality, the system must provide the capability of selecting the frequency at which data is sampled/collected from the source.
32.		The system will be able to change interval capture settings based on triggers set for example: rapid logging when the currents and voltages exceed the dead band values.
33.		This system shall be able to synchronize the data from multiple sources for the same data item.
34.		The system will include a buffer facility to serve as temporary storage in the event of failures at the primary servers.
35.		The system will be capable of storing both instantaneous and cumulative values
36.		The collection component of the system must retry if a connection is lost. Retry interval must be configurable per interface instance (since each interface might have different communication limitations)
37.		If the retries are unsuccessful for a configurable limit, the system must trigger an alarm
38.		The system must allow configuration of data validation rules to ensure the accurate and reliable capture of data. For example, check digits, data type checks, limit check, logic check
39.		The system must provide functionality to handle data validation exceptions For example, alerts, modifying the data, fill missing data.
40.		The system shall be capable of interfacing to Eskom building management systems (BMS) and access control systems used in substations.
	<u>Historize</u>	
41.		The system must be capable of storing data in a virtual storage environment
42.		The system must be able to retain the original data granularity
43.		Stored data shall be associated with a specific equipment or plant that can be used to filter the data in search queries.
44.		Timestamp resolution of tags shall support 0.1ms or better.
	<u>Advanced Analytics</u>	
45.		The system must provide the capabilities for searching (Programmatic or Manual).
46.		The system must allow access to search functionality by external systems.
47.		The system must have the ability to navigate and search through data, by type, source, time, and parameter values.
48.		The system must have the capability of finding items using inaccurate or incomplete search arguments.
49.		All searches must not be case sensitive.
50.		Scrolling must be allowed if multiple search results are generated.
51.		Where there are multiple tags for the same asset, searches should be permitted first by asset and then tag.
52.		The system must be able to perform computations on the data. (Simple computations: Addition, Subtraction etc. and Advanced computations: Fast Fourier Transforms, Lagrange interpolations etc.)
53.		The system must be able to store the new computed tags as new values.

ID	Category	Description
54.		Schedule these reports, with user defined intervals, and user defined destinations and format – electronic(file or email) / hardcopy.
	<u>Modelling</u>	
55.		Must be object oriented without methods/functions.
56.		Modelling must be, but not limited to, preserve object oriented relationships between elements such as parent-child, and association.
57.		Attributes of elements can be, but no restricted to, tags, static data, referenced data.
58.		The system shall be capable of mapping and representing all data in a hierarchical or network structure that is customisable by the user. The structure shall support both the physical layout of equipment as well as business processes.
59.		The system shall be capable of excluding user selectable data points from trends and analysis.
60.	<u>Alerts and Notification</u>	
61.		Alerts shall be delivered upon detection to a configured user or group for further action.
62.		The system shall support the raising of alerts that is based on user configurable triggers.
63.		The system must support the sending of alerts or notifications to multiple personnel
64.		Unacknowledged alerts shall be escalated by the system. Such functionality will ensure prompt action to faults.
65.		The system must have the ability to automatically attach other asset data [metadata] to assist in resolving alerts
	<u>Visualization</u>	
66.		The system must be capable of fitting curves to data (trending).
67.		The system must have the ability to record and provide access to alarms (post trip analysis and early warnings).
68.		The system must allow the provision of communication across multiple communication channels and platforms
69.		The system should provide Alarm / Alert history information
70.		All downloading of configurations will be acknowledged by the system to ensure that the settings were successfully downloaded.
71.		While polling intervals should be capable of being set by the system, the system should allow any abnormalities to be sent immediately as events to the respective support centres in the business.
72.		The history of the alarms and durations (age) will be available in CSV and PDF formats.
73.		The system shall be capable of visualising the following displays with supporting data from the enterprise historian.
74.		Single line diagrams of substation, networks and plant processes.
75.		Load profile of feeders, transformers, capacitor banks, reclosers, temperature and dynamic load duration curves.
76.		Monitoring of official network mitigation strategies to ensure their validity
	<u>System Interfaces</u>	
77.		The system must interface to other operational and non-operational engineering systems such EMS, DMS and MV90.
78.		The system must support OT protocols used for data acquisition from plant systems.
79.		File formats: csv, xml, kml

ID	Category	Description
80.		The system must provide access to other systems and databases through standard connectivity methods for example ODBC
		The system must allow importing of data directly from source systems or linking to the data in the source systems Link = referenced, source = duplicated in the EH.
81.		The system must allow either trigger based or manual refresh to synchronize data from linked systems.
82.		The system should allow the importing of an asset hierarchy from source systems
83.		Should provide downstream integration to existing plant historians
84.		Should provide upstream integration.
85.		The system should be flexible to allow for development and configuration of new interfaces as requested by the business
86.		The System must interface with weather data.
87.		There must be an interface existing for the reporting tools to link into the EHs data.
88.		Requires the EH to export weather data in Keyhole Markup Language (KML) and KMZ files (KML zip files) for use as input into operational visualisation tools.
89.		Data flows from system integration between IT and OT shall adhere to the OT cyber security standard.

2.3 NON-FUNCTIONAL REQUIREMENTS

2.3.1 Software Licensing

- ✓ Negotiate with supplier for an Enterprise Agreement. This will enable the use of unlimited tags.
- ✓ Include all functionality and server components to be inclusive.
- ✓ SLA's to manage contract to be developed
- ✓ Negotiate a phased approach to implementation

2.3.2 Operational requirements

The adoption of the infrastructure provided by this URS will be Enterprise Wide.
Provision is to be made for usage of the infrastructure by:

- ✓ Primary Energy
- ✓ KSACS
- ✓ Technology
- ✓ Transmission
- ✓ Distribution
- ✓ Generation Operation Units
- ✓ Renewables

2.3.3 Technology and Portability Requirements

The data from Real time historians are to be used in the following context:

- ✓ Management support
- ✓ Operator assistance
- ✓ Trip Monitoring and Diagnostics
- ✓ Routine Plant Monitoring
- ✓ Specialised Monitoring
- ✓ Alarm/Alert Management
- ✓ Remaining life calculations
- ✓ Recommendations and advisory

- ✓ Training
- ✓ Mentoring
- ✓ Skills transfer
- ✓ Forecasting

2.3.4 Usability Requirements

The system must have the following:

- ✓ Graphical User Interface
- ✓ The system shall support graphing of trends using raw or computed data.
- ✓ The system must be capable of allowing external applications access to data stored within the system (i.e. visualization, automation tools)
- ✓ The exact visualisation capabilities and requirements will be determined by the specific usage and integration patterns of the identified projects and stakeholders
- ✓ Level of help required (including tutorials, wizards, context sensitive help)
- ✓ Operating environment in which components of the solution will operate (e.g. will it be used by unskilled people in an industrial setting, it may be used by elderly or disabled users)
- ✓ Environmental (Weather) Data : Two sets of data based initially on a Southern African 30 x 30 km grid matrix of as follows:
 - 24 hour prediction of the parameters listed below at 15 minute intervals updated each hour
 - 7 day prediction of the parameters listed below at 1 hour intervals updated at midnight each day.
- ✓ The level of fault-tolerance (error handling) required in the interface.

2.3.5 Training

- ✓ Training should be part of package negotiated with Supplier.
- ✓ Training in functional use per role to be provided.
- ✓ System administration training provided.
- ✓ Training manuals provided.
- ✓ Transfer of skills to key Eskom personnel/CoE.
- ✓ Training should be customised to the Business.
- ✓ Train the Trainer (CoE) approach can be used.
- ✓ Training should be provided "Just in Time" to ensure personnel do not lose the skills learnt.
- ✓ Provide updates to training material.
- ✓ Assist Eskom to create a Training environment.

2.3.6 Security and Access Control Requirements

The following are the security and access control requirements:

- ✓ The system must have authentication (User name and password for access control) as defined by the Eskom IT Security access standards.
- ✓ The system must have the ability to create roles and provide role based access. The management, configuration and authorisations of the roles will be determined during the design stage.
- ✓ Profiles also needs to be created for Access Control
 - Local PI Admin
 - Global PI Admin
 - PI Everyone (Read Access to Historian)
 - Could use Integrated Security with Active Directory(AD)
- ✓ Data Ownership needs to be determined (Business (OT), Group IT).
- ✓ The system shall provide users with different scopes of visibility of data, for instance of a single Power Station or all turbines.
- ✓ The system must maintain and Provide Audit Trail of all activities conducted by the system users
- ✓ The system must allow integration to Microsoft Active Directory for authentication.

- ✓ There will be a single, secure real time data hand-over point between the Real Time Historian and control layer systems.
- ✓ The Real Time Historian data Servers must be housed within a De-Militarised Zone [DMZ].
- ✓ Physical and Logical security must be enabled as per Eskom IS Security Standard, OT Cyber Security Policy and IT/OT Remote Access Standard.
- ✓ Security implemented as per IT / OT Governance Models, policies etc.
- ✓ Manage Third Party access as per support agreements.

2.3.7 Supportability/Maintainability

- ✓ Ability to provide remote support 24/7
- ✓ Appropriate SLA's need to be created
 - Between Supplier and Business Partner
 - Between Business Partner and Eskom
 - Between Internal Service Provider and Eskom
 - Group IT and Business(OT)
- ✓ Supplier to Provide Bug fixes
- ✓ Supplier to provide Software updates
- ✓ Group IT CoE and OT CoE must be developed. Both CoE's can be merged to form one CoE.

This system will have the same critical level as SCADA if information from the EH is used in the control rooms see Table 7.

2.3.8 Scalability

The system must be scalable and capable of handling at least 20 million tags:

- ✓ Generation: 10 million (Coal, Peaking & Nuclear power stations) , RMDC and IGCC
- ✓ Distribution : 8 million (Considered 3500 substations, 250 000 MV Transformers)
- ✓ Transmission: 2 million (Considered 230 Substations, System Control) Performance Requirements.

2.3.9 Reliability and Performance

The system must have no loss of performance, as volumes increase from the inception of the service to the point where the envisaged final state is achieved (20 Million tags).

The tags will be implemented over 5 years as follows:

- ✓ 30% of the tags will be implemented initially, including the take on of exiting tags.
- ✓ 17.5% of tags will be implemented per year for 4 years.

The system must not exhibit performance degradation as the frequency of data accesses is increased, provided due diligence is applied in capacity planning.

2.3.10 Solution Availability

Table 7 indicates the requirements from the various stakeholders on the availability of the system.

Table 7: Stakeholders Requirements for Availability of the Historian

Business Units/ Stakeholders	Information Required	Data Frequency	Impact if the System is Unavailable
National Control and other Regional Control Centre's	• NCC requires non-SCADA data, such as weather data, fire, GIS. • RCC needs non-SCADA data such as QOS and outages	• 24/7 • Real time	Mission Critical This may require to change to Tier 0 : Safety and Revenue Critical if weather data and forecast data is used to change the generation pattern which may have an

Tx Group: BIPM – Business Integration and Performance Management Grids Grid Planning AME. Dx Operating Units	• Need non-SCADA and SCADA data, maintenance history, lightning data, fire data for the following: ○ Incident Resolution ○ Forecast to achieve to stability ○ To dispatch renewables ○ Incident (Interruption and Plant Failure) investigation ○ QOS incident investigation and managing network operation ○ Performance analysis ○ Performance Reporting • Need line loading data • Fire • Weather • Lightning • Single line diagram • GIS map • Plant specifications, condition and performance • Need Historical Load data ○ QOS compliance reporting	• 24/7 • Daily	impact on payments. Business Critical
CE	• Need line loading data • Fire • Weather • Single line diagram • GIS map • Plant condition and performance	• 24/7 • Real time, mobile data	Unknown
Risk	• SCADA data • Non-SCADA data • Maintenance history • Lightning, fire, etc.	• 8/5 • Daily	Business Critical
Operation Planning	• Need data for power network snapshots		
Tele-Protection	• Need SCADA data for investigation	• 8/5 • Daily	Business Critical
Network Optimization	• Need Historical Load data • Equipment ratings	• 24/7 • Daily	Mission Critical

	- Statistical metering - Need fault data to validate simulated network models		
Network Planning	- Need Historical Load data - Equipment ratings - Statistical metering - Need fault data to validate simulated network models	Daily	Business Critical
EDNM	SCADA data	24/7 - Daily	Mission Critical
Field services	SCADA and condition monitoring data	24/7	Mission Critical
Billing	Need SCADA data and Statistical metering data	8/5 - Daily	Business Critical
Security	Video surveillance, access control, time and attendance records data	24/7 - Real time	Mission Critical
KSACS	SCADA data	8/5 - Daily	Business Critical
CoE Engineering – PTMC	Condition monitoring data	8/5 - Daily	Business Critical
CoE Engineering – Primary Plant	SCADA and condition monitoring data	8/5 - Daily	Business Critical
NCC Standby	- Telecoms and statistics - Performance and alerts	8/5 - Daily 24/7 - Real time	Mission Critical

2.3.11 Integrity

The system will be expected to provide a mechanism for the validation and verification of data. This system will ensure the integrity of data that is passed internally as well as between externally connected systems.

2.3.12 Recoverability

The system must be available 24/7. If the system is down all the data must still be made available offline. Once the system is online again, it must sync the data.

2.3.13 Archiving Requirements

- Retention period for different types of data must be determined in the detail design.
- Consider system and data compatibility when versions change.
- Include the use of integrated archiving solutions.
- Active data, medium term archive and long term archive periods must be determined in detail design.
- Data must be archived for the lifetime of the plant.