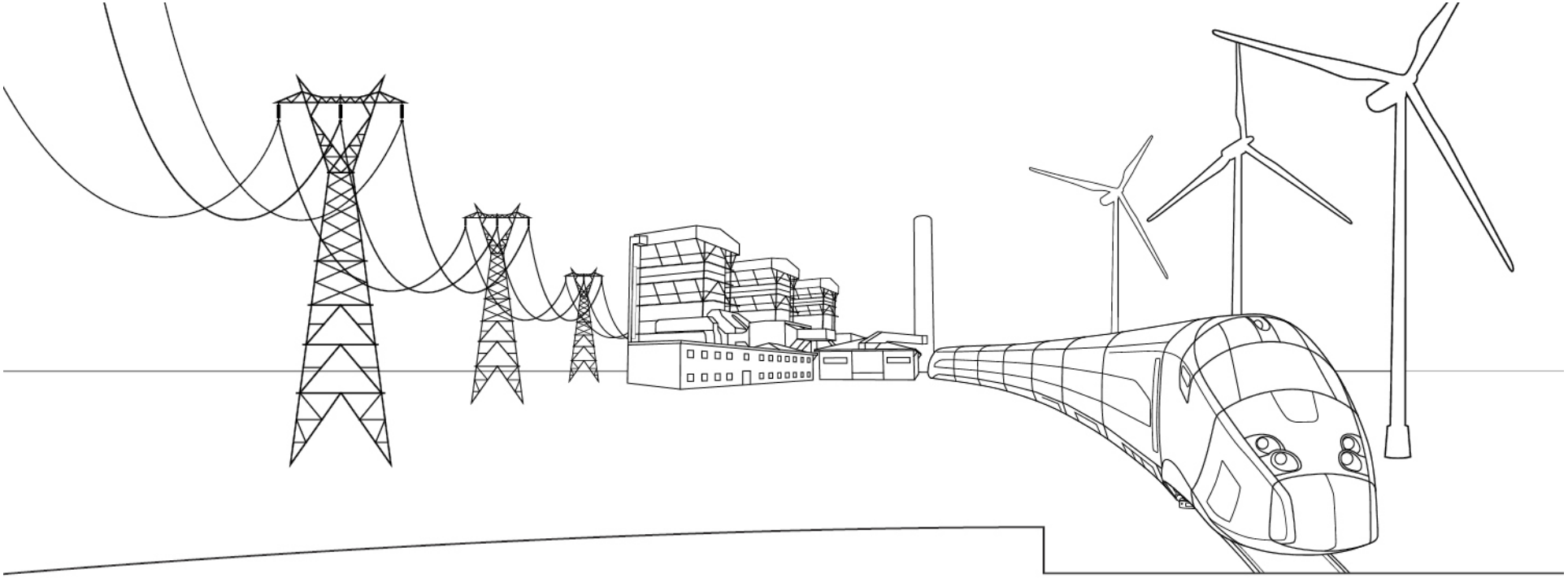
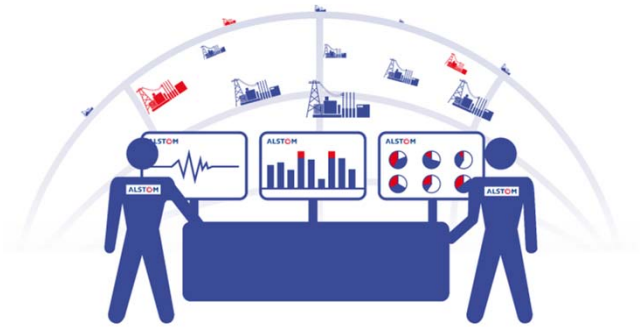


Flexible Analytics for Asset Management of Distribution Networks



Hamed HEYAT

Grid Of The Future

October 2014

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Shaping the future

Managing Electrical Assets: What is at stake?

Asset Management Perspective

- How to develop the best **maintenance** strategy?
- How to develop the best **replacement** strategy?

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QATAR GTC 501 - Business Objectives Customer requirements

- Business Objectives:
  - maintain high level of **reliability** for the Distribution grid
  - fix **priorities** for condition based maintenance / repairs
  - enhance personnel & equipment **safety**
- Required process:
  - Assess **in live state** the current condition of the equipment, insulation, performance (probability of failure) and risk
  - Maintain a database
  - Enable asset management decisions to be made based on an accurate understanding of asset condition.
  - Identify the equipment that needs corrective action.
  - Suggest corrective action to eliminate possible failures

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GTC 501 – Project Summary

Business objectives: Priorities for Condition based Maintenance and Repair

- Assess in live state the condition of 150,000 distribution assets (12 asset types)
- Identify equipment that need corrective action
- Propose Maintenance and Replacement priorities via a consistent methodology from a central system

Alstom Grid Solution:

- 3 years contract
- Process & Tools:
  - ✓ Site inspections & Data collection tools,
  - ✓ Oil tests from Alstom Labs
  - ✓ eterraAssetCare for data consolidation, key indices & reports (AHI, EOL, ..)

KPI1: Measurements Coverage	KPI2: Health & Risk Assessment	KPI3: Periodic Reports

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GTC 501 – Scope of Works

- Identification and Condition Assessment of assets in:
  - 3,800 Indoor substations
  - 7,200 Outdoor substations
  - 300 Package units
- Scope:
  - Asset data collection
  - Visual inspections
  - Transformers Oil sampling and Analysis
  - Partial Discharge testing of switchgear and transformers
  - SF6 leakage detection
  - Infra-Red thermography of switchgear, Transformers, LV feeder pillars
  - Complete methodology and analytics for Condition and Risk based Maintenance
  - Evaluation of results and suggestion of Remedial Measures
  - Training of Utility staff

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GTC 501 – Design process

Field Side

- Design methods for PD, IR, Oil Analysis, Leak Detection
- Organize the data collection teams
- Select the Oil Laboratory for oil sampling
- Prepare specs for Field Mobility Tool

Software Side

- Design of Analytics + Work Statement for eterraassetcare
- Define the Data Dictionary
- Design the Data Collection File
- Define the H/W & S/W BOQ

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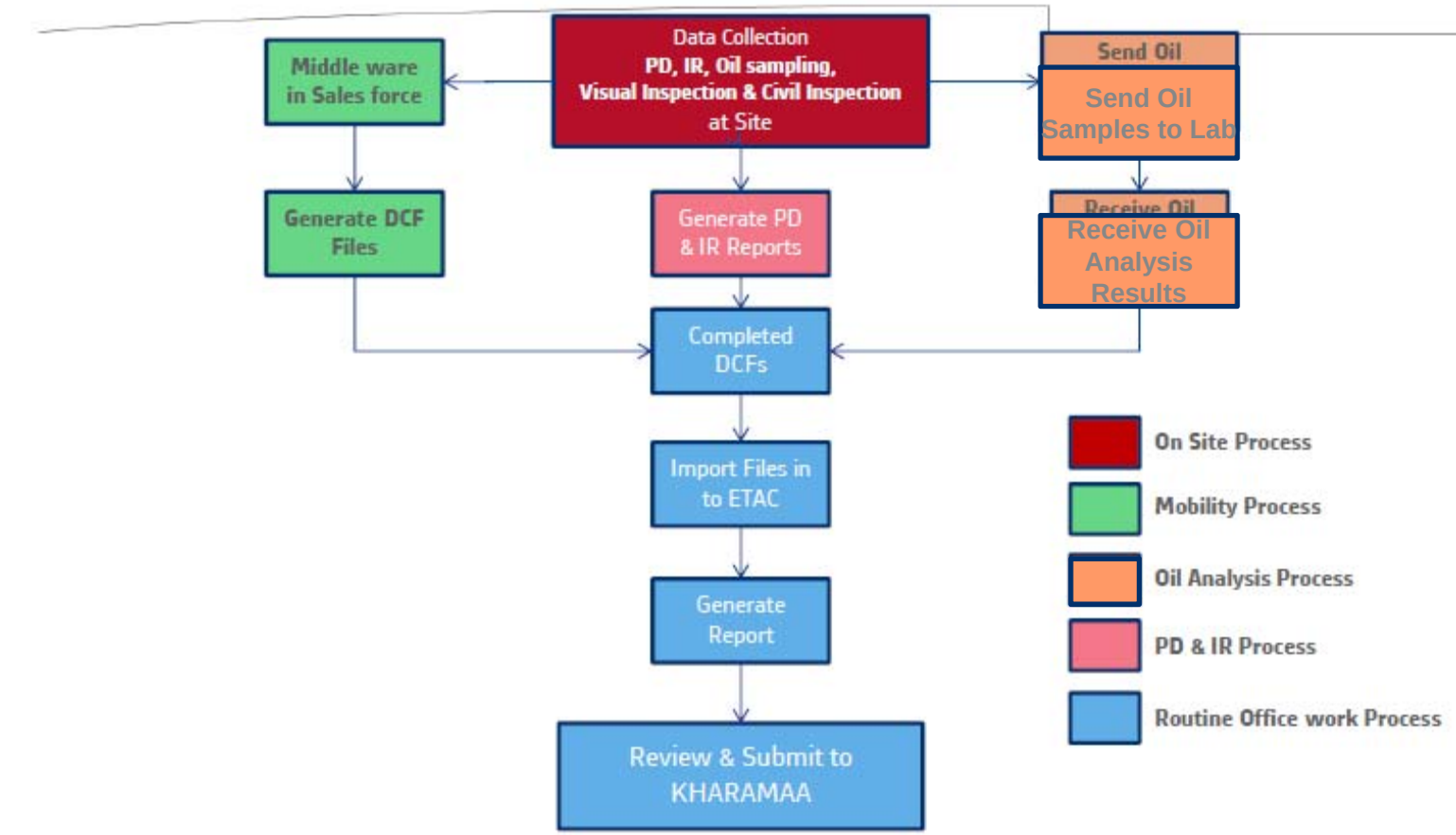
GTC 501 – Main Data flow



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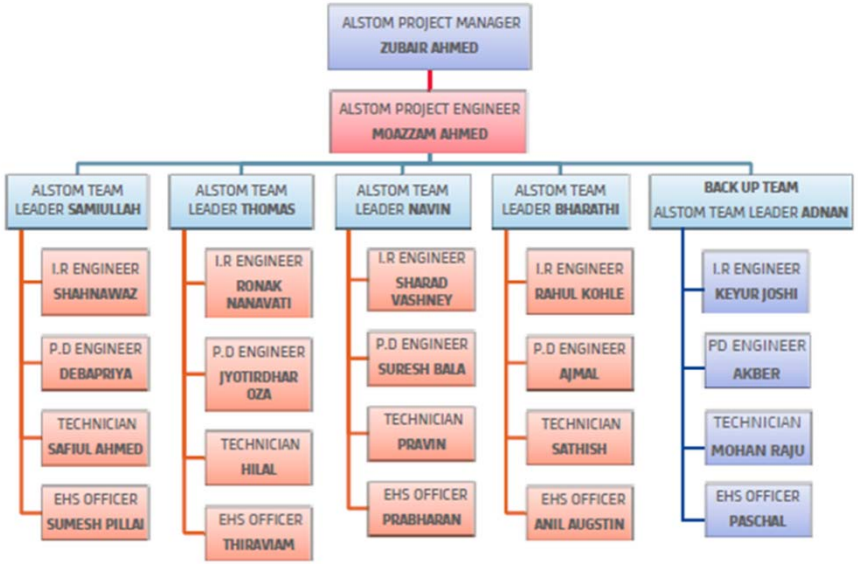
Site Inspection & Data Collection



KAHRAMAA — Qatar General Electricity & Water Corporation

Quality & Continual Improvement Department
Quality Assurance and Control Section

SITE QUALITY CONTROL INSPECTION

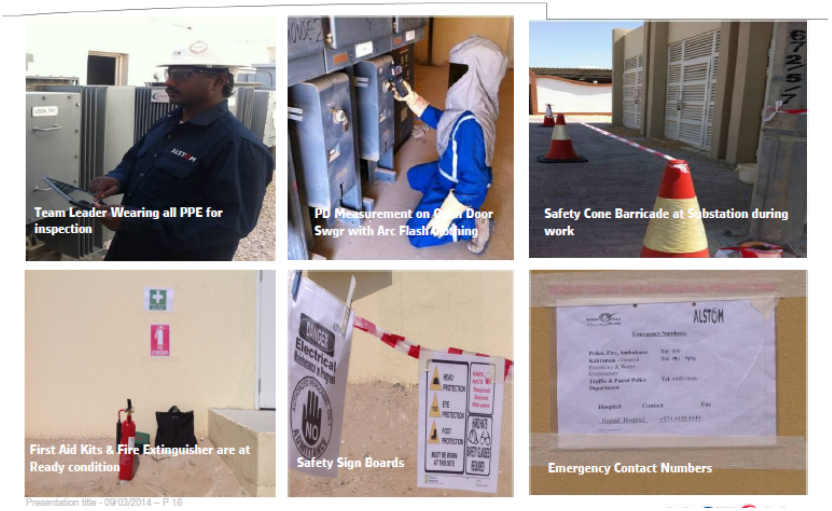
Good Points:

1. Conduct of safety briefing and orientation of the inspection and test to be performed.
2. Strict in the implementation of PPE at the site.
3. M/s Alstom have specialized personnel for the test to be implemented.
4. Good planning and execution of the inspection and test (photo #3,4,5)
5. M/s Alstom High management involvement of the works.
6. Implementation of Automated inspection and data gathering.

Sr. QCE:	Mario Solang	Signature:		Date:	01.01.2014
QA/QC HOS	Hesham Ali Hassan Al Ailah	Signature:		Date:	01.01.2014

On Site Routine Activities Photographs

Compliance to Safety Rules



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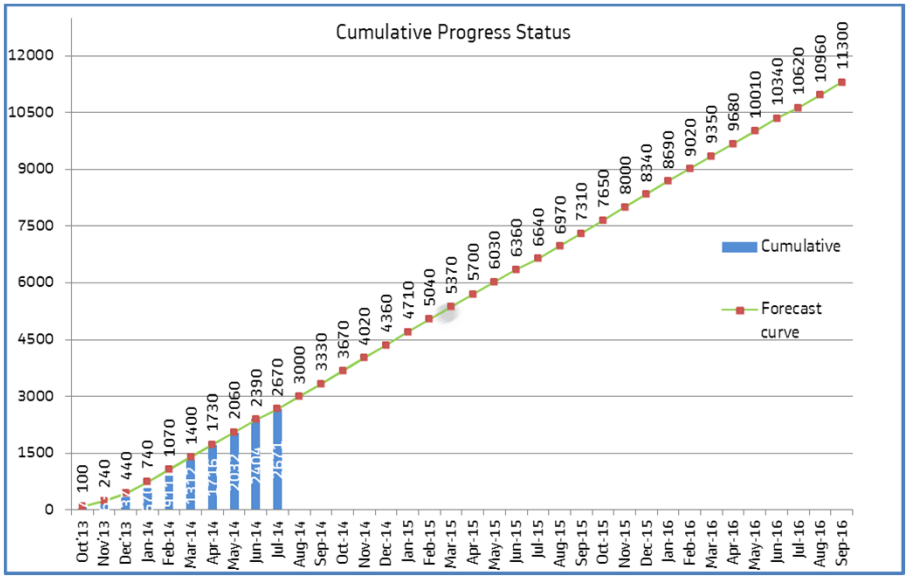
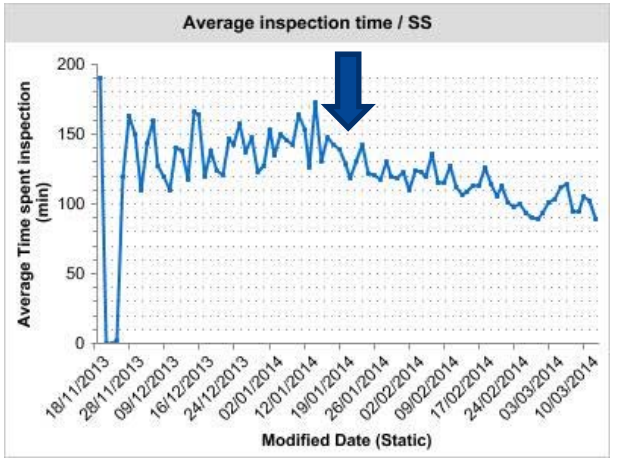
Progress of Inspections:
Tablet applications are a key enabler



30% productivity improvement



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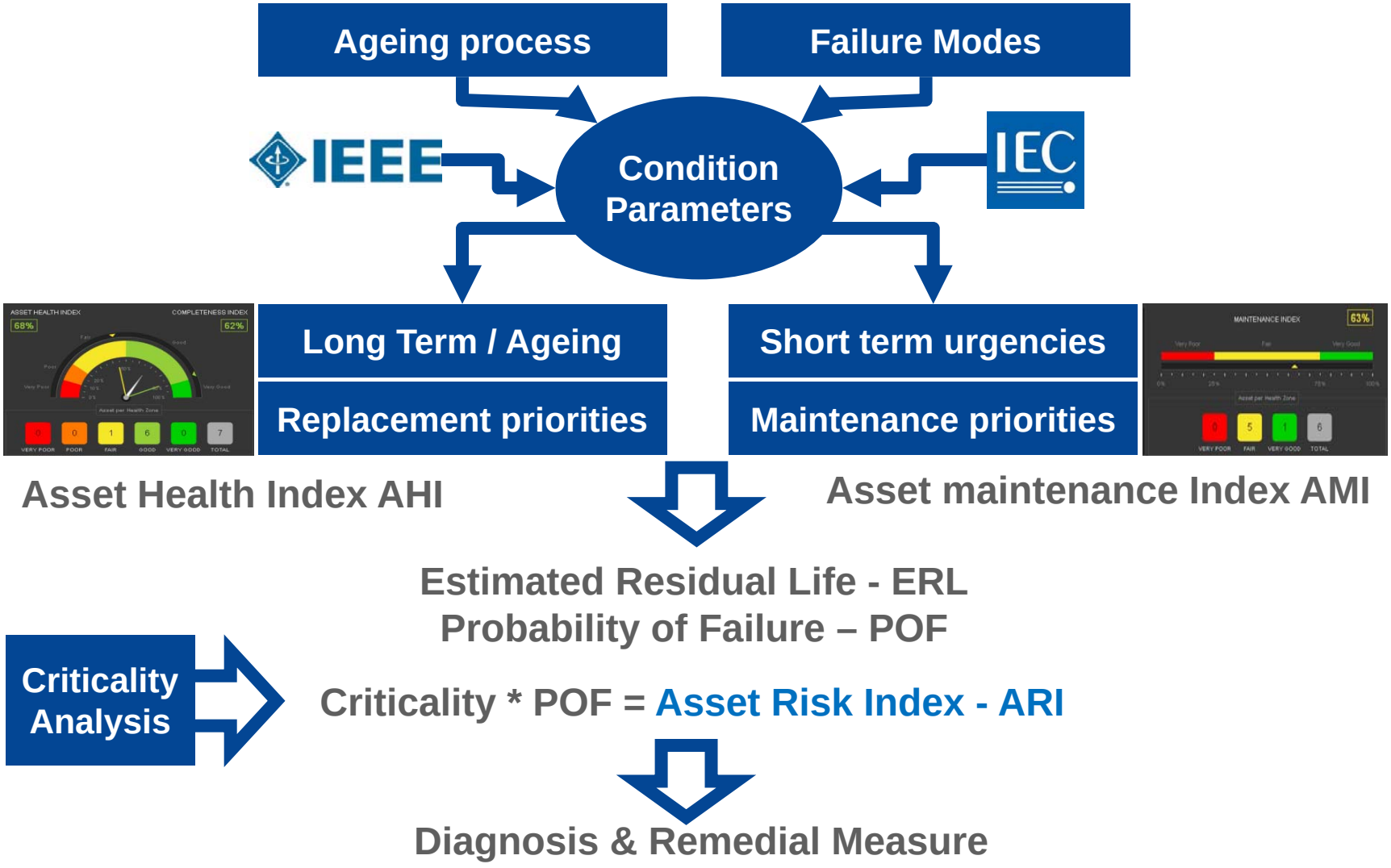
Health Management Analytics
e-terra*assetcare* methodology



Asset Health Index AHI and Health Zones

- Used to align Condition Parameters together
- Fully customizable

AHI	Condition	Expected Lifetime	Requirements
90-100	Very Good	> 15 Years	Normal Maintenance
80-90	Good	> 10 Years	Normal Maintenance
65-80	Fair	3-10 Years	Increase diagnostic testing, possible remedial work or replacement needed depending on criticality
50-65	Poor	< 3 Years	Start planning replacement or rebuild, considering risks and consequence of failure
0-50	Very Poor	Near end of Life	Immediately assess risk, replace or rebuild

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Summary of Analytics from **e-terra***assetcare*

	Index	Name	Purpose
1	AHI	Asset Health Index	Analyse the health in a replacement/end of life perspective
2	AMI	Maintenance Index	Where is the severity & urgency for action ?
3	CPLI	Completeness Index	Do we have all required data ?
4	ERL	Estimated Residual Life	How many years are left ?
5	POF	Probability of Failure	Of a major failure
6	ACI	Criticality Index	What is the $/€/QAR impact in case of failure ?
7	ARI	Risk Index	My exposure in $/€/QAR = ACI*POF
8	RM	Remedial Measure	What should I do ?

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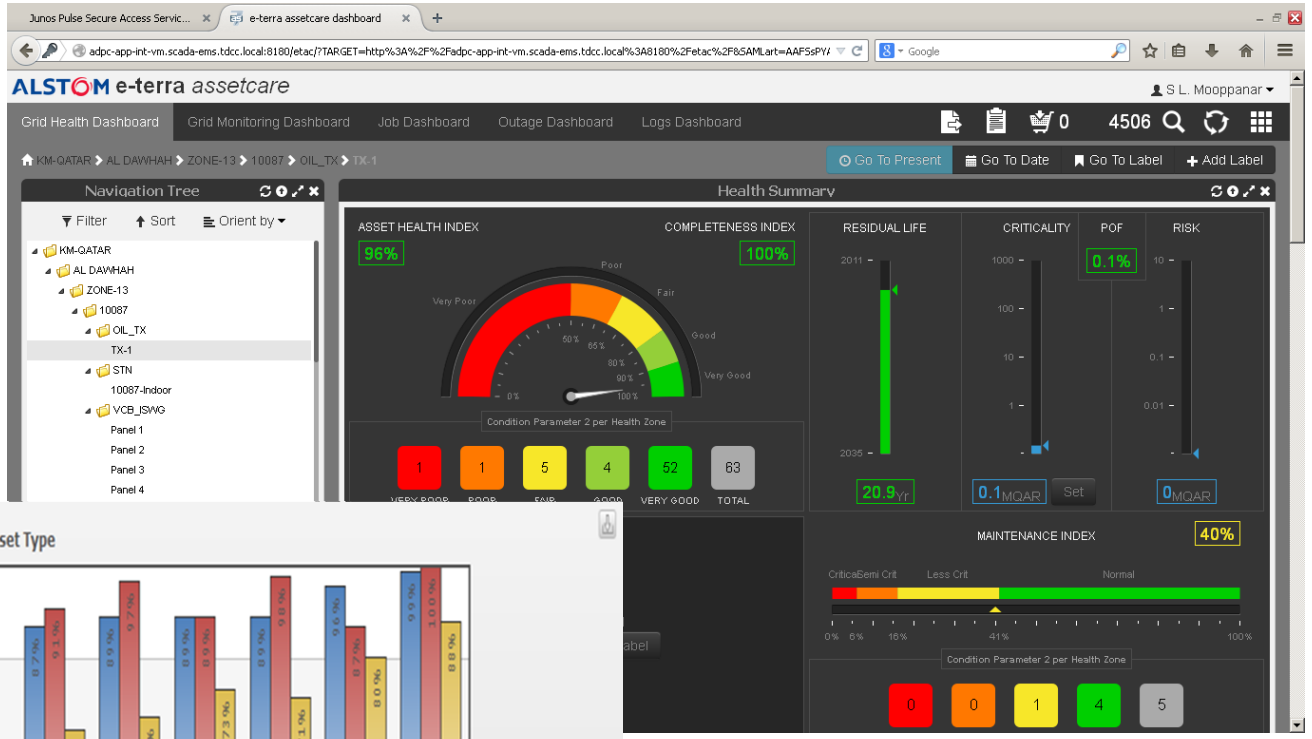
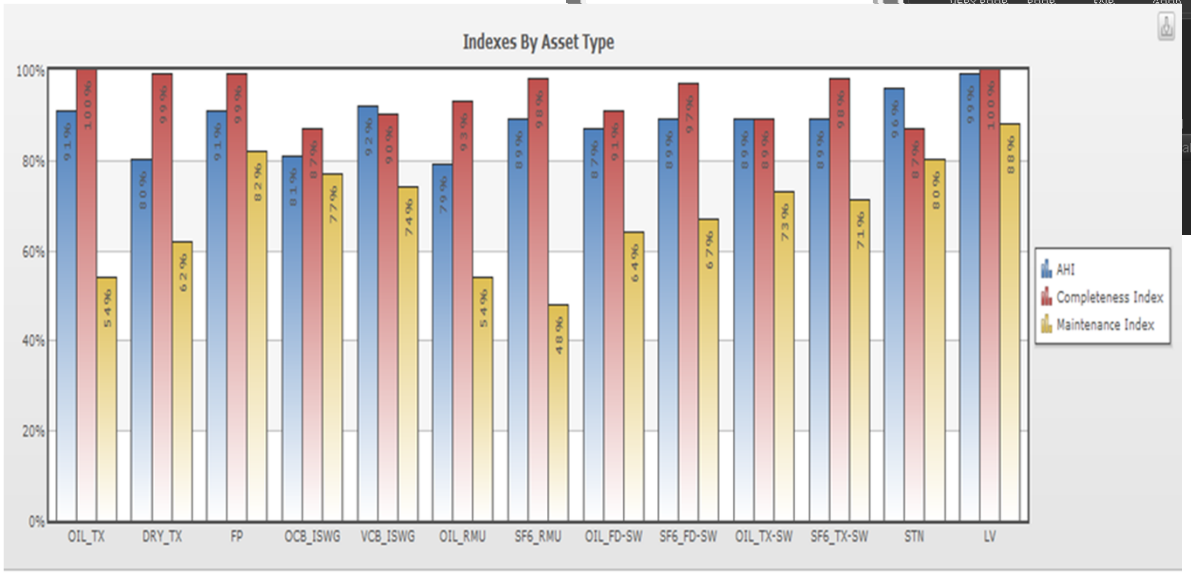
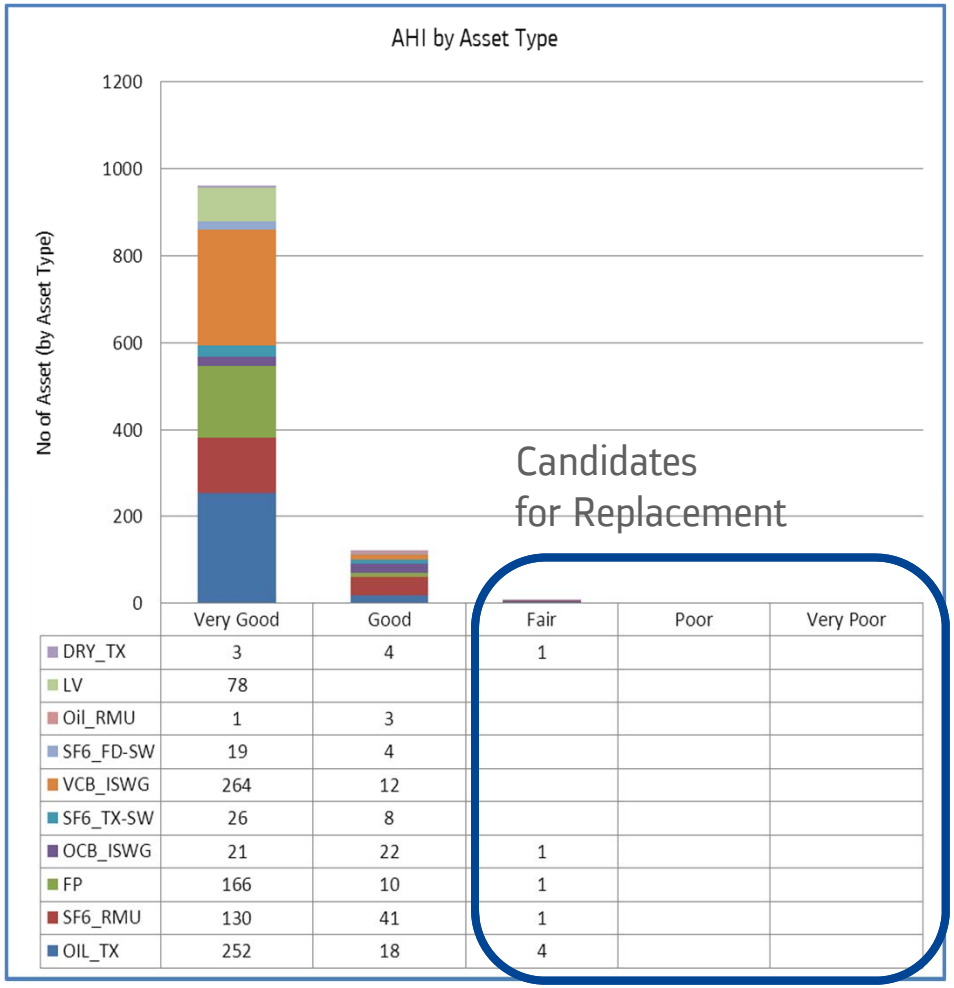
Analytics: Ex of Dashboards & Charts





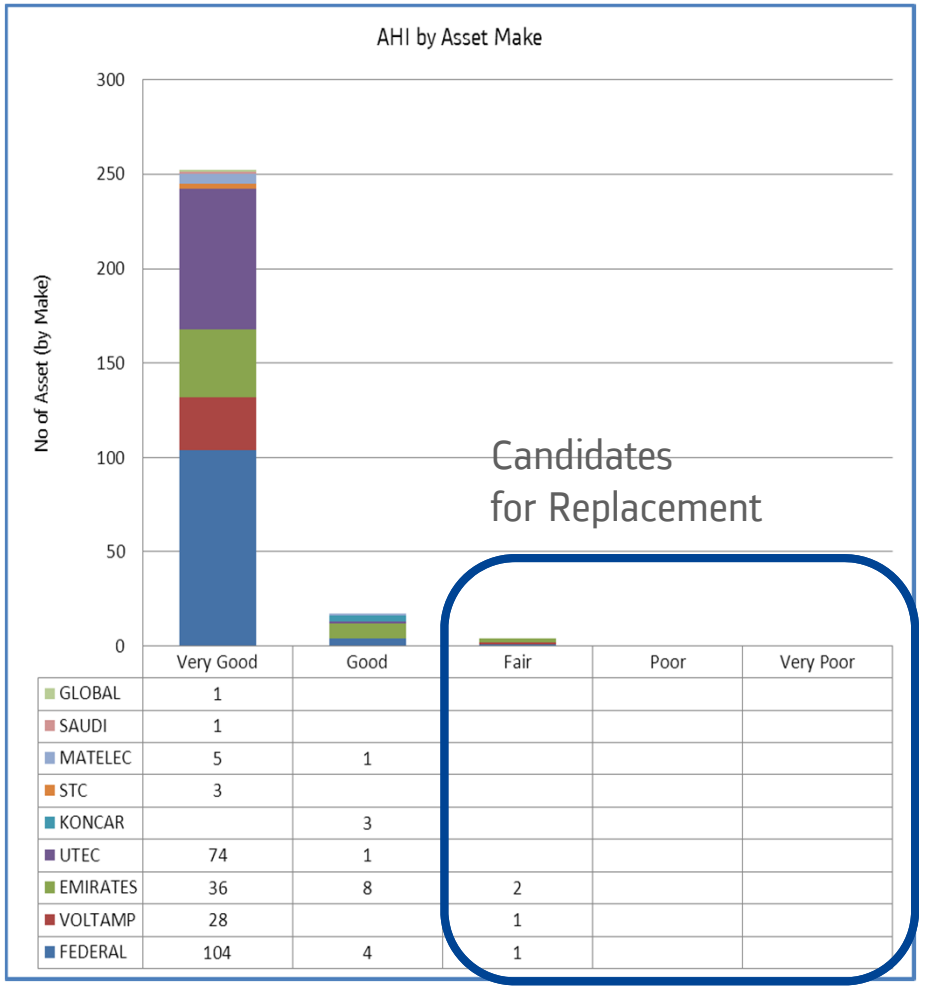
Monthly inspections / Customer Report
Ex of AHI charts

All Inspected Assets - per Asset Type



	Very Good	Good	Fair	Poor	Very Poor
DRY_TX	3	4	1		
LV	78				
Oil_RMU	1	3			
SF6_FD-SW	19	4			
VCB_ISWG	264	12			
SF6_TX-SW	26	8			
OCB_ISWG	21	22	1		
FP	166	10	1		
SF6_RMU	130	41	1		
OIL_TX	252	18	4		

Inspected Oil Transformers - per Make



	Very Good	Good	Fair	Poor	Very Poor
GLOBAL	1				
SAUDI	1				
MATELEC	5	1			
STC	3				
KONCAR		3			
UTEC	74	1			
EMIRATES	36	8	2		
VOLTAMP	28		1		
FEDERAL	104	4	1		

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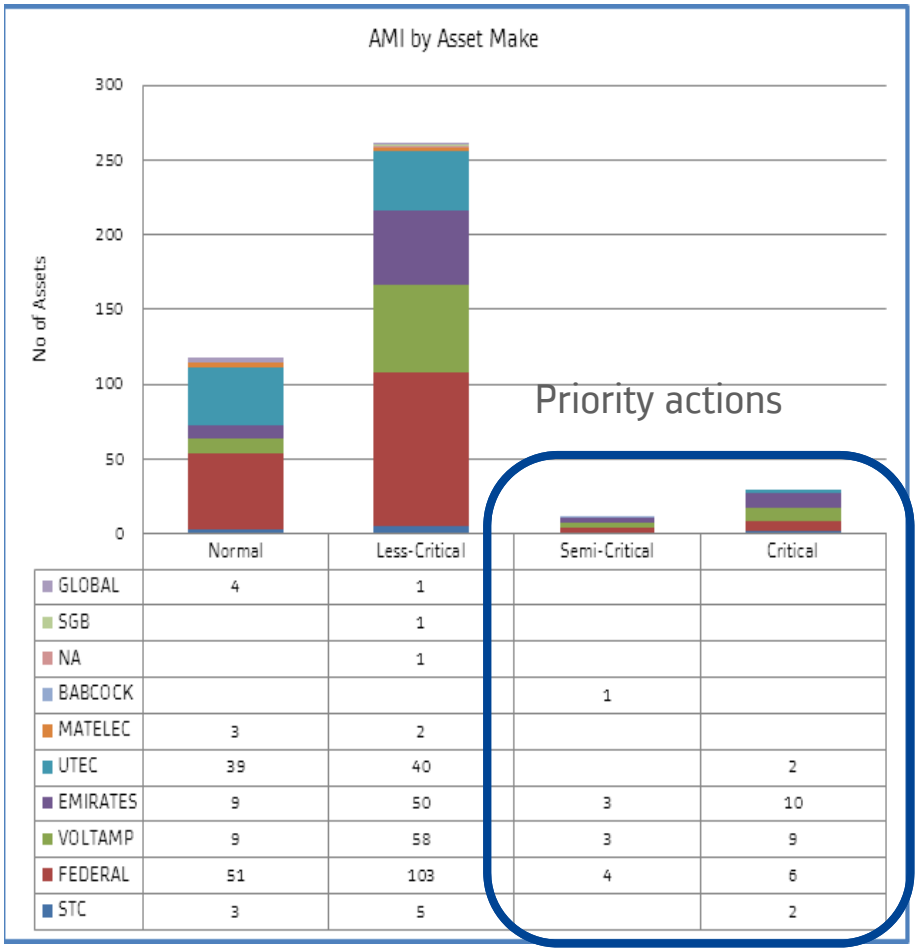
Monthly inspections / Customer Report
Ex of AMI charts

Maintenance Index - per Asset Type

	Normal	Less-Critical	Semi-Critical	Critical
DRY_TX	3	9		
OIL_FD-SW	1	1		
OIL_TX-SW	3			
LV	87	16		
OIL_RMU		4		
OCB_ISWG	35	15	1	
SF6_FD-SW	23	11	2	1
SF6_TX-SW	18	11		2
VCB_ISWG	192	232	12	1
FP	259	27	2	
SF6_RMU	20	186	21	6
OIL_TX	118	261	11	29

Maintenance Index - per Asset Make



	Normal	Less-Critical	Semi-Critical	Critical
GLOBAL	4	1		
SGB		1		
NA		1		
BABCOCK			1	
MATELEC	3	2		
UTEC	39	40		2
EMIRATES	9	50	3	10
VOLTAMP	9	58	3	9
FEDERAL	51	103	4	6
STC	3	5		2

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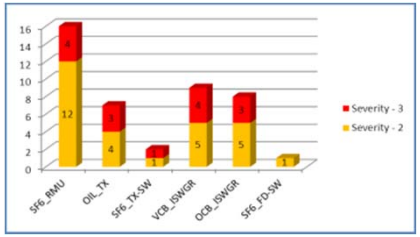
Benefits for Customer

- Comprehensive information on assets
  - Correct static description of assets
  - Detailed assessment of condition
  - Modern web based tool for sharing data
- Objective, reliable assessment of overall condition and urgencies for intervention
  - Effective scheduling of priorities
  - Decisions shared throughout the company
  - Indices can be used to assign global performance objectives
- Avoided Failures acknowledged by Customer - via:
  - List of critical maintenance actions
  - List of recommended replacements



Sr No.	SS No	Substation Name	SS Type	YOM	SR NO	MFG	Replacement Date
1	488	NEW SALATA 3	ID	2006	813628	Voltamp	09-02-2014
2	488	NEW SALATA 3	ID	2003	3280	Federal	09-02-2014
3	3065	N.D.-16	OD	1994	135388	South Wales	19-03-2014
4	10778	NEW WAKRAH SOUTH	ID	2006	8813919	Voltamp	12-01-2014
5	4427	Baharna HSQ South-3	ID	2007	8814323	Voltamp	20-03-2014
6	4008	Najeea West-11	OD	2004	15183	Federal	18-02-2014
7	1981	Najeea Sports Club	ID	2007	8813706	Voltamp	19-03-2014
8	3629	Fariq Blouch No-09	OD	2008	8816195	Voltamp	12-02-2014
9	3000	Doha Motor Showroom	OD	2006	18047/11	Emirates	20-03-2014
10	1034	Ghanim Garden 2	ID	1996	1895708	Emirates	26-01-2014
11	1049	Fahad Bin Abdullah	ID	2006	1701018619	Emirates	21-01-2014
12	1051	Montaza School-1	OD	2007	8814080	Voltamp	19-01-2014
13	3954	FERIQ BALOUCH 10	OD	2007	8814925	Voltamp	12-02-2014
14	2987	TRADE GALLERY	ID	1993	122884-56	Babcock	18-03-2014
15	20	SH FB Jassem-B	ID	NA	8813058	Voltamp	02-02-2014
16	16413	IH COMPLEX-4 S/S-4	ID	2000	1852304	Emirates	30-03-2014
17	2809	BANI HAJIR - 18	ID	2009	8817203	Voltamp	23-03-2014

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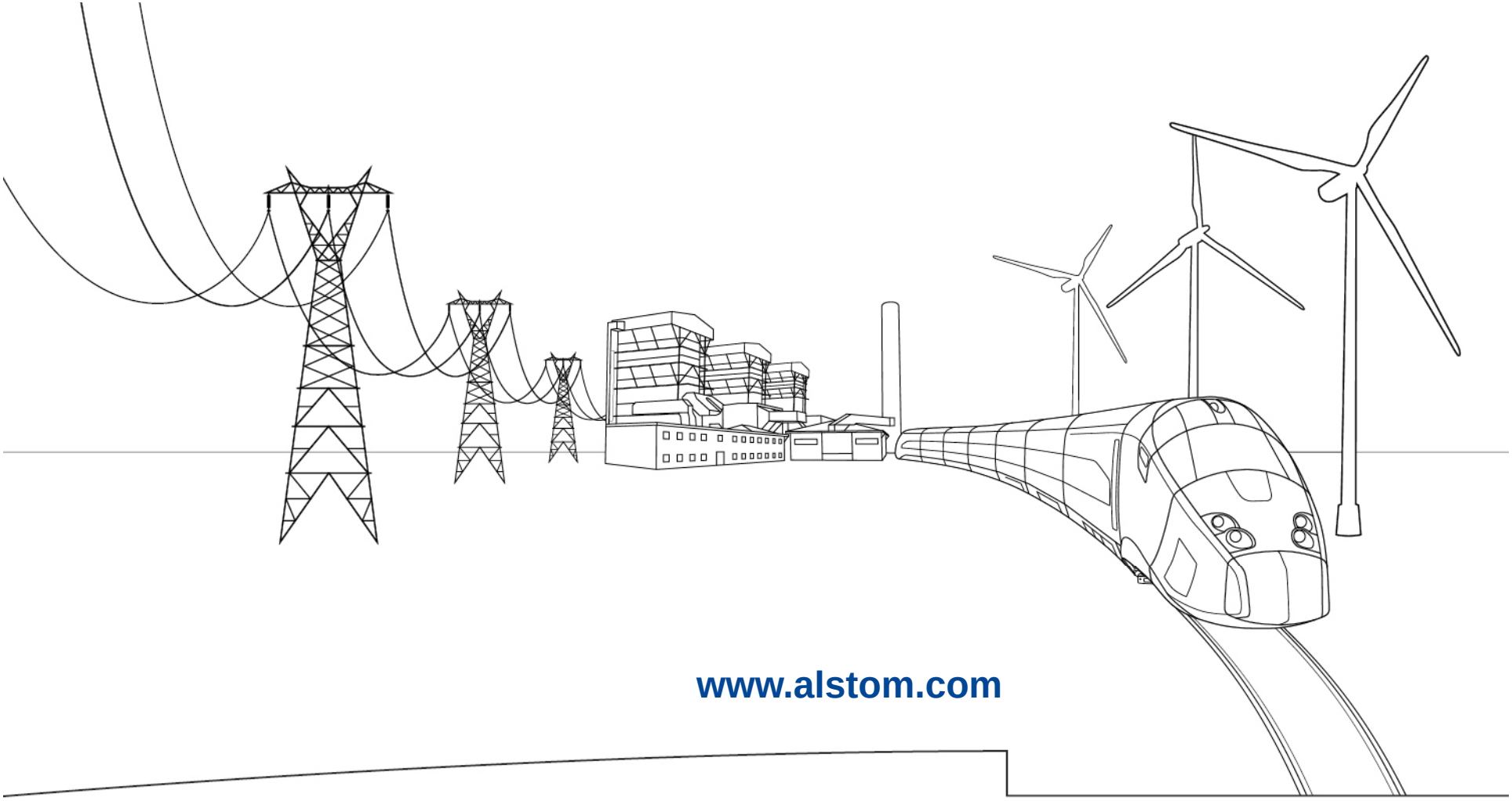

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