



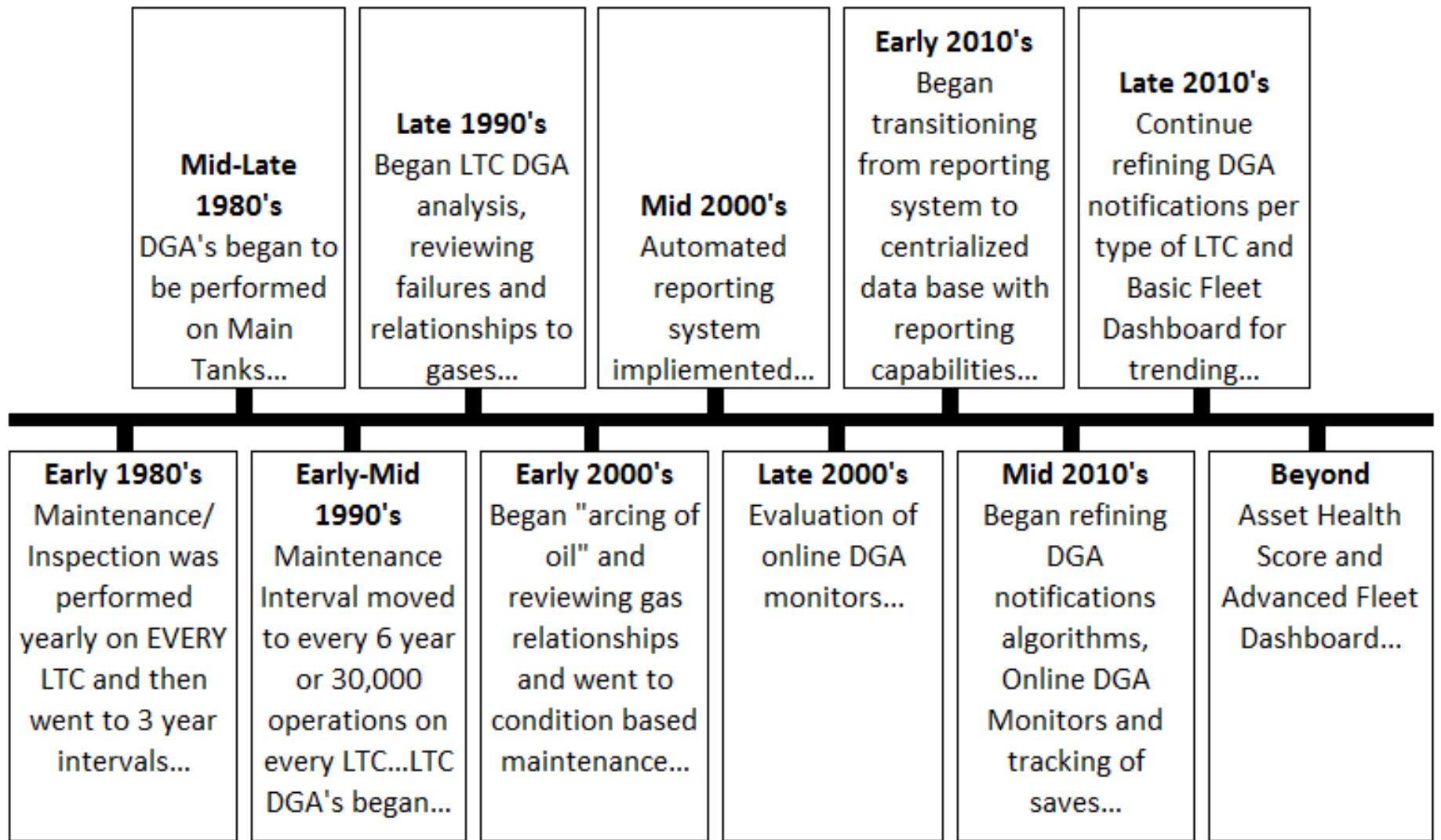
THE UNIVERSITY OF TEXAS AT ARLINGTON

DGA – Oncor’s Past, Present, and Future

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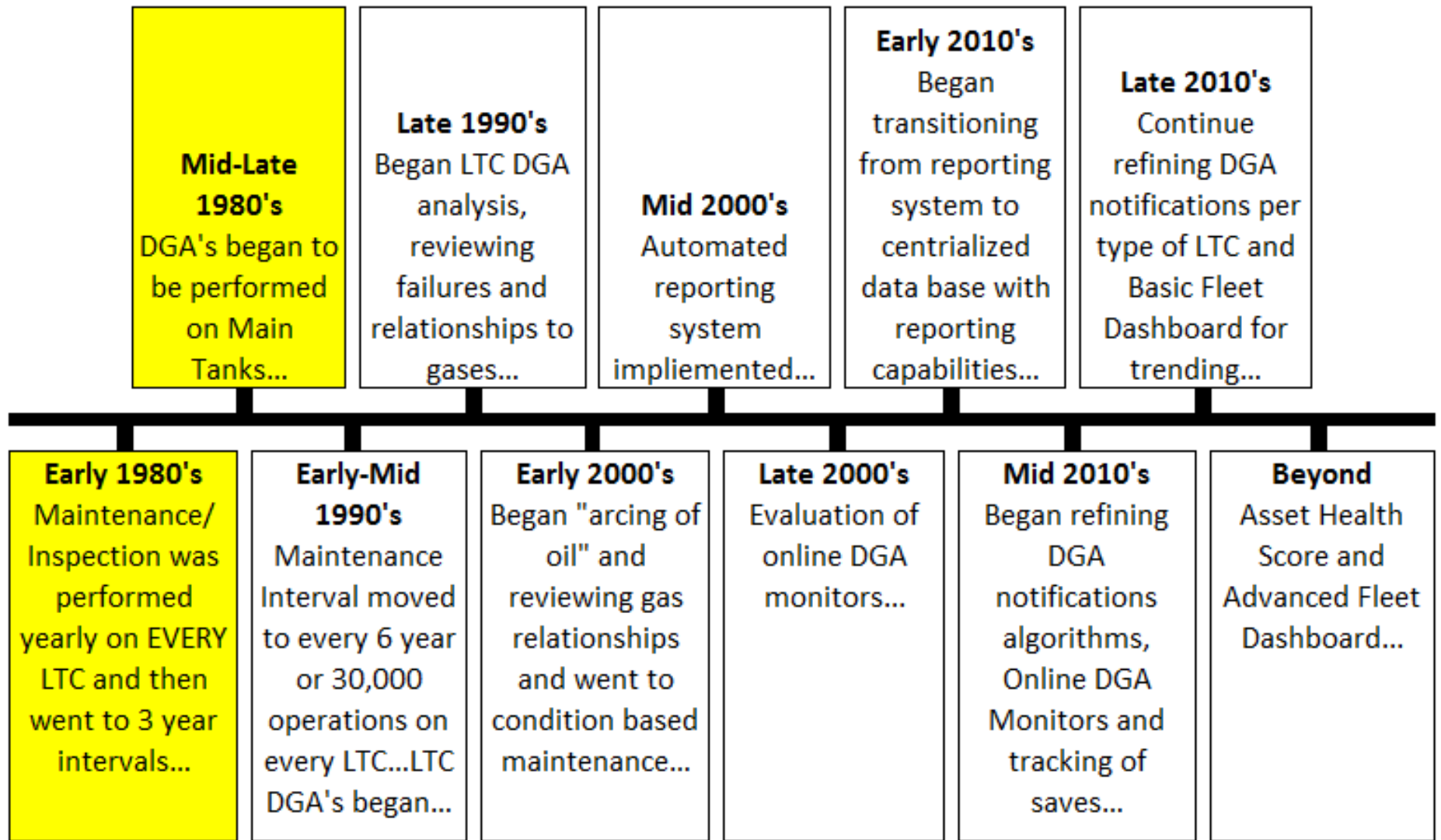
Hannah Webb



Oncor Transformer Fleet

Transformer	Approximate Number of Transformers	Approximate Number of DGA's Annually (not including resamples)
3 Phase with LTC	1,232	2,464
3 Phase without LTC	718	718
1 Phase Substations	75	0
Total	2,025	3,182

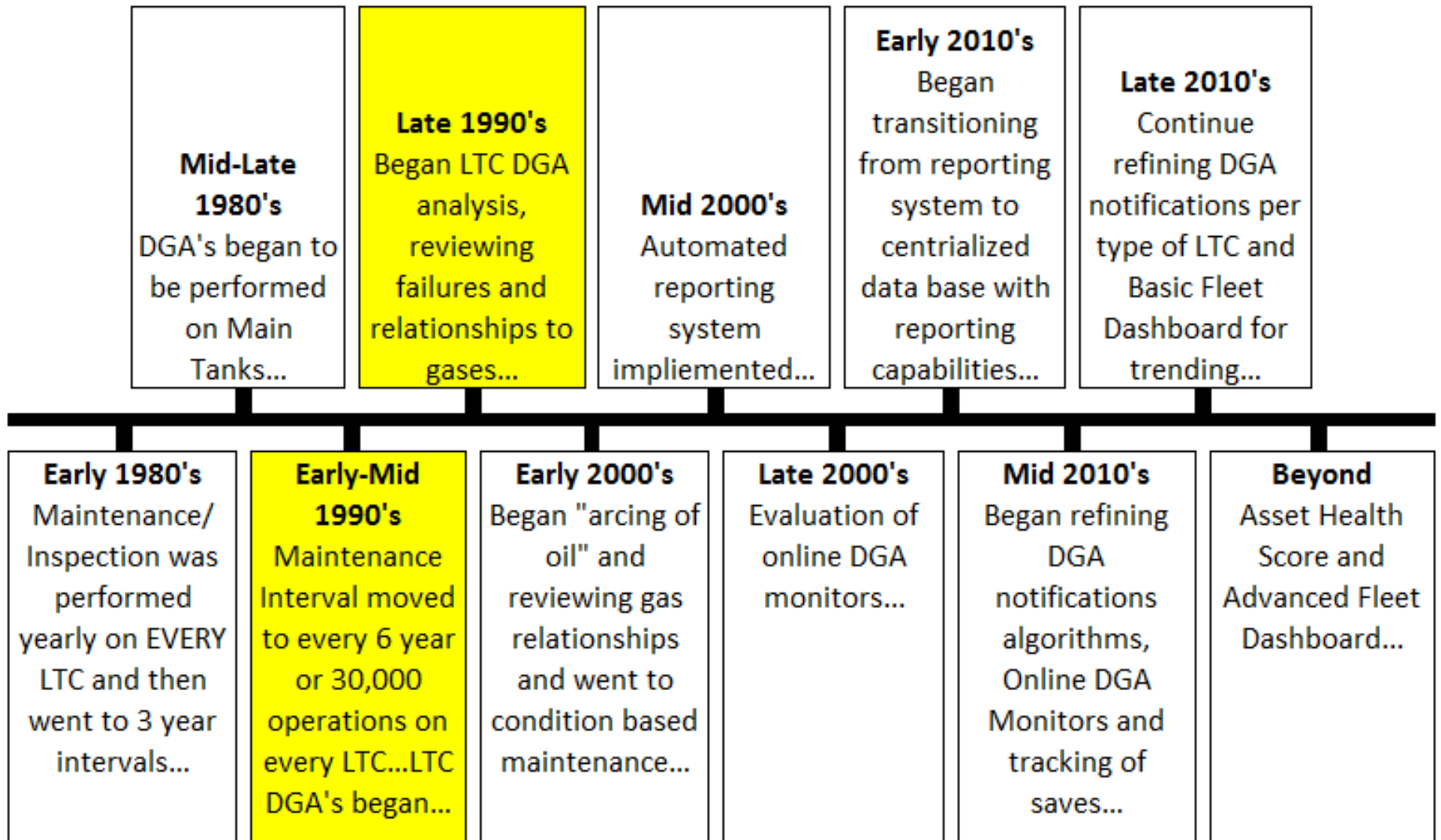




1980's

- Early 1980's
 - Time-based maintenance on every LTC yearly and eventually moved to every 3 years.
 - Very Labor Intensive
- Mid-Late 1980's
 - Dissolved Gas Analysis (DGA) began on main tanks.
 - Focus: Acetylene, Moisture Content, and Total Combustible Gas





1990's

- Early-Mid 1990's
 - Time-based maintenance on every LTC moved to every 6 years or after 30,000 operations .
 - Unknown condition between the 6 years.
- Late 1990's
 - Oncor committee formed to focus on the development of analyzing LTC DGAs.
 - Research cause of coking.



Mid-Late 1980's
DGA's began to be performed on Main Tanks...

Late 1990's
Began LTC DGA analysis, reviewing failures and relationships to gases...

Mid 2000's
Automated reporting system implemented...

Early 2010's
Began transitioning from reporting system to centralized data base with reporting capabilities...

Late 2010's
Continue refining DGA notifications per type of LTC and Basic Fleet Dashboard for trending...

Early 1980's
Maintenance/ Inspection was performed yearly on EVERY LTC and then went to 3 year intervals...

Early-Mid 1990's
Maintenance Interval moved to every 6 year or 30,000 operations on every LTC...LTC DGA's began...

Early 2000's
Began "arcing of oil" and reviewing gas relationships and went to condition based maintenance...

Late 2000's
Evaluation of online DGA monitors...

Mid 2010's
Began refining DGA notifications algorithms, Online DGA Monitors and tracking of saves...

Beyond
Asset Health Score and Advanced Fleet Dashboard...



2000's

- Early 2000's
 - Committee began experimenting with arcing in oil and reviewing the gas relationships.

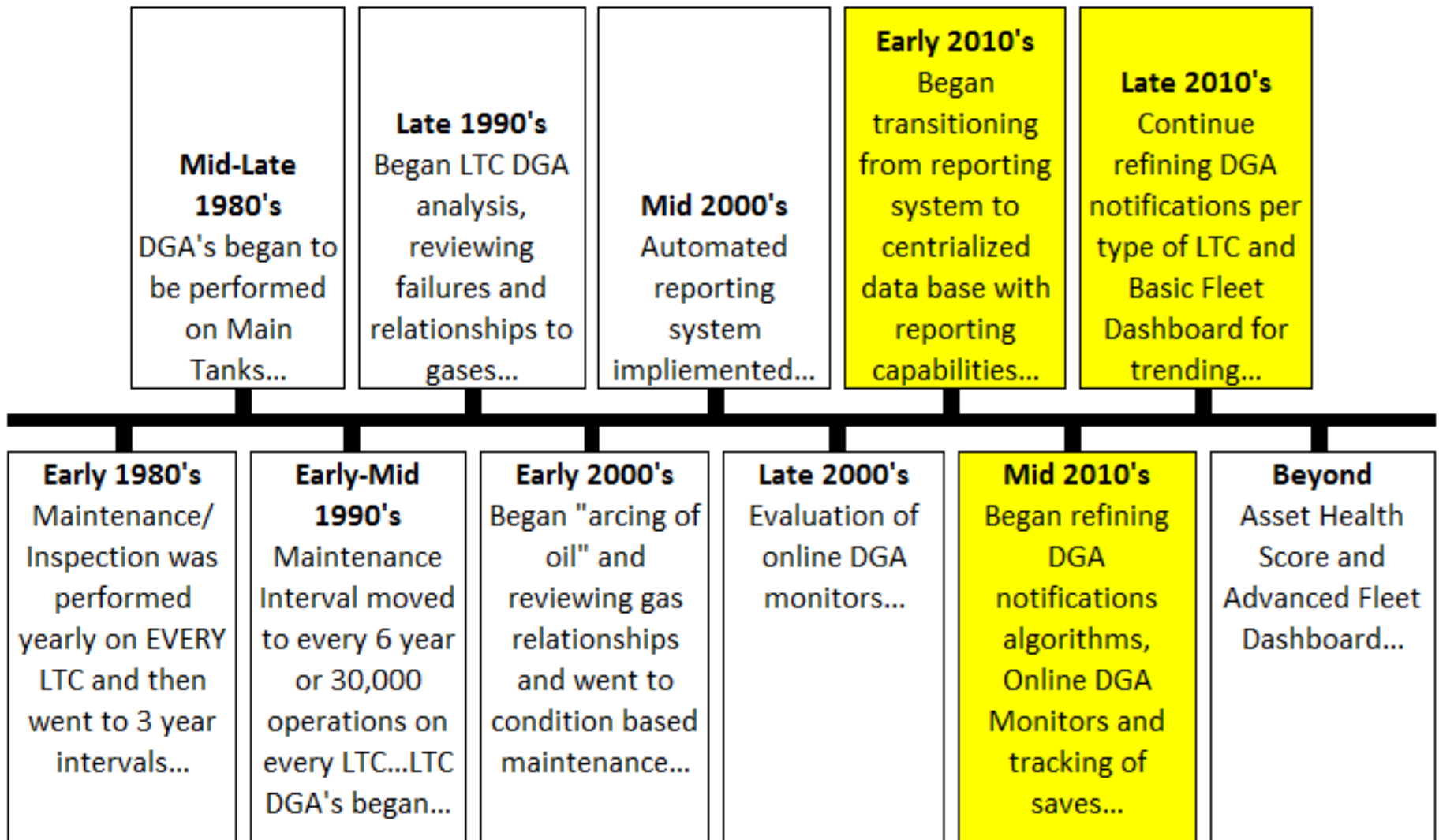
Number of Arcs	Hydrogen	Methane	Ethane	Ethylene	Acetylene	Gee's Ratio
1	0	0	2	2	18	0.11
10	105	12	4	20	185	0.11
20	155	19	5	38	311	0.12
10 W/water	96	11	4	19	187	0.10



2000's

- Mid 2000's
 - Transition to automated DGA email notifications.
 - Reporting system used algorithms developed by the committee to determine the condition of the asset.
 - Levels of Concern: caution, warning, wet, etc.
 - Notifications sent to specific lists of personnel.
- Late 2000's
 - Single and Multi-gas online monitors evaluated for selected autotransformer main tanks.





2010's

- Early 2010's
 - Transition to a centralized asset data base with reporting capabilities.
 - Same algorithms utilized
 - Better organization and tracking



413 - TRANSFORMER ACETYLENE C2H2 TRACKING

Region:	METRO WEST	Client:	ONCOR ELECTRIC DELIVERY TRANSMISSION
Office:	FORT WORTH	Serial #:	D203132
Location:	DUVAL	Metername:	DGAMAIN
Transformer:	DUVAL-TRF04	Compartment:	MAIN
Source:	LIMS	Manufacturer:	GE
Assetnum & Description:	253821 - Power Transformer,With Ltc, 3 PH, 69.00 KV, 12.5 KV, 38.8 KV, 7.2 KV, 20.0 MVA, POWER	LTC Class:	REACTIVE

Condition Base Monitoring : *Acetylene increases by 2 ppm or greater from the last sample.*

ACETYLENE_TRK

Action Item: *Resample immediately and ask the lab to rush the sample. If the acetylene content is verified, contact Equipment Support for further analysis.*

HISTORICAL DATA TABLE

Lab ID	16L04821	16L04368	16L04255	14L00736
Sample Date	Sep 27, 2016, 12:00 AM	Sep 8, 2016, 12:00 AM	Aug 30, 2016, 12:00 AM	Feb 14, 2014, 12:00 AM
Analysis Date	Oct 3, 2016, 12:00 AM	Sep 8, 2016, 12:00 AM	Sep 7, 2016, 12:00 AM	Feb 21, 2014, 12:00 AM
Oil Temperature	24	60	55	38

DISSOLVED GAS, PPM

Hydrogen (H2)	186	223	159	19
Methane (CH4)	643	633	611	140
Ethane (C2H6)	291	283	284	137
Ethylene (C2H4)	784	659	628	11
Acetylene (C2H2)	9	5	6	0
Carbon Monoxide (CO)	584	705	628	77
Carbon Dioxide (CO2)	6239	8404	8541	3744
Nitrogen (N2)	111018	119296	99440	66924

October 3, 2016 at 11:05:25 PM CDT

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SEPTEMBER 5 - 7, 2018

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Oxygen (O2)	3607	232	236	245
Total Gases	123361	130440	110533	71297
Combustible Gases	2497	2508	2316	384
TCG %	1.15	1.25	1.28	.27
Oil Dielectric (D1816)				

OIL QUALITY

Water	11	19	14	7
Water % Sat	16.92	7.88	6.83	6.51

GENERATION RATE (GR)

H2	-.87	CH4	.08	C2H6	.15	C2H4	1	C2H2	4.21	CO	-.9	Totalgas	-.02
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Comment 1	G, 11:30, OIL-24/70, WDG-26/70, BEFORE ENERGIZING, DUE TO GASING.
Comment 2	F.F, 14:00, OIL-60/73, WDG-62/72, RESAMPLE CAME BACK WITH HIGH GASES CONCENTRATION.
Comment 3	F.F, 12:45, OIL-55/73, WDG-55/72.
Comment 4	FF, 1030, OIL 38/45, WDG 38/45,



2010's

- Mid 2010's
 - Refinement of DGA notification algorithms on both main tanks and LTCs.

DGA Notification Refinements			
Refinement	Before	After	Reduced by
Moisture tracking	695	154	541
LTC	802	222	580
Total	1497	376	1121

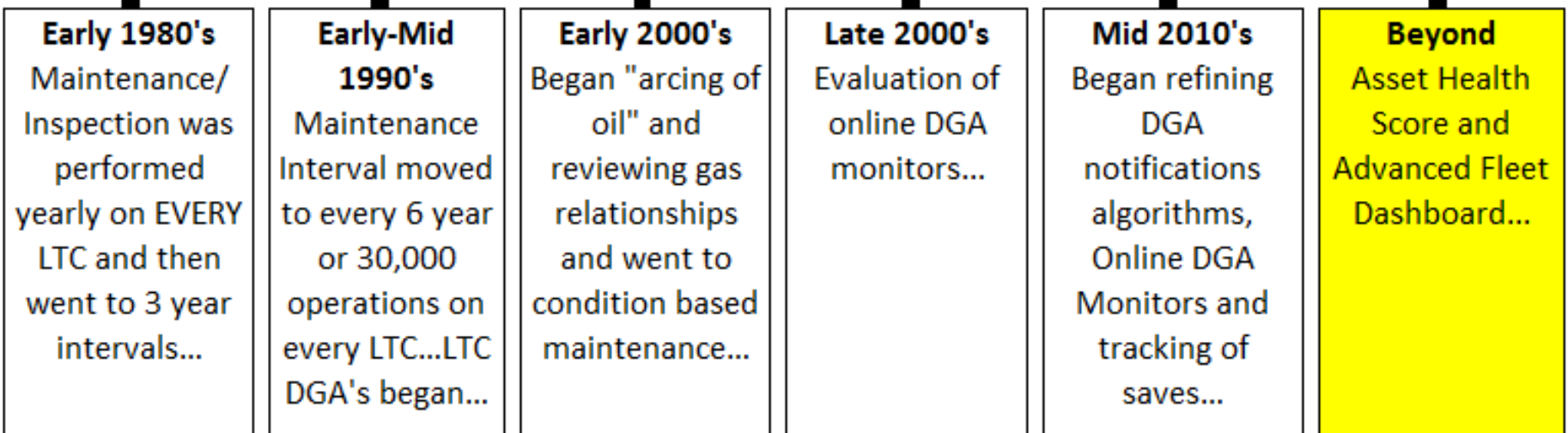
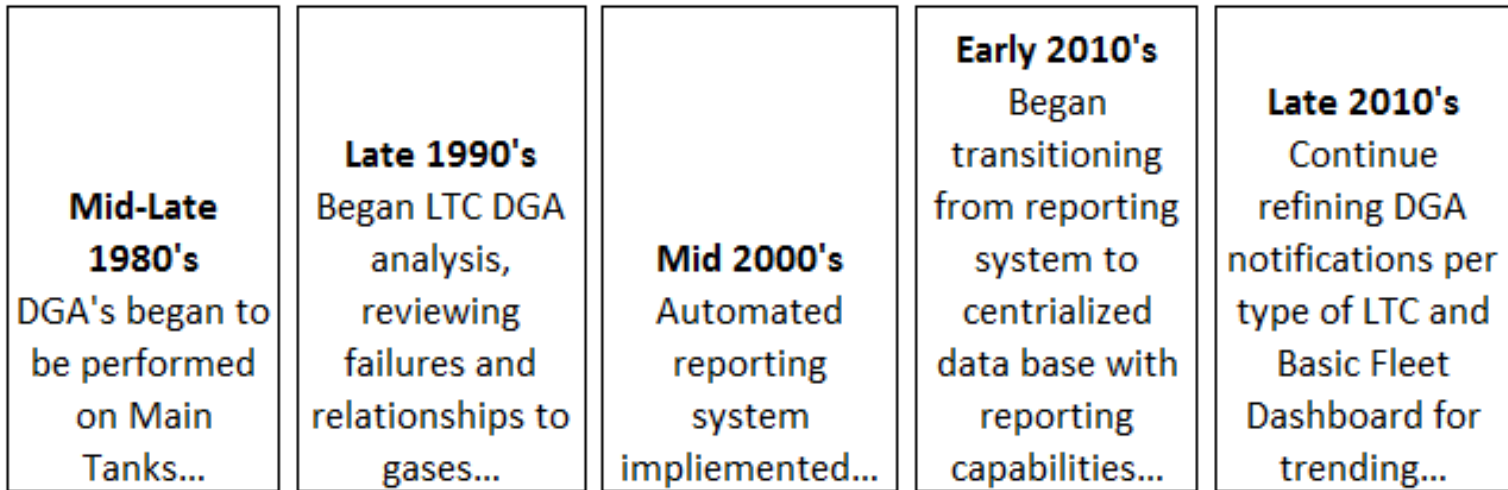
- Single gas online monitors were specified to come on all new medium power transformers on both main tank and vacuum LTC.



2010's

- Late 2010's
 - Basic DGA trending dashboard
 - Notifications setup for online monitors
 - Further refinement on DGA notifications
 - LTC model specific





Beyond

- Advanced DGA Fleet Dashboard
 - Arrange assets in order of highest concern
- Asset Health Score
 - Prioritize maintenance and/or proactive replacements based on score



Conclusion

Saves Based on DGAs (2016 to 2018)	
Transformers	19
LTCs	36

