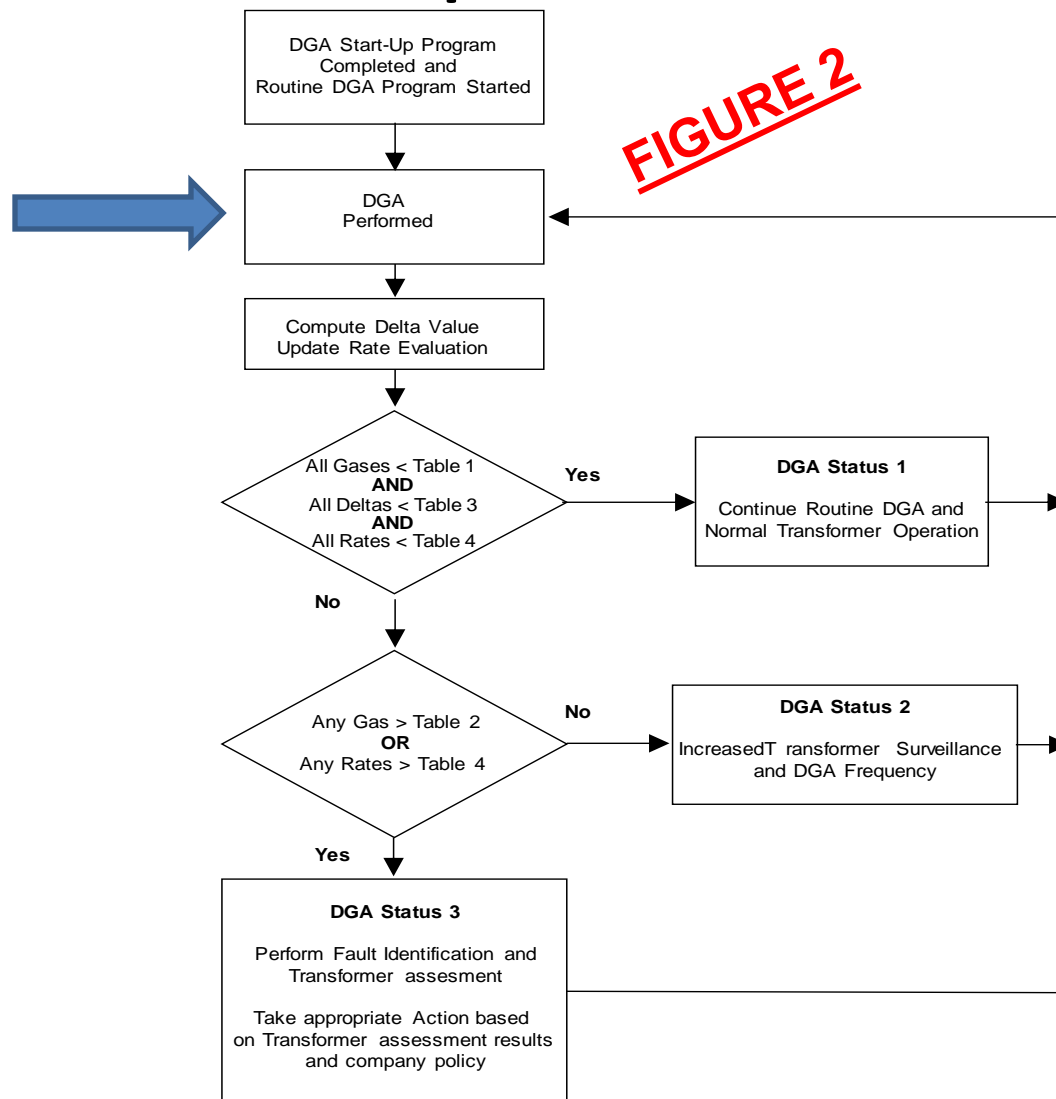


DGA INTERPRETATION EXAMPLE

DGA Interpretation Example



DGA Interpretation Example

DGA Sample Results for High Resistance DETC Contact

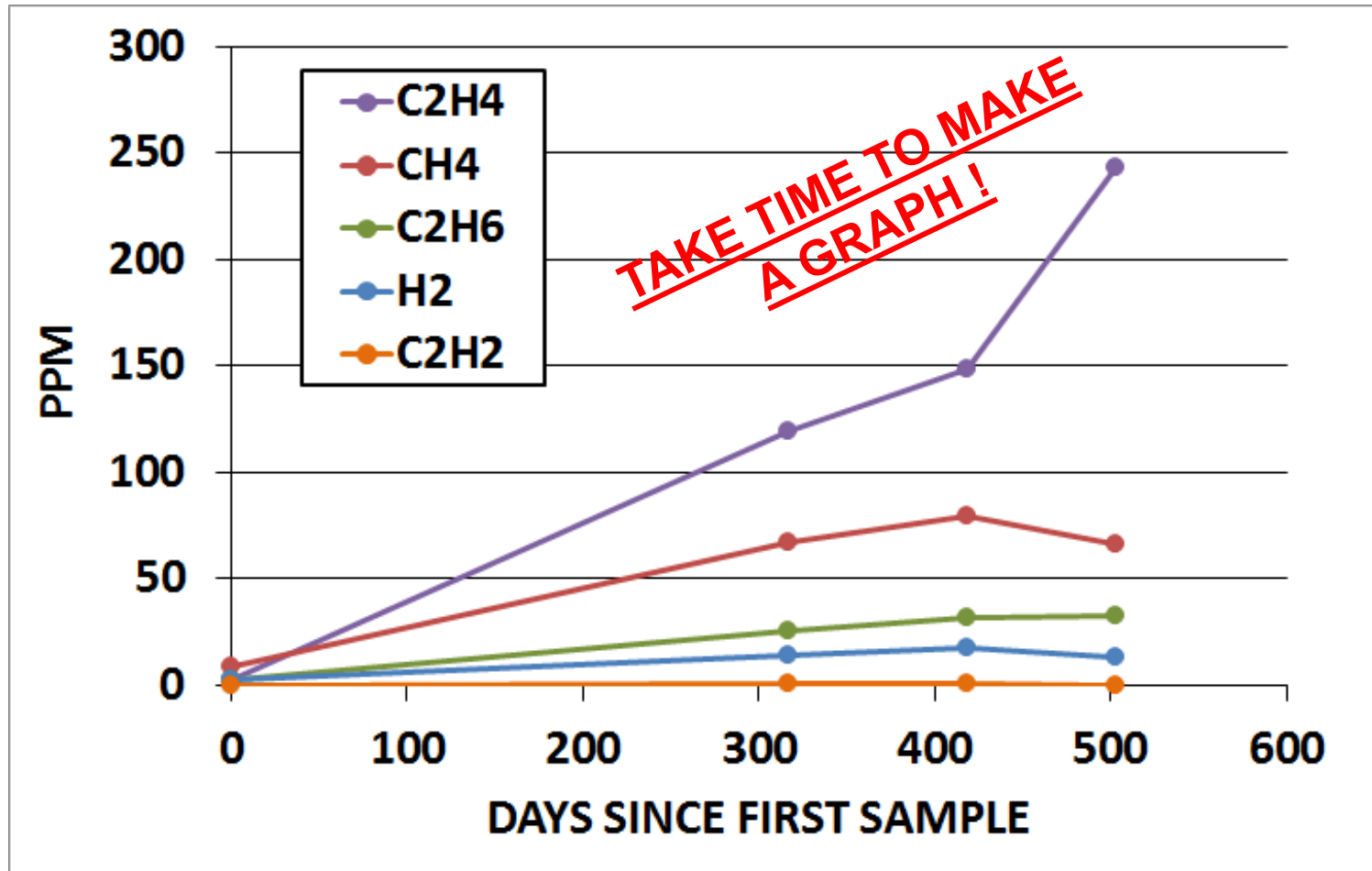
CASE STUDY E.4

Gas Concentration (ppm)										
Data Point	Sample Date	H ₂	CH ₄	C ₂ H ₆	C ₂ H ₄	C ₂ H ₂	CO	CO ₂	N ₂	O ₂
1	Day 0	3	9	3	3	0	653	3,603	76,587	6,085
2	Day 317	14	67	26	119	1	705	4,002	76,256	6,423
3	Day 419	18	80	32	149	1	727	3,951	78,592	7,188
4	Day 503	13	66	33	243	0	816	3,531	45,599	1,431

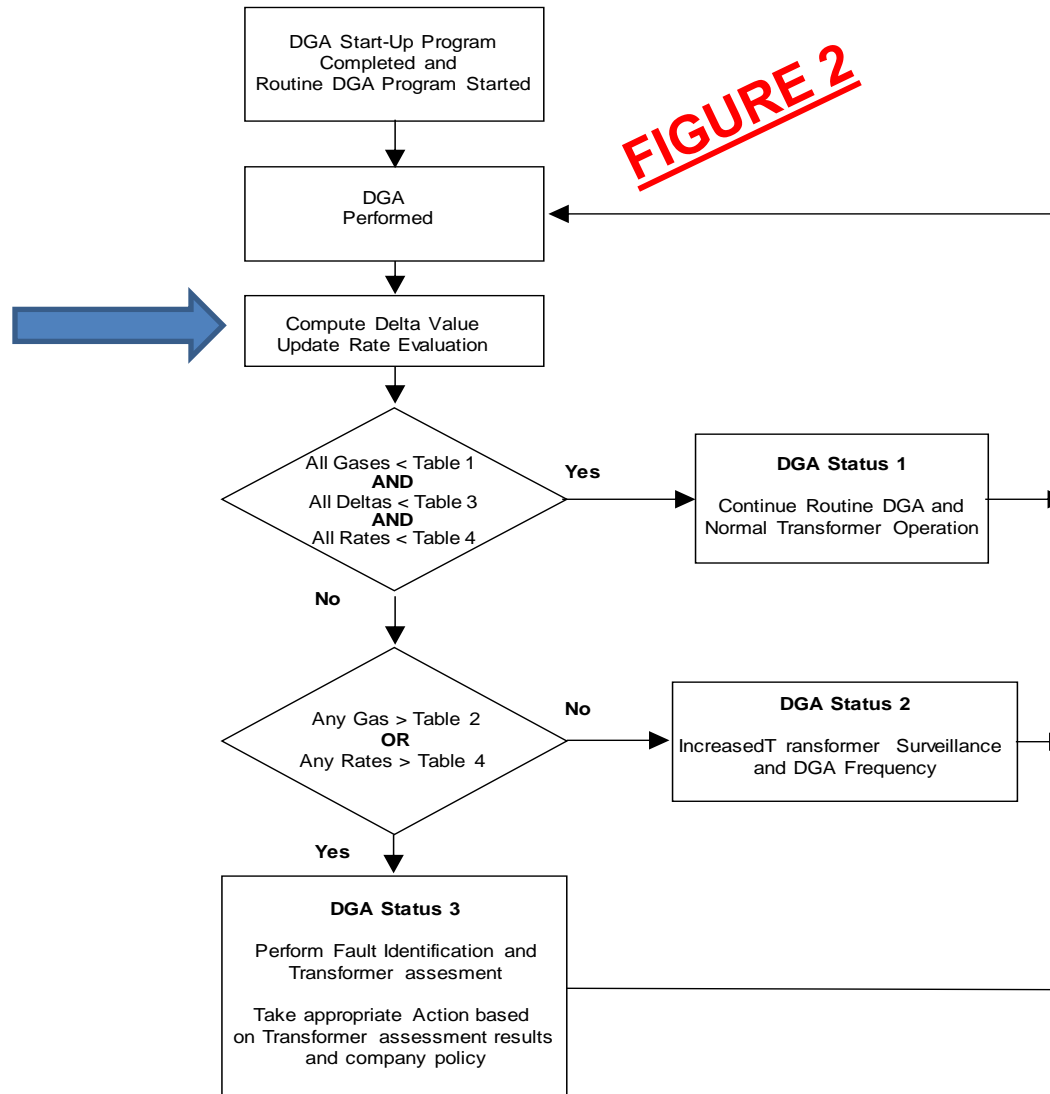
O₂ / N₂ < 0.2

15 Years in Service

DGA Interpretation Example



DGA Interpretation Example



DGA Interpretation Example

	$O_2/N_2 \leq 0.2$				$O_2/N_2 > 0.2$			
Gas (ppm)	Transformer Age in Years				Transformer Age in Years			
	Unknown	1 – 10	10 – 30	>30	Unknown	1 – 10	10 – 30	>30
H ₂	80	75		100	40	40		
CH ₄	90	45	90	110	20	20		
C ₂ H ₆	90	30	90	150	15	15		
C ₂ H ₄	50	20	50	90	50	25	60	
C ₂ H ₂	1	1			2	2		
CO	900	900			500	500		
CO ₂	9000	5000	10000		5000	3500	5500	

**IDENTIFY TABLE 1 LIMITS
(90TH PERCENTILE)**

DGA Interpretation Example

Comparison to Table 1							
Sample Date:	H ₂	CH ₄	C ₂ H ₆	C ₂ H ₄	C ₂ H ₂	CO	CO ₂
Day 317	14	67	26	119	1	705	4002
Table 1 Limit	75	90	90	50	1	900	10000
Above Table 1 ?	N	N	N	Y	N	N	N

**TABLE 1 LIMIT
EXCEEDED**

DGA Interpretation Example

	Maximum ppm Variation between Consecutive DGA Samples	
Gas (ppm)	$O_2/N_2 \leq 0.2$	$O_2/N_2 > 0.2$
H ₂	40	25
CH ₄	30	10
C ₂ H ₆	25	7
C ₂ H ₄	20	
C ₂ H ₂	Any Increase	
CO	250	175
CO ₂	2500	1750

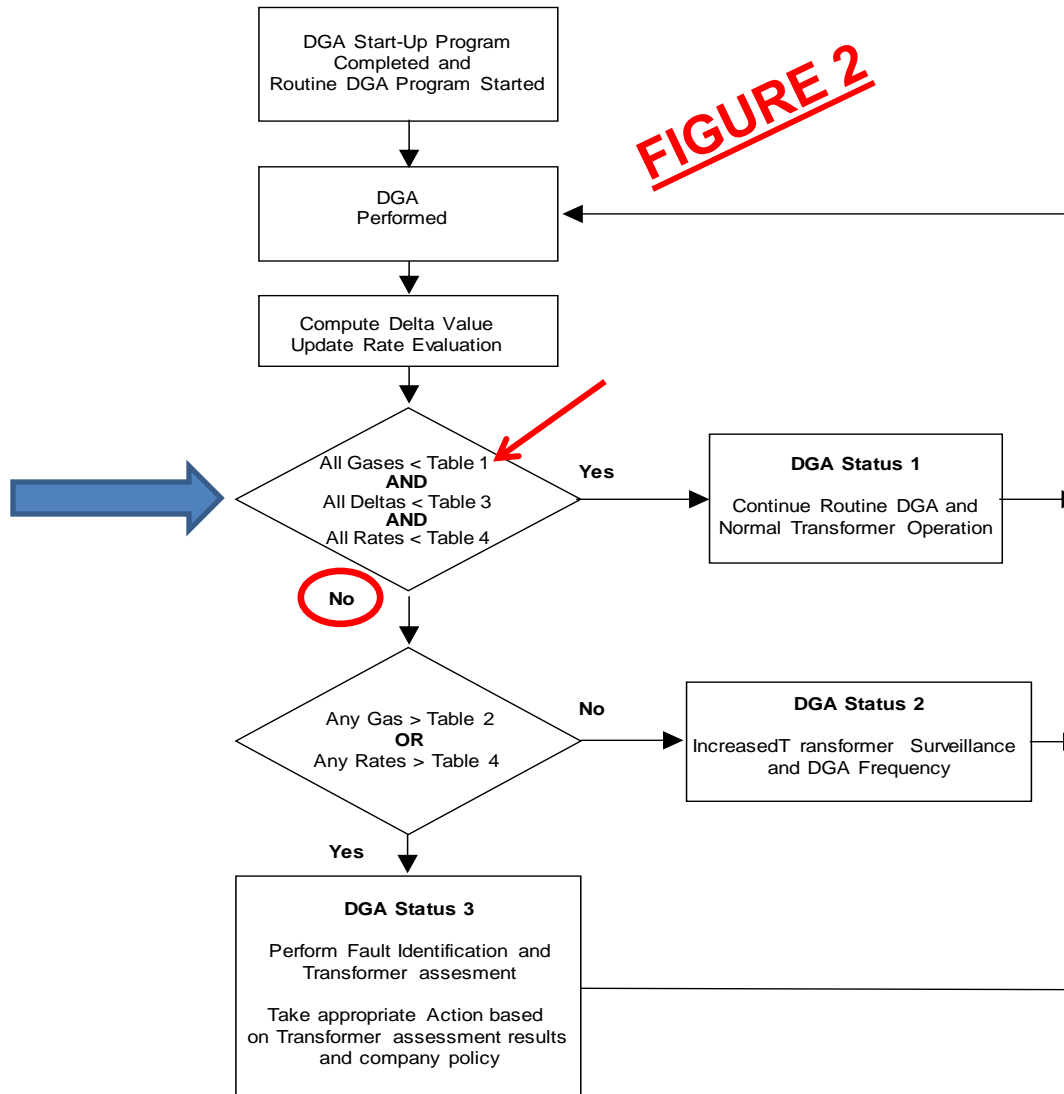
**IDENTIFY TABLE 3 LIMITS
(Δ PPM)**

DGA Interpretation Example

Delta Values (Δ ppm)					
Comparison to Table 3					
Sample Date:	H ₂	CH ₄	C ₂ H ₆	C ₂ H ₄	C ₂ H ₂
Day 0	3	9	3	3	0
Day 317	14	67	26	119	1
Δ ppm	11	58	23	116	1
Table 3 Limit	40	30	25	20	0
Above Table 3 ?	N	Y	N	Y	Y

**TABLE 3 LIMITS
EXCEEDED**

DGA Interpretation Example



DGA Interpretation Example

O ₂ Ratio:	$O_2/N_2 \leq 0.2$				$O_2/N_2 > 0.2$			
Gas/Age	Transformer Age in Years				Transformer Age in Years			
	Unknown	1 – 10	10 – 30	>30	Unknown	1 – 10	10 – 30	>30
H ₂	200	200			90	90		
CH ₄	150	100	150	200	50	60	30	
C ₂ H ₆	175	70	175	250	40	30	40	
C ₂ H ₄	100	40	95	175	100	80	125	
C ₂ H ₂	2	2		4	7	7		
CO	1100	1100			600	600		
CO ₂	12500	7000	14000		7000	5000	8000	

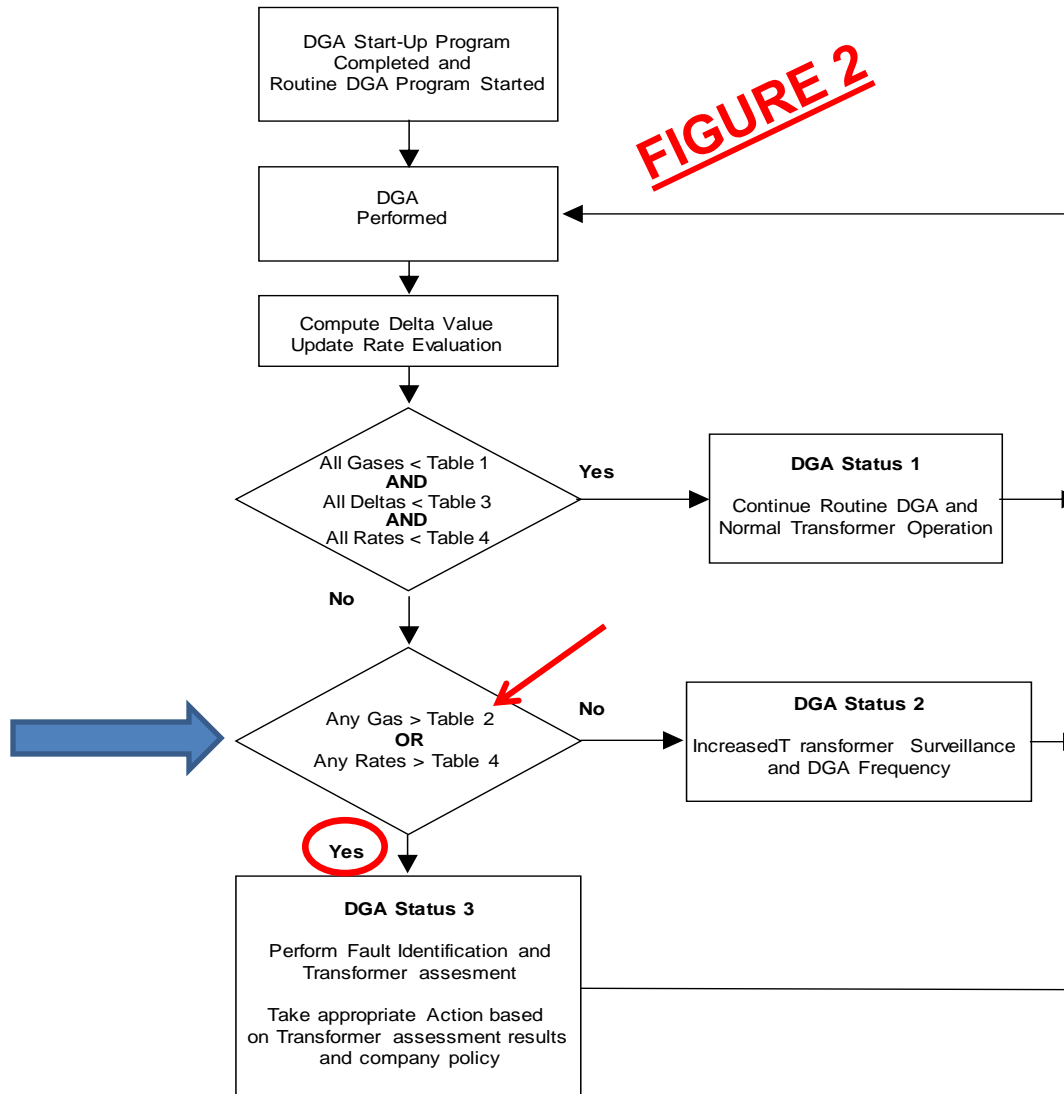
**IDENTIFY TABLE 2 LIMITS
(95TH PERCENTILE)**

DGA Interpretation Example

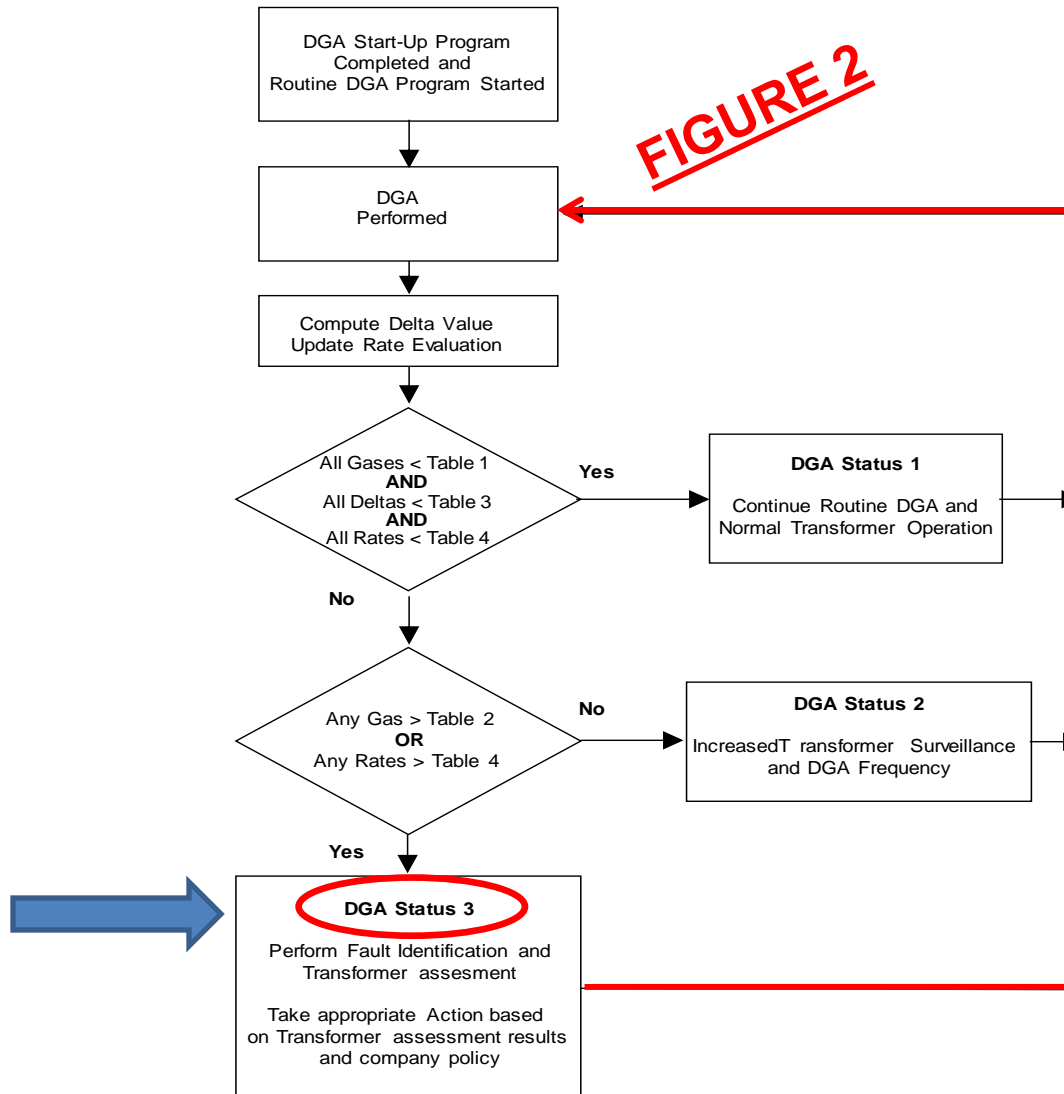
Comparison to Table 2							
Sample Date:	H ₂	CH ₄	C ₂ H ₆	C ₂ H ₄	C ₂ H ₂	CO	CO ₂
Day 317	14	67	26	119	1	705	4002
Table 2 Limit	200	150	175	95	2	1100	14000
Above Table 2 ?	N	N	N	Y	N	N	N

TABLE 2 LIMIT EXCEEDED

DGA Interpretation Example



DGA Interpretation Example



DGA Interpretation Example

- Future DGA samples will remain in Status 3 due to the high concentration of C₂H₄.
- Future DGA samples are taken to monitor the gassing rate and track any change in fault type.
- Let's move on to the 4th sample...

DGA Interpretation Example

Comparison to Table 2							
Sample Date:	H ₂	CH ₄	C ₂ H ₆	C ₂ H ₄	C ₂ H ₂	CO	CO ₂
Day 503	13	66	33	243	0	816	3531
Table 2 Limit	200	150	175	95	2	1100	14000
Above Table 2 ?	N	N	N	Y	N	N	N

TABLE 2 LIMIT EXCEEDED

DGA Interpretation Example

Gas Rate (ppm/year)	Time Period between First and Last Point of the DGA Series			
	$O_2/N_2 \leq 0.2$ 4-9 Months	$O_2/N_2 \leq 0.2$ 9-24 Months	$O_2/N_2 > 0.2$ 4-9 Months	$O_2/N_2 > 0.2$ 9-24 Months
H ₂	50	20	25	10
CH ₄	15	10	4	3
C ₂ H ₆	15	9	3	2
C ₂ H ₄	10	7	7	5
C ₂ H ₂	Any increase		Any increase	
CO	200	100	100	80
CO ₂	1750	1000	1000	800

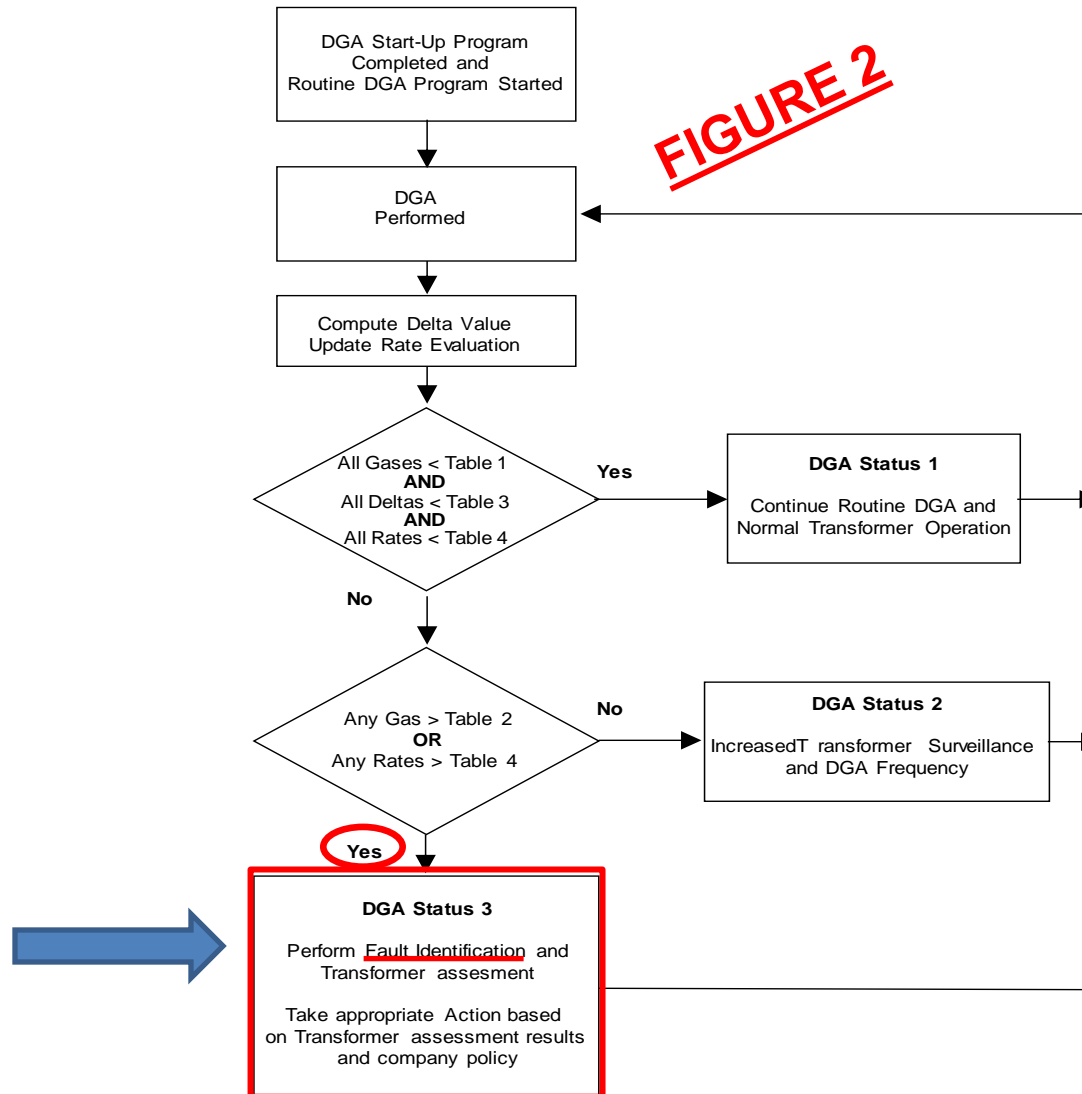
**IDENTIFY TABLE 4 LIMITS
(PPM/YEAR)**

DGA Interpretation Example

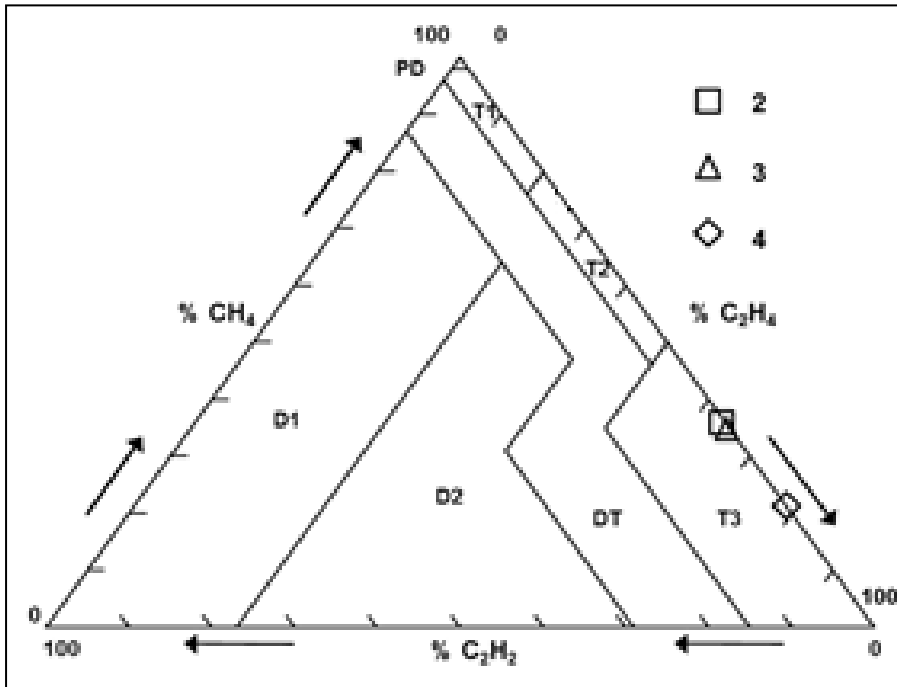
Multi-Point Rate (ppm/year)					
Comparison to Table 4					
Sample Date:	H ₂	CH ₄	C ₂ H ₆	C ₂ H ₄	C ₂ H ₂
Day 0	3	9	3	3	0
Day 503	13	66	33	243	0
ppm/year	7	41	22	174	0
Table 4 Limit	20	10	9	7	0
Above Table 4 ?	N	Y	Y	Y	N

**TABLE 4 LIMITS
EXCEEDED**

DGA Interpretation Example



DGA Interpretation Example



Duval Triangle Ratios			
	% CH ₄	% C ₂ H ₄	% C ₂ H ₂
Day 0	-	-	-
Day 317	36 %	64 %	0 %
Day 419	35 %	65 %	0 %
Day 503	21 %	79 %	0 %

FAULT IDENTIFICATION:
T3

DGA Interpretation Example

ACTIONS:

- Internal inspection revealed coking on the DETC contacts, resulting in high contact temperature.
- Repaired and put back in service.

New Business

- Any New Business?

Adjourn

- Thank you everyone