DC Cook Alpha Summary

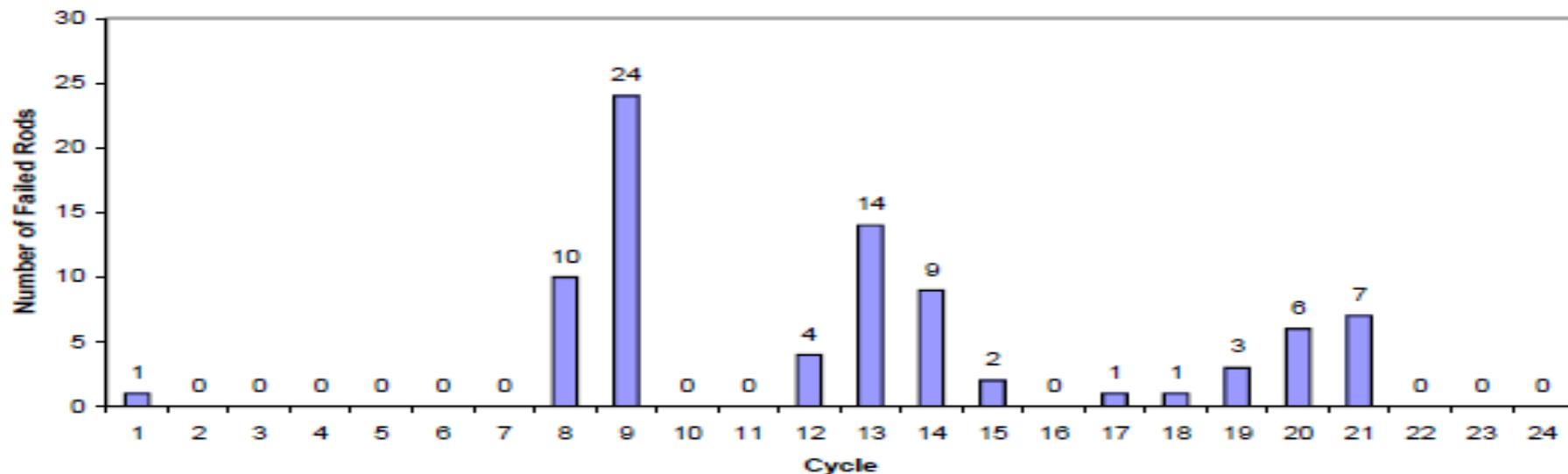## 2014 ISOE Conference
Fort Lauderdale, Florida

Industry Knowledge

- Plants should consider the question of fuel defects

- By whose definition?
  - Nuclear fuels?
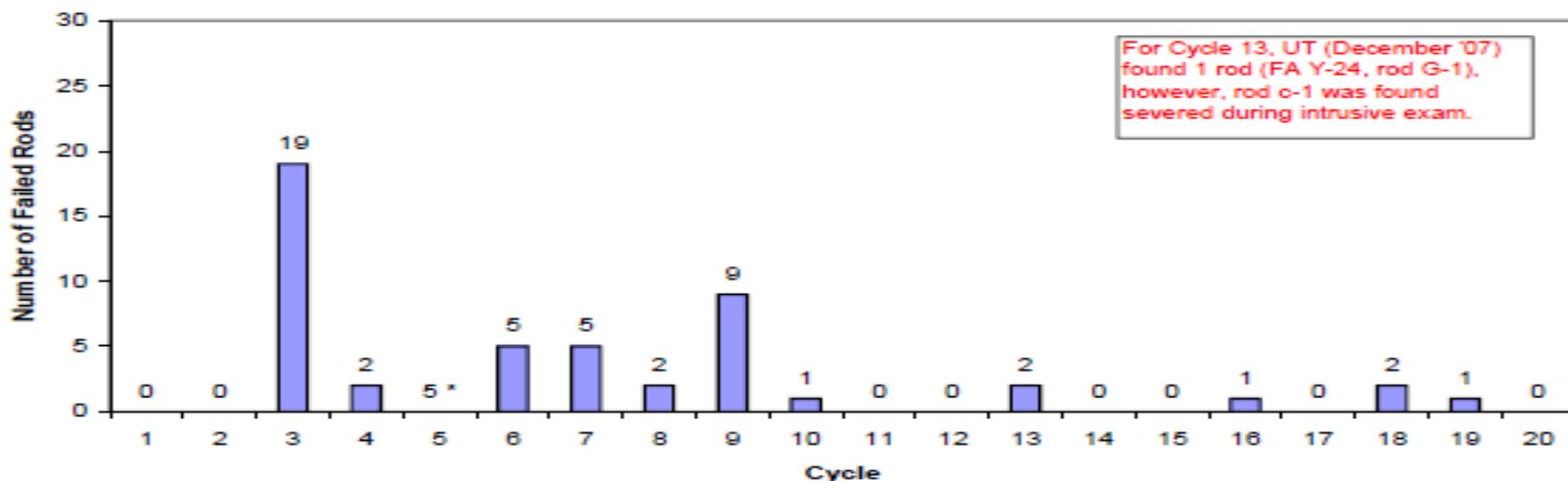 - Chemistry?
  - INPO?
  - Management?

Industry Knowledge

- Historically, many plants have continued operation without mitigating known fuel defects (15-30 years ago)
  - Legacy contamination from these defects is not:
    - Known
    - Remembered
    - Always being considered

Unit 1 Failed Rod History

Number of Failed Rods vs Cycle

Cycle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Failed Rods	1	0	0	0	0	0	0	10	24	0	0	4	14	9	2	0	1	1	3	6	7	0	0	0

Unit 2 Failed Rod History

For Cycle 13, UT (December '07) found 1 rod (FA Y-24, rod G-1), however, rod c-1 was found severed during intrusive exam.

Cycle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Failed Rods	0	0	19	2	5 *	5	5	2	9	1	0	0	2	0	0	1	0	2	1	0

* Identified in cycle 6 by UT, inadvertantly inserted into cycle 7 and verified by UT in cycle 7 (F/A T24)

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Industry Knowledge

- Is there an understanding that alphas remain while betas decay in abandoned systems or equipment removed from the RCS and stored?
  - Beta gamma ratios from the operating plant no longer apply
  - Need to look for alpha at lower beta gamma levels

Legacy Alpha Contamination

- Historical fuel defects may have deposited alpha activity that may be ingrained into the RCS crud layers:
  - May not show on smears
  - Alpha shielded within crud layers
  - Activity will appear when aggressively disturbed
    - May get lower ratios or higher alpha activity
    - We do not have this information

Alpha Air Samples

Location	Date	Radionuclide	Activity (uCi)	% of total TU	DAC (uCi/cc)	DAC fraction
U1, RCP 12	Oct-06	Am-241	5.66 E-6	47.6	3 E-12	0.07
		Cm-243/244	2.27 E-6	19.1	4 E-12	0.02
		Pu-238	2.13 E-6	17.9	3 E-12	0.026
		Pu-239/240	1.83 E-6	15.4	3 E-12	0.023
U1, SG 1/4 Platform	Oct-06	Cm-242	3.10 E-6	100	1 E-10	0.009
U1, SG 1/4 Platform	Oct-06	Pu-241	5.17 E-4	91.1	1 E-10	0.1
		Am-241	1.48 E-6	0.26	3 E-12	0.0097
		Cm-242	3.34 E-5	5.88	1 E-10	0.009
		Cm-243/244	7.23 E-6	1.27	4 E-12	0.036
		Pu-238	6.57 E-6	1.15	3 E-12	0.043
		Pu-239/240	2.01 E-6	0.35	3 E-12	0.013
U1, RHR Grinding	Apr-08	Pu-239/240	7.54E-06	2	3 E-12	0.081
		Pu-241	3.70E-04	98	1 E-10	0.12

DAC Analysis of Air Samples

Location	Date	B/G DAC %	alpha DAC %	total DAC %
U1, RCP 12	Oct-06	48.2	ND	48.2
U1, RCP 12	Oct-06	25.7	13.9	39.6
U1, SG 1/4 Platform	Oct-06	44.5	0.9	45.4
U1, SG 1/4 Platform	Oct-06	48.6	21.1	69.7
U12, Transfer Canal	Apr-07	2.61	13.3	15.9
U12, Transfer Canal	Apr-07	0.64	ND	0.64
U12, Transfer Canal	Apr-07	0.43	4.3	4.7
U12, Transfer Canal	Apr-07	0.86	ND	0.86
U1, RHR Grinding	Apr-08	2.28	20.1	22.4

Summary of Alpha Data from 2007 to Current

	LEVEL 1[*]	LEVEL 2[**]	LEVEL 3[***]
2007 **U2C17**	90%	10%	0
2008 **U1C22**	84%	15%	1%
2009 **U2C18**	84%	16%	0
2010 **U1C23/U2C19**	94% / 96%	6% / 4%	0 / 0
2011 **U1C24**	78.3%	21.7%	0
2012 **U2C20**	91.7%	8.3%	0
2013 **U1C25/U2C21**	88% / 87%	12% / 13%	0 / 0

Unit 1 – 2013 Surprises

	B/G dpm	Alpha dpm	BG/A Ratio	
U1 RHR (1-IMO-350)	80,000	122	656	Bonnet seating surface
U1 RHR (1-IMO-350)	124,225	344	361	I/S 1-IMO-350 smear of smear (original 1.2 million BG and 3324 alpha)
U1 RHR (1-IMO-350)	187,677	237	792	Valve wedge smear of smear (original 600K BG = 757 alpha)
U1 RHR (1-IMO-350)	31,578	80	395	Valve body seating surface
U1 E RHR Floor	99	30	3	Level III. I/S Blank Flange

Spent Fuel Pool – 2013 Surprises

B/G dpm	Alpha dpm	BG/A Ratio	
6,462	28	231	Level III. I/S Pump
26,970	47	574	Level II I/S Pump
23,130	43	538	Level II. Stuffing Box
4,666	29	161	Level III. Impeller
6,768	23	294	Level III. I/S Pump

Conclusions

- Alpha contamination found in areas where it was not expected

- Monitoring less than 20,000 dpm smears provides important information especially for legacy alpha

- Lack of fuel performance information in early days of operation is a warning signal

- Under different circumstances the Cook program may not have protected the worker from alpha exposure

The End