INTERNATIONAL WORKSHOP ON CABLE AGING

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U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

OUTLINE

1. STATE OF KNOWLEDGE
   - ❑ ELECTRICAL CONDITION MONITORING METHODS
   - ❑ CABLE AGING RESEARCH GAPS
2. ONGOING RESEARCH
   - ❑ NRC's ONGOING CABLE AGING PROJECT TEST RESULTS
3. OPERATING EXPERIENCE AND LONG-TERM OPERATION
4. INTERNATIONAL PLATFORM TO DISCUSS AND SHARE RESEARCH

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STATE OF KNOWLEDGE

1. CONDITION MONITORING METHODS (ELECTRICAL)

- ❑ FURTHER RESEARCH IS NEEDED TO DETERMINE WHICH ELECTRICAL CONDITION MONITORING METHODS ARE CAPABLE OF TRACKING LOCAL AND/OR GLOBAL AGING
  - REDUCE AMBIGUITY ON THE CAPABILITIES OF ELECTRICAL CONDITION MONITORING METHODS
  - DETERMINE THE STRENGTH AND LIMITATIONS OF EACH ELECTRICAL CONDITION MONITORING METHOD
  - INCREASE THE USE OF ELECTRICAL MONITORING METHODS OR NON-DESTRUCTIVE EXAMINATION

STATE OF KNOWLEDGE

2. CABLE AGING

- ACCELERATED AGING RESEARCH GAPS
  - SYNERGISTIC EFFECTS
    - DETERMINE WHETHER OR NOT PERFORMING CONCURRENT AGING IS MORE CONSERVATIVE THAN SEQUENTIAL AGING
  - INVERSE TEMPERATURE EFFECTS
    - CERTAIN POLYMERS MAY DEGRADE FASTER AT CONSTANT DOSE RATE AT LOWER TEMPERATURE
  - DIFFUSION LIMITED OXIDATION
    - LACK OF OR LOWER THAN NORMAL LEVELS OF OXYGEN DIFUSSING TO THE INTERIOR PORTION OF THE CABLE
    - REDUCE OXYDATION REACTIONS IN THE INTERIOR PORTION OF THE CABLE
  - ACTIVATION ENERGY CALCULATION
    - CONFIRM THAT THE MATERIAL ACTIVATION ENERGY DOES NOT DECREASE AS YOU EXTRAPOLATE FROM AGING TEMPERATURE TO ENVIRONMENTAL TEMPERATURE (NON-ARRHENIUS BEHAVIOR)

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PURPOSE:

- EVALUATE THE EFFECTIVENESS OF COMMONLY USED CABLE CONDITION MONITORING METHODS

CONTRACTOR & COLLABORATORS

- NATIONAL INSTITUTE OF STANDARD AND TECHNOLOGY
- ELECTRIC POWER RESEARCH INSTITUTE (EPRI)
- DEPARTMENT OF ENERGY (PNNL & ORNL)
- LIGHT WATER REACTOR SUSTAINABILITY (LWRS) PROGRAM

CONDITION MONITORING METHODS INCLUDED IN THE PROJECT

- MECHANICAL CONDITION MONITORING METHODS
  - ELONGATION AT BREAK
  - INDENTER
- ELECTRICAL CONDITION MONITORING METHODS
  - LINE RESONANCE ANALYSIS
  - INSULATION RESISTANCE
  - CHAR PACKAGE
- CHEMICAL CONDITION MONITORING METHODS
  - OXIDATION INDUCTION TIME/TEMPERATURE
  - FOURIER TRANSFORM INFRARED SPECTROSCOPY
  - THERMAL GRAVIMETRIC ANALYSIS

CHAMBER ENVIRONMENTAL CONDITIONS

- CONCURRENT THERMAL AND RADIATION AGING
- FOR THE THERMAL AGING:
  - 4 CHAMBERS @ 81C
  - 1 CHAMBER @ 55C
- FOR THE RADIATION AGING:
  - 3 CHAMBERS @69 G/h
  - 2 CHAMBERS @ ~20 G/h

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

CHAMBER ENVIRONMENTAL CONDITIONS

- INSULATION TYPES INCLUDED IN THE PROJECT:
  - ETHYLENE PROPYLENE RUBBER (EPR)
  - CROSS-LINKED POLYETHYLENE (XLPE)
- SAMPLES INCLUDED IN THE PROJECT ARE FROM 4 CABLE MANUFACTURERS (ROCKBESTOS, ANACONDA, OKONITE, BIW)
- THREE SAMPLES FROM EACH CABLE IN EACH CHAMBER
- SAMPLES AGED TO SIMULATE 50, 60, AND 80 YEARS OF OPERATION
- FIVE CHAMBERS WITH DIMENSIONS (2ft x 2ft x1ft)
- CONDITIONS (DOSE RATE, RELATIVE HUMIDITY, TEMPERATURE) VARY FROM CHAMBER TO CHAMBER TO PERFORM AGING COMPARISON

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

CHAMBERS AGING COMPARISON

- CONDITION MONITORING TESTS WILL BE PERFORMED ON A TWO MONTHS INTERVAL
- THE CONDITION MONITORING TEST RESULTS FROM THE CHAMBERS WILL BE COMPARED TO EACH OTHER
- THE COMPARISON WILL PROVIDE INSIGHTS ON:
  - THE EFFECTS OF RELATIVE HUMIDITY DURING THE AGING PROCESS
  - THE EFFECTS OF PERFORMING AGING AT A LOWER TEMPERATURE
  - THE EFFECTS OF PERFORMING THE AGING AT A LOWER RADIATION DOSE RATE

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

RADIATION DOSE RATE AND TOTAL RADIATION DOSE

- DOSE RATE IN CHAMBERS 1, 2, 3 is 69 G/h
- TOTAL RADIATION DOSE IN CHAMBERS 1, 2, 3 WILL BE 50, 60, AND 80 Mrad
- DOSE RATE IN CHAMBERS 4 & 5 IS ~20 G/h
- TOTAL RADIATION DOSE IN CHAMBERS 4 AND 5 WILL BE ~14, ~17, AND ~23 Mrad

CHAMBER	DOSE RATE G/h	TOTAL DOSE AT 50 YEARS (Mrad)	TOTAL DOSE AT 60 YEARS (Mrad)	TOTAL DOSE AT 80 YEARS (Mrad)
1	69	50	60	80
2	69	50	60	80
3	69	50	60	80
4	~20	~14	~17	~23
5	~20	~14	~17	~23

AGING TEMPERATURE

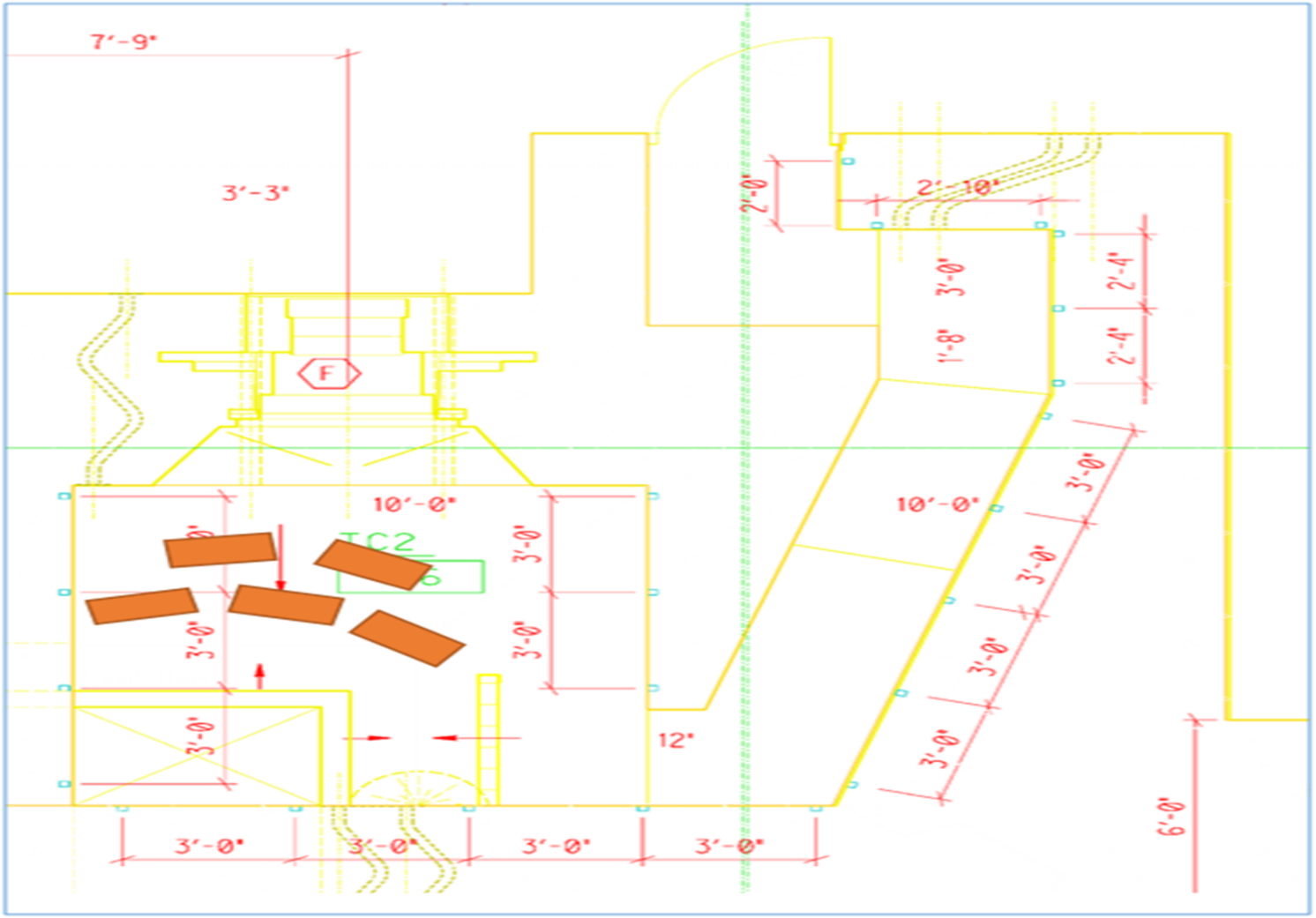
- THE BASIS FOR THE AGING TEMPERATURE WILL BE THE ARRHENIUS EQUATION
- ASSUMED SERVICE TEMPERATURE WILL BE 45C
- SIMULATED SERVICE LIFE 50, 60, AND 80 YEARS OF OPERATION
- AGING TIME WILL BE 10, 12, AND 16 MONTHS
- ACTIVATION ENERGY WILL BE 1.2 eV
- AGING TEMPERATURE WILL BE 81C

SERVICE LIFE (YEARS)	AGING TIME (MONTHS)	SERVICE TEMPERATURE (C)	AGING TEMPERATURE (C)	ACTIVATION ENERGY
50	10	45	81	1.2
60	12	45	81	1.2
80	16	45	81	1.2

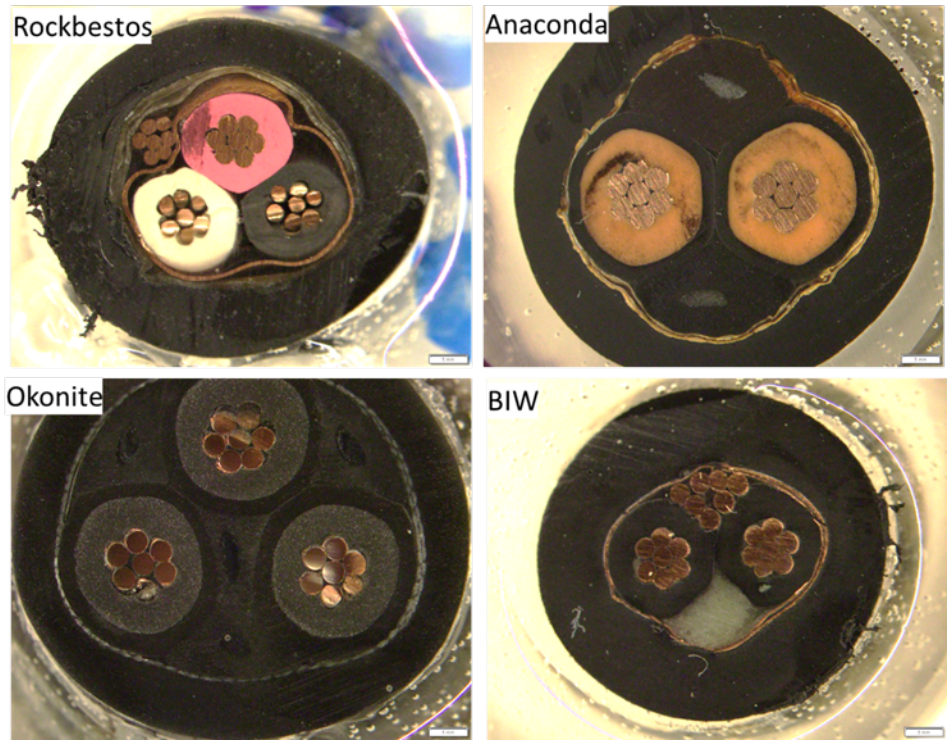
RELATIVE HUMIDITY

- THE RELATIVE HUMIDITY VALUE AT 81C FOR CHAMBERS 1 AND 4 WILL BE BETWEEN 40% AND 50%

CHAMBER CONFIGURATION INSIDE THE DRY-CELL



CABLES INCLUDED IN THE PROJECT



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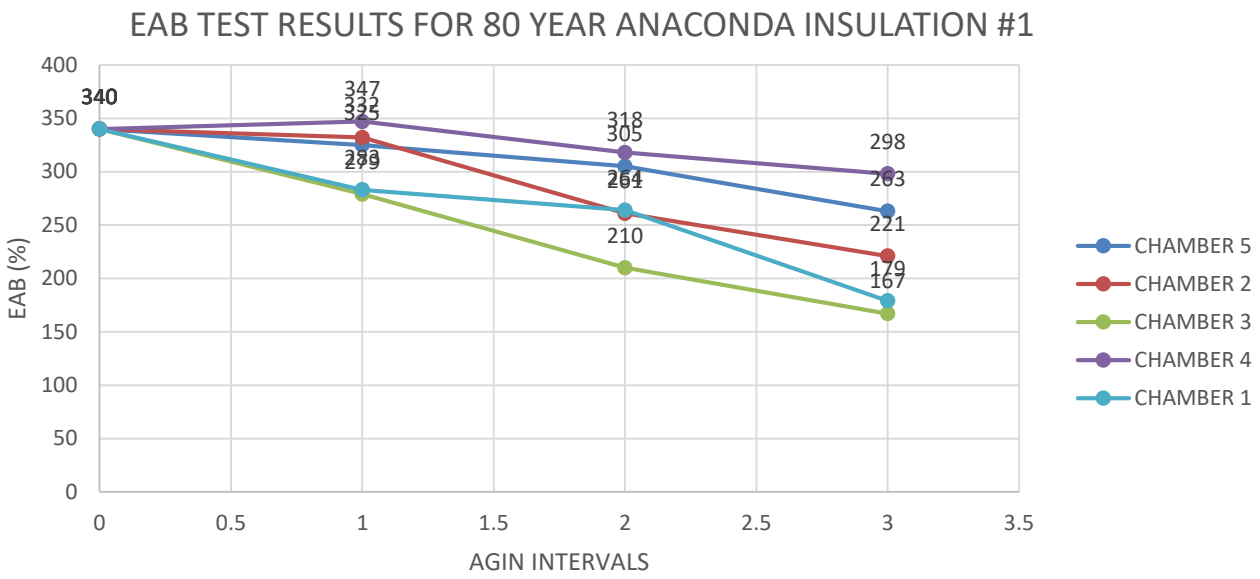
NRC CABLE AGING CONDITION MONITORING TEST RESULSTS

- ELONGATION-AT-BREAK (EAB) TEST RESULTS ON THE CABLES AGED TO 80 YEAR
- EAB PERCENT (%) ON THE Y AXIS
- AGING INTERVALS ON THE X AXIS
- NIST PERFORMED EAB ON UP TO 5 REPLICATE SAMPLES
- NIST FOLLOWED IEC/IEEE 62582-3 TO CONDUCT THE EAB TESTS

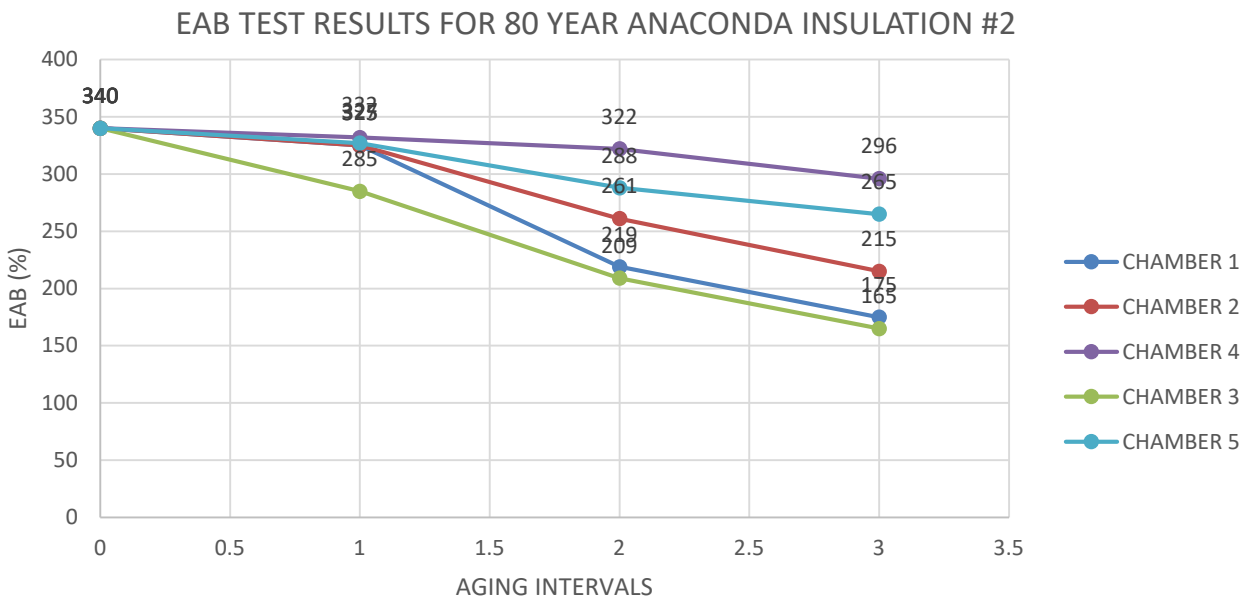
CABLE AGING TEST RESULTS (ANACONDA)



TEST RESULTS FOR ANACONDA INSULATION #1					
INTERVAL	CHAMBER 1	CHAMBER 2	CHAMBER 3	CHAMBER 4	CHAMBER 5
0	340	340	340	340	340
1	283	332	279	347	325
2	264	261	210	318	305
3	179	221	167	298	263

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

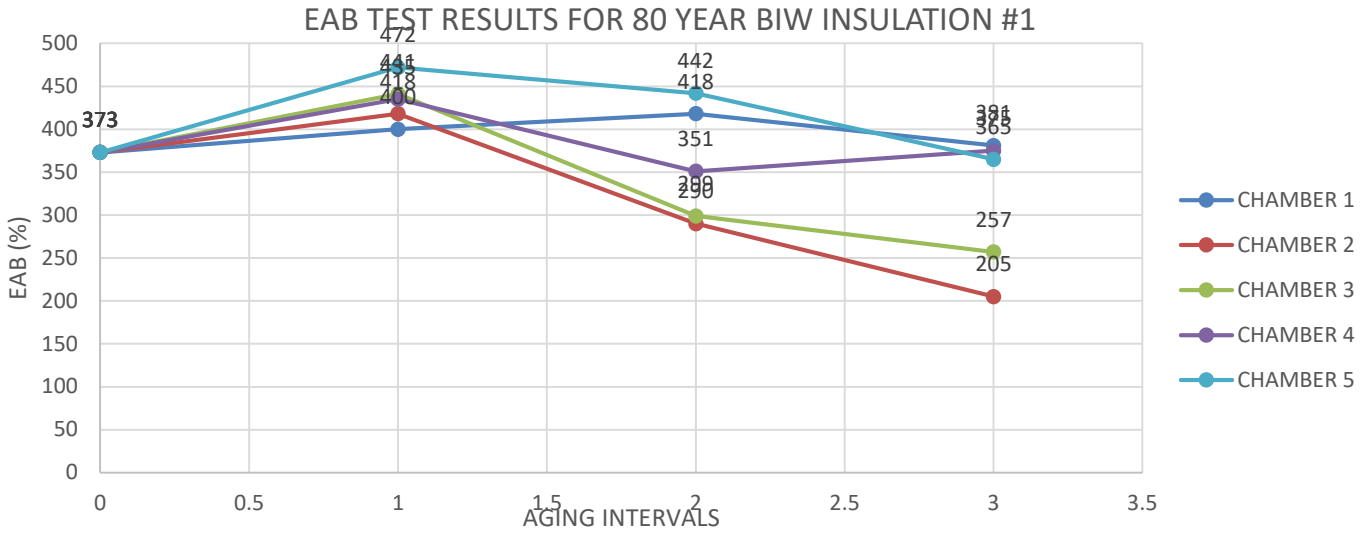
CABLE AGING TEST RESULTS (ANACONDA)



TEST RESULTS FOR ANACONDA INSULATION #2					
INTERVAL	CHAMBER 1	CHAMBER 2	CHAMBER 3	CHAMBER 4	CHAMBER 5
0	340	340	340	340	340
1	325	325	285	332	327
2	219	261	209	322	288
3	175	215	165	296	265

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

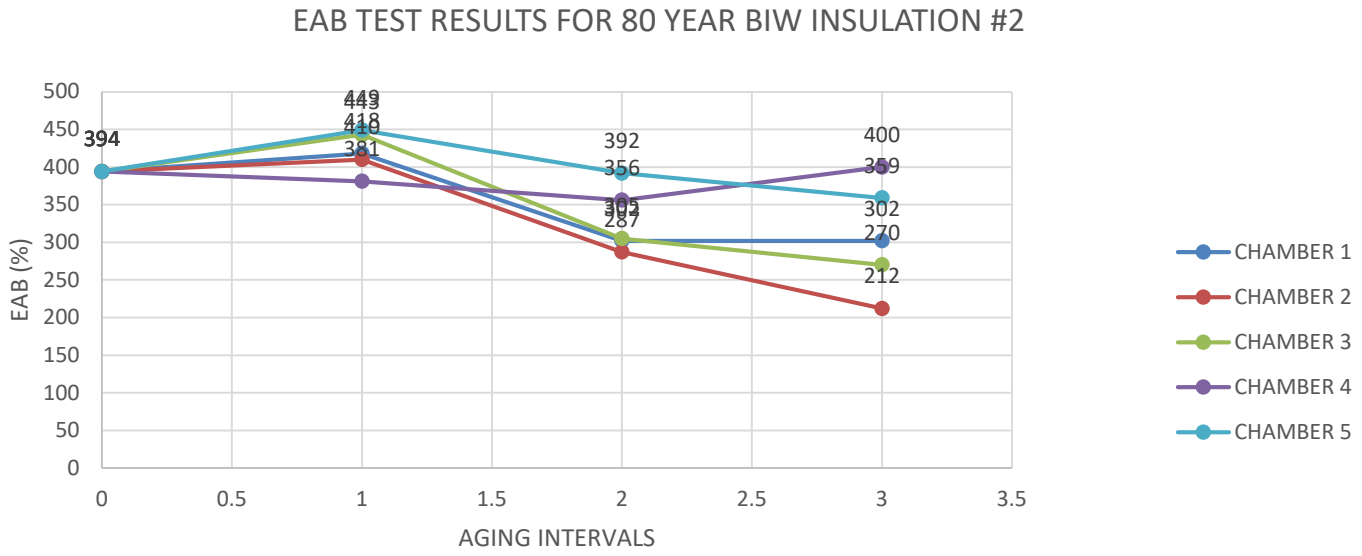
CABLE AGING TEST RESULTS (BIW)



TEST RESULTS FOR BIW INSULATION #1					
INTERVAL	CHAMBER 1	CHAMBER 2	CHAMBER 3	CHAMBER 4	CHAMBER 5
0	373	373	373	373	373
1	400	418	441	435	472
2	418	290	299	351	442
3	381	205	257	375	365

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

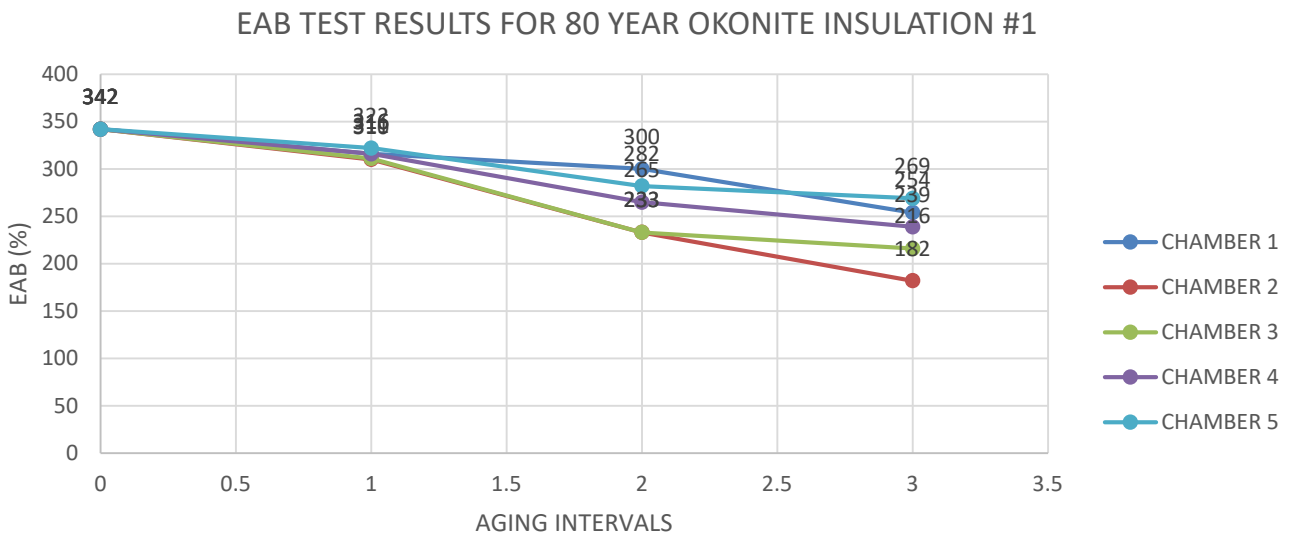
CABLE AGING TEST RESULTS (BIW)



TEST RESULTS FOR BIW INSULATION #2					
INTERVAL	CHAMBER 1	CHAMBER 2	CHAMBER 3	CHAMBER 4	CHAMBER 5
0	394	394	394	394	394
1	418	410	443	381	449
2	302	287	305	356	392
3	302	212	270	400	359

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

CABLE AGING TEST RESULTS (OKONITE)

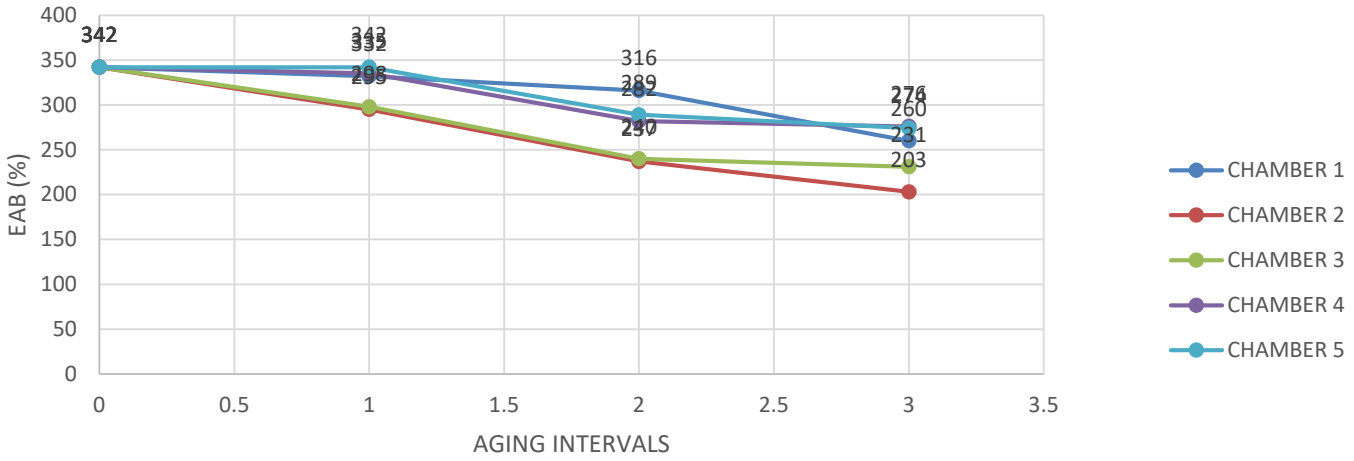


TEST RESULTS FOR OKONITE INSULATION #1					
INTERVAL	CHAMBER 1	CHAMBER 2	CHAMBER 3	CHAMBER 4	CHAMBER 5
0	342	342	342	342	342
1	316	310	311	316	322
2	300	233	233	265	282
3	254	182	216	239	269

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

CABLE AGING TEST RESULTS (OKONITE)

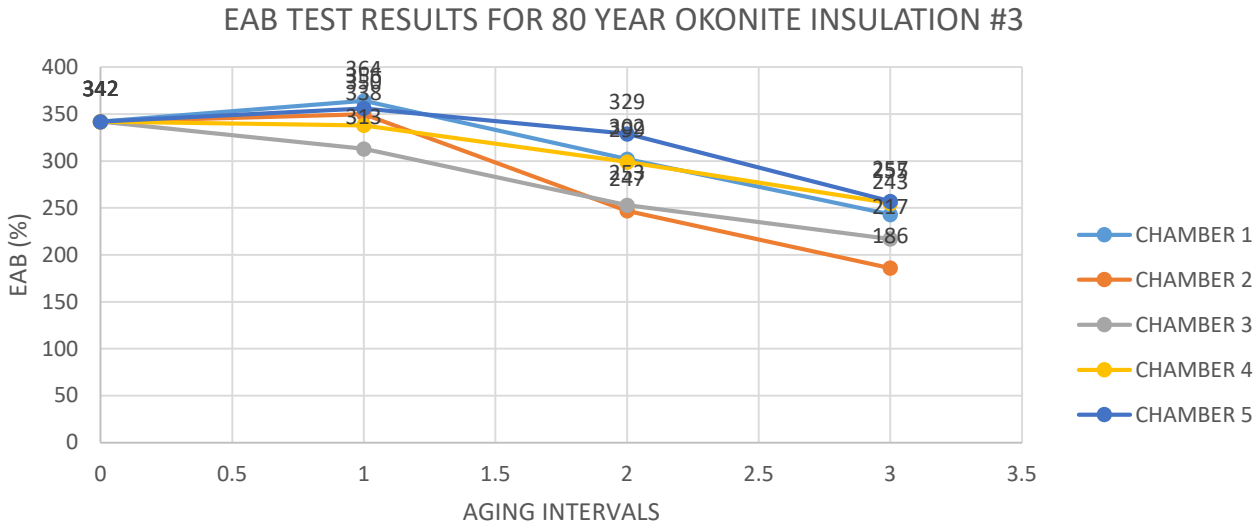
EAB TEST RESULTS FOR 80 YEAR OKONITE INSULATION #2



TEST RESULTS FOR OKONITE INSULATION #2					
INTERVAL	CHAMBER 1	CHAMBER 2	CHAMBER 3	CHAMBER 4	CHAMBER 5
0	342	342	342	342	342
1	332	295	298	335	342
2	316	237	240	282	289
3	260	203	231	276	274

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

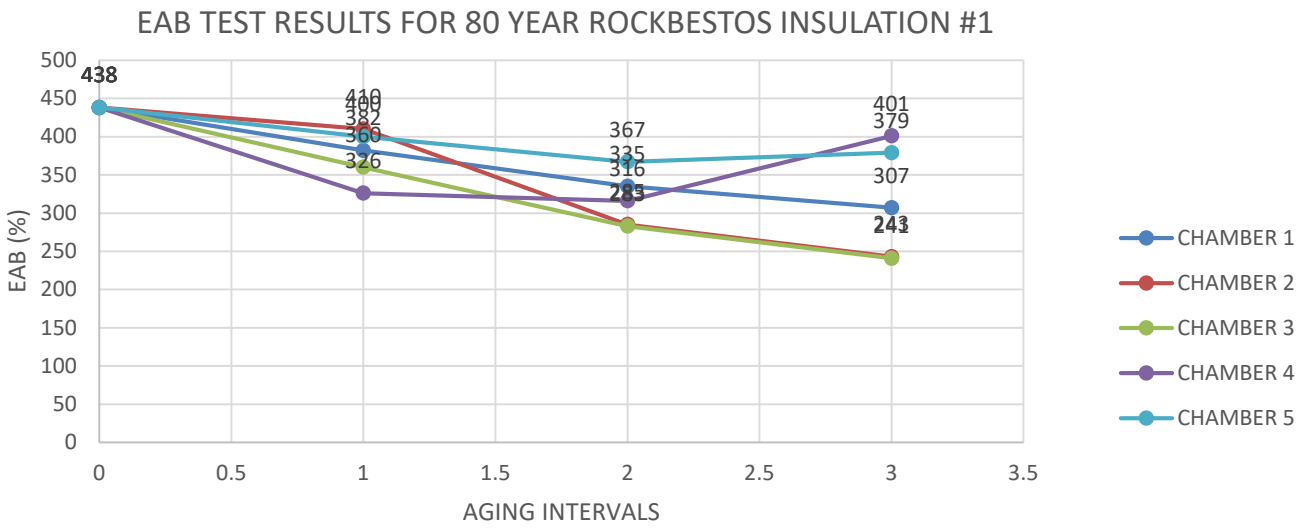
CABLE AGING TEST RESULTS (OKONITE)



TEST RESULTS FOR OKONITE INSULATION #3					
INTERVAL	CHAMBER 1	CHAMBER 2	CHAMBER 3	CHAMBER 4	CHAMBER 5
0	342	342	342	342	342
1	364	350	313	338	356
2	302	247	253	299	329
3	243	186	217	255	257

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

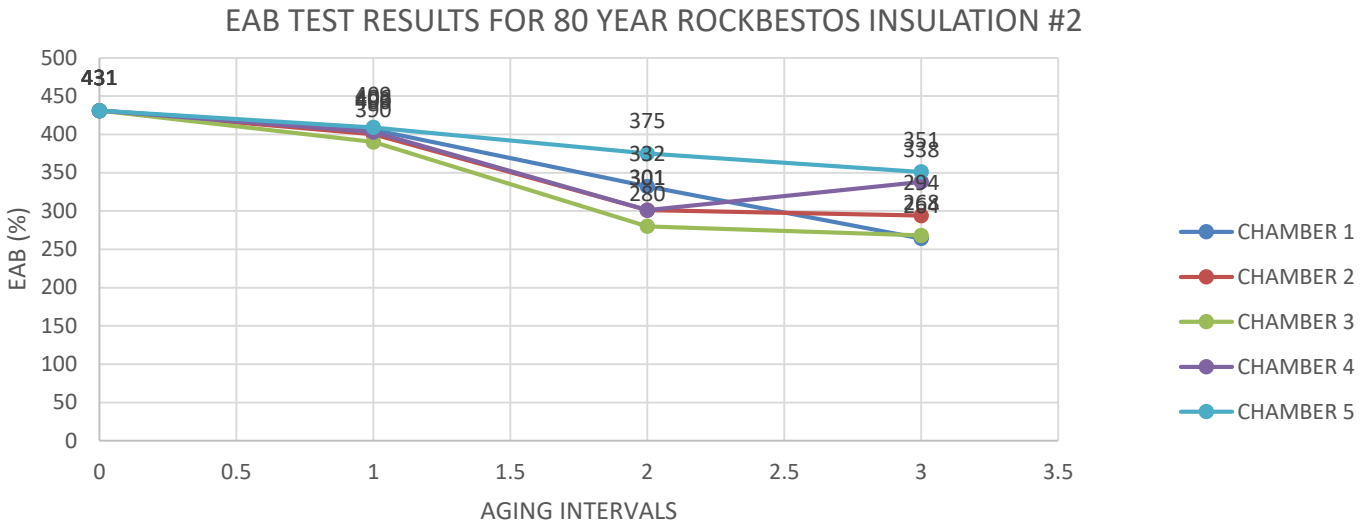
CABLE AGING TEST RESULTS (ROCKBESTOS)



TEST RESULTS FOR ROCKBESTOS INSULATION #1					
INTERVAL	CHAMBER 1	CHAMBER 2	CHAMBER 3	CHAMBER 4	CHAMBER 5
0	438	438	438	438	438
1	382	410	360	326	400
2	335	285	283	316	367
3	307	243	241	401	379

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

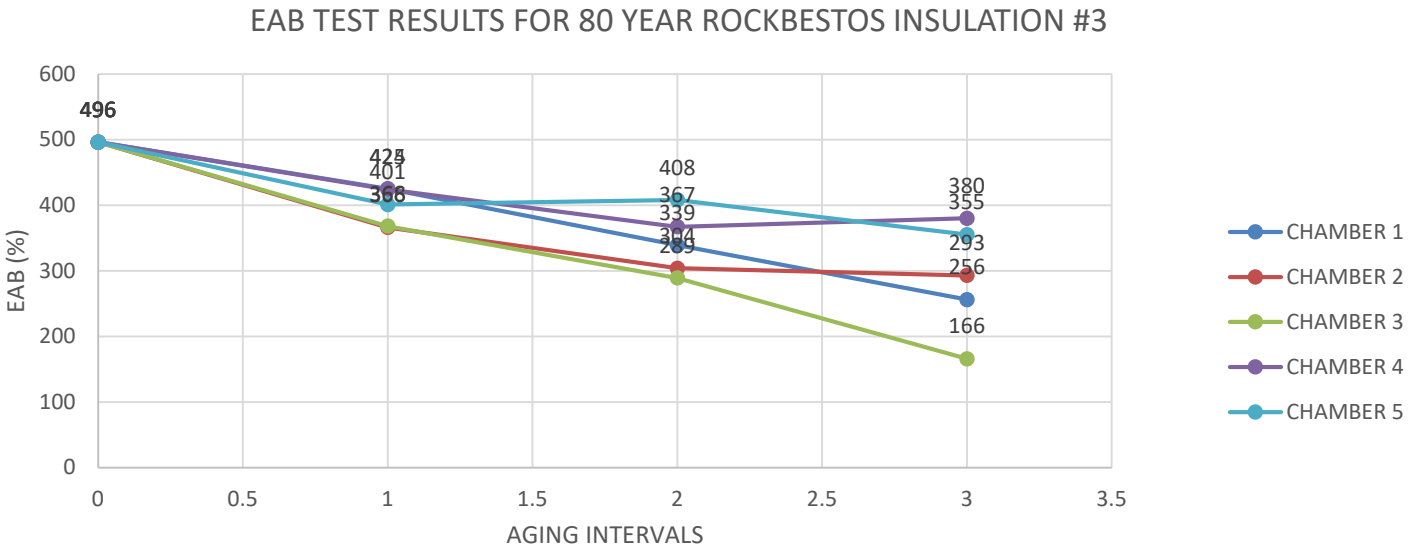
CABLE AGING TEST RESULTS (ROCKBESTOS)



TEST RESULTS FOR ROCKBESTOS INSULATION #2					
INTERVAL	CHAMBER 1	CHAMBER 2	CHAMBER 3	CHAMBER 4	CHAMBER 5
0	431	431	431	431	431
1	406	400	390	403	409
2	332	301	280	301	375
3	264	294	268	338	351

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

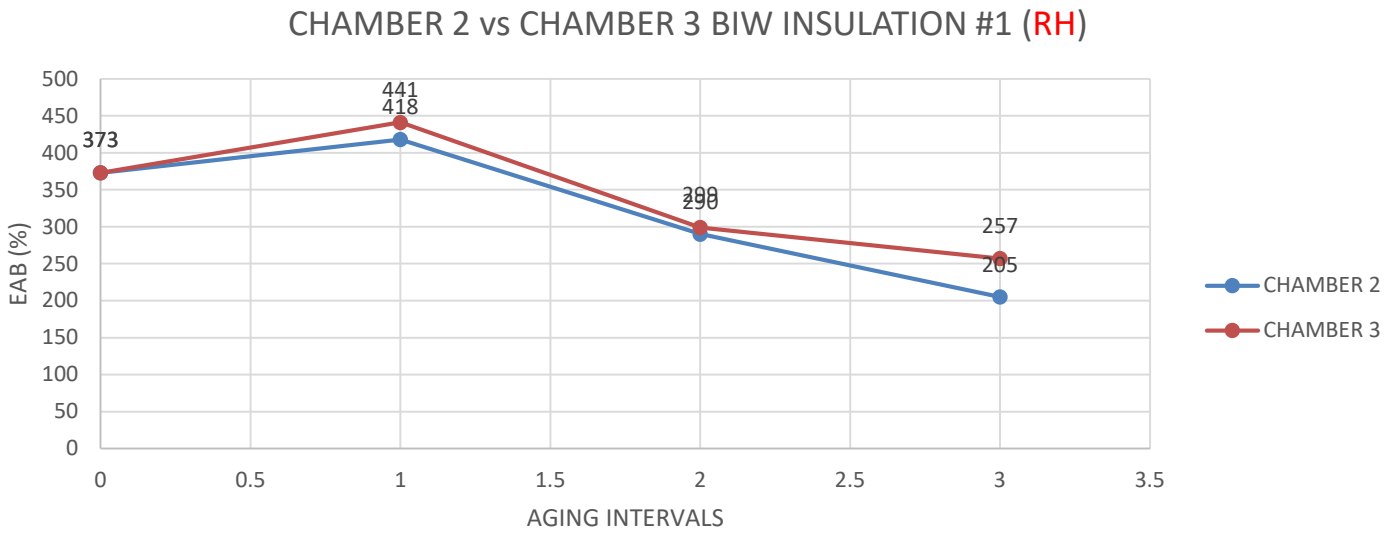
CABLE AGING TEST RESULTS (ROCKBESTOS)



TEST RESULTS FOR ROCKBESTOS INSULATION #3					
INTERVAL	CHAMBER 1	CHAMBER 2	CHAMBER 3	CHAMBER 4	CHAMBER 5
0	496	496	496	496	496
1	425	366	368	424	401
2	339	304	289	367	408
3	256	293	166	380	355

CHAMBERS CONDITION
Chamber #1 (55C, @69G/h, @0% RH)
Chamber #2 (81C, @69G/h, @50% RH)
Chamber #3 (81C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)

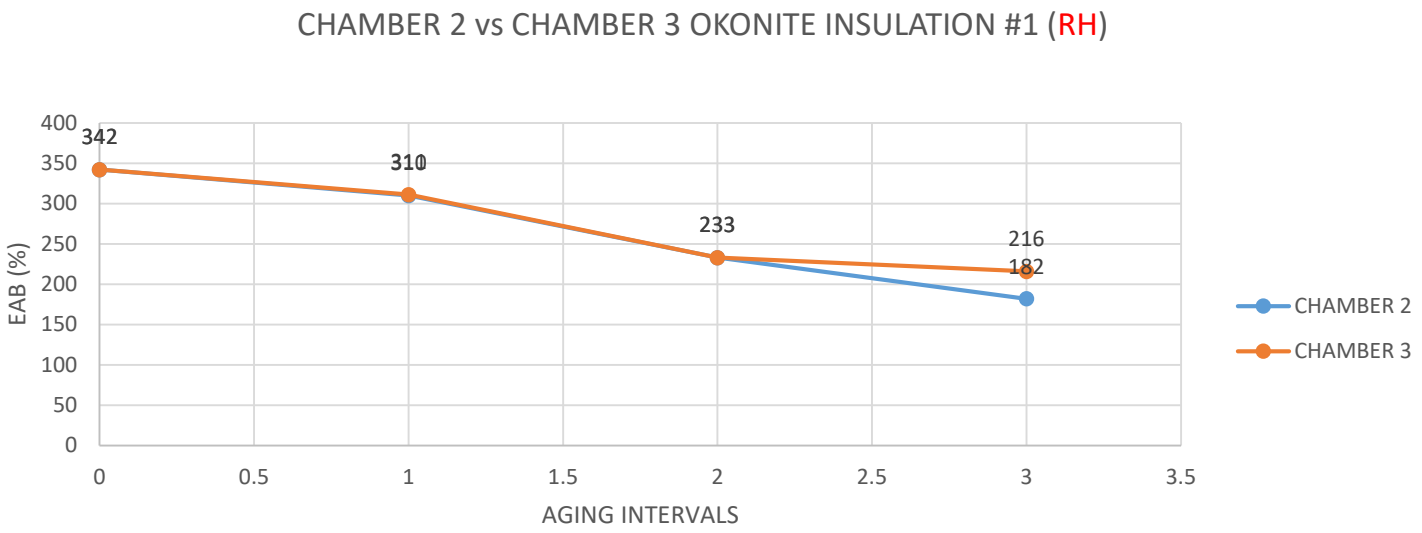
CHAMBER COMPARISON (BIW #1)



CHAMBER 2 vs CHAMBER 3 BIW INSULATION #1		
INTERVAL	CHAMBER 2	CHAMBER 3
0	373	373
1	418	441
2	290	299
3	205	257

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

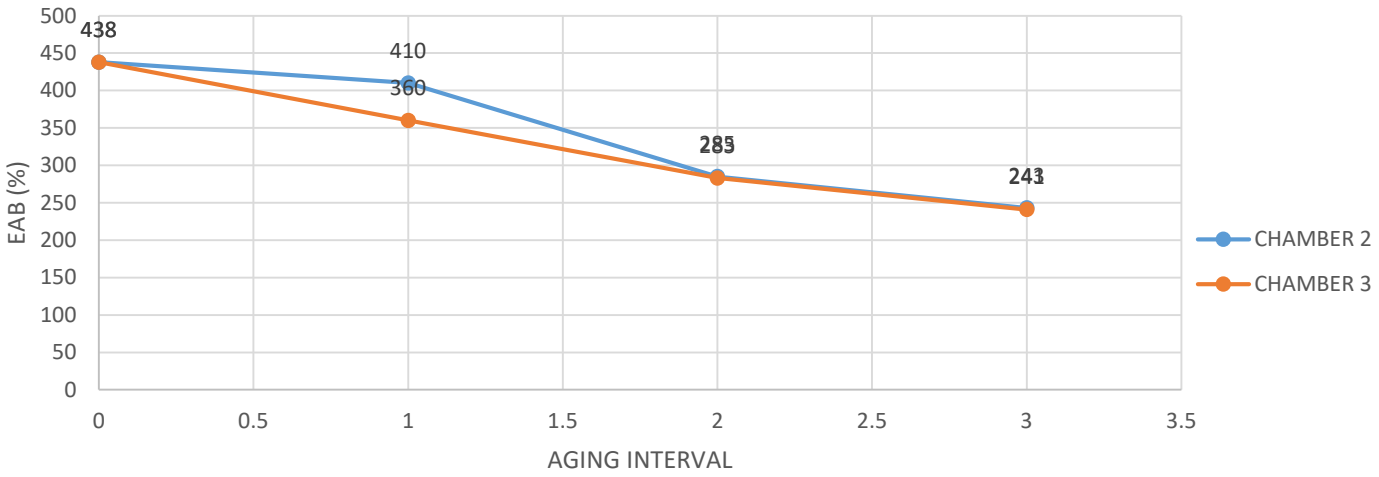
CHAMBER COMPARISON (OKONITE #1)



CHAMBER 2 vs CHAMBER 3 OKONITE INSULATION #1		
INTERVAL	CHAMBER 2	CHAMBER 3
0	342	342
1	310	311
2	233	233
3	182	216

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

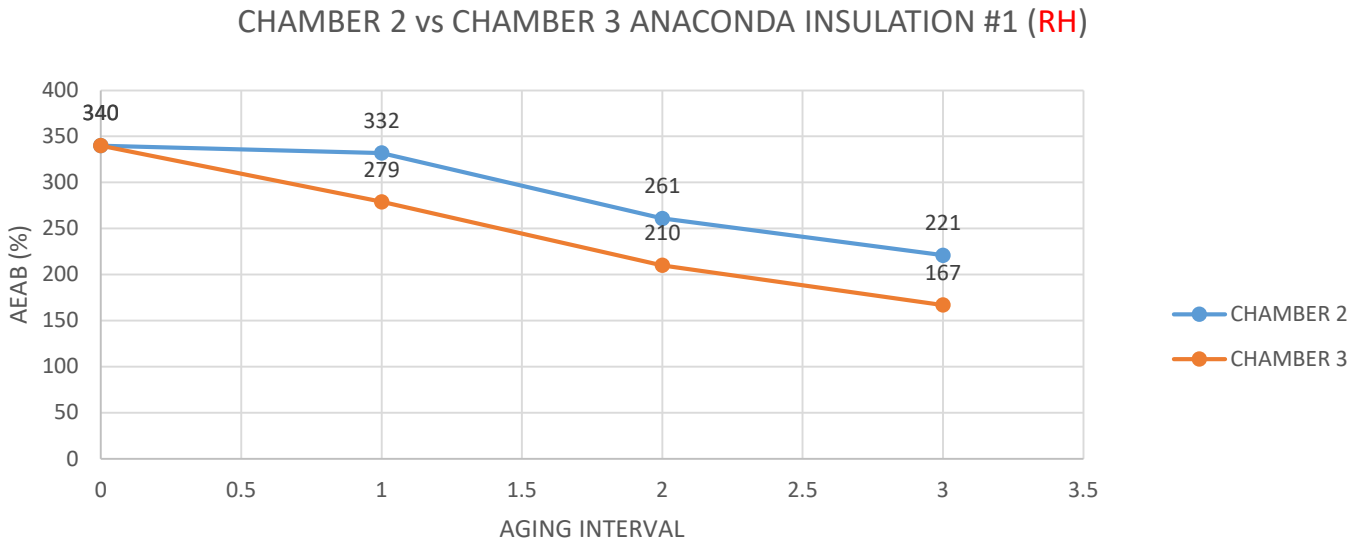
CHAMBER COMPARION (ROCKBESTOS #1)



CHAMBER 2 vs CHAMBER 3 ROCKBESTOS INSULATION #1		
INTERVAL	CHAMBER 2	CHAMBER 3
0	438	438
1	410	360
2	285	283
3	243	241

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

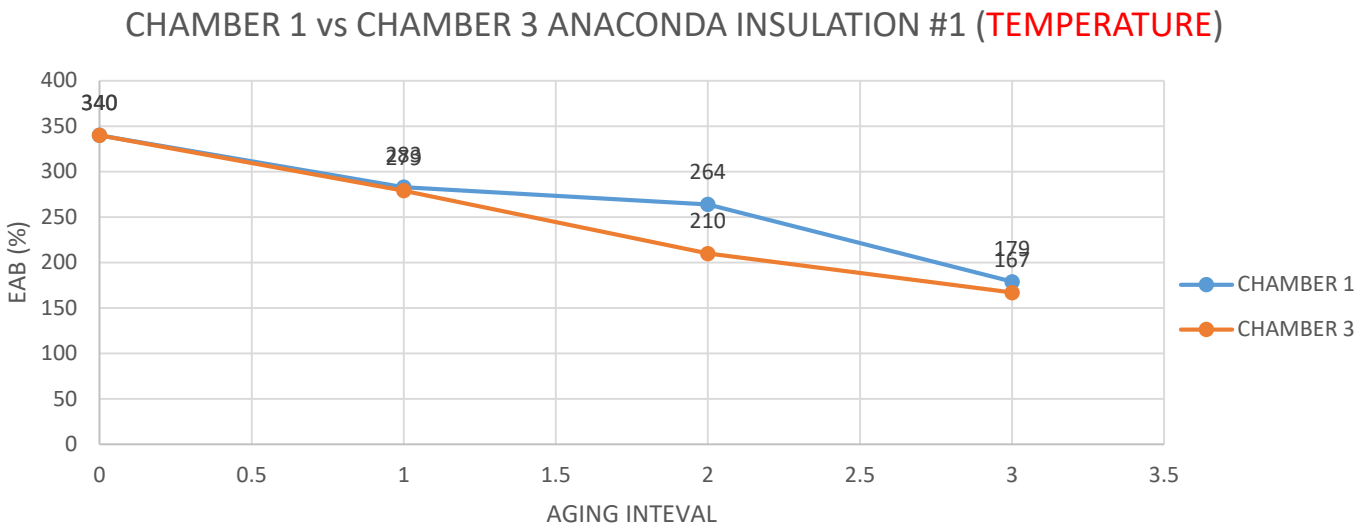
CHAMBER COMPARION (ANACONDA #1)



CHAMBER 2 vs CHAMBER 3 ANACONDA INSULATION #1		
INTERVAL	CHAMBER 2	CHAMBER 3
0	340	340
1	332	279
2	261	210
3	221	167

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

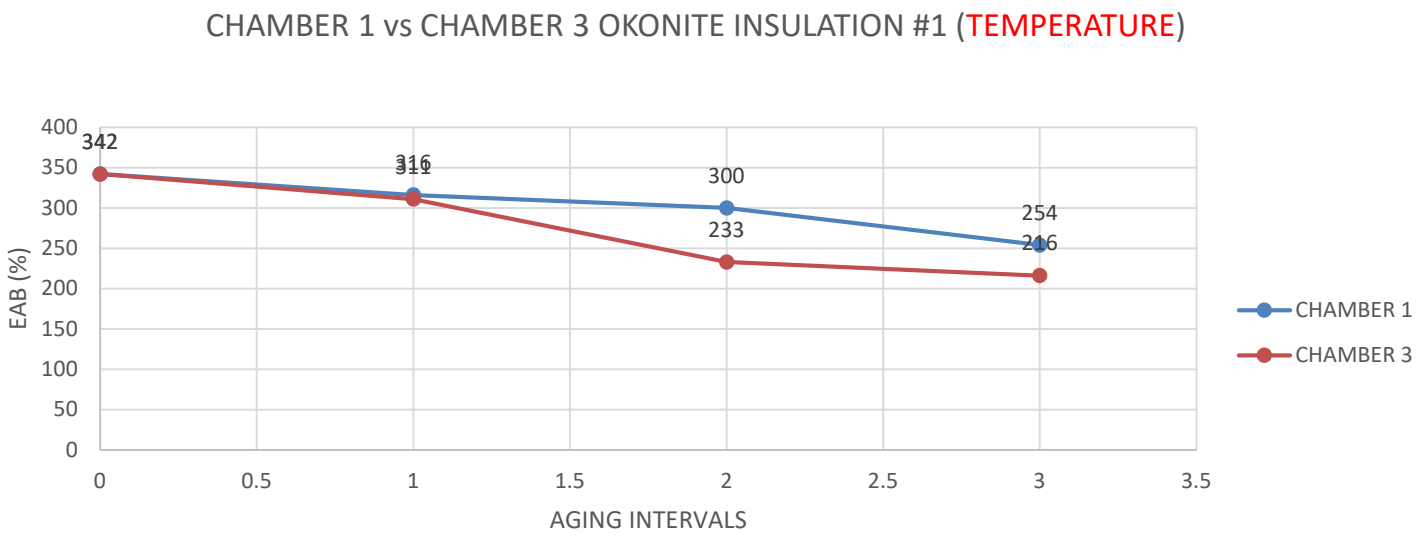
CHAMBER COMPARION (ANACONDA #1)



CHAMBER 1 vs CHAMBER 3 ANACONDA INSULATION #1 (TEMPERATURE)		
INTERVAL	CHAMBER 1	CHAMBER 3
0	340	340
1	283	279
2	264	210
3	179	167

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

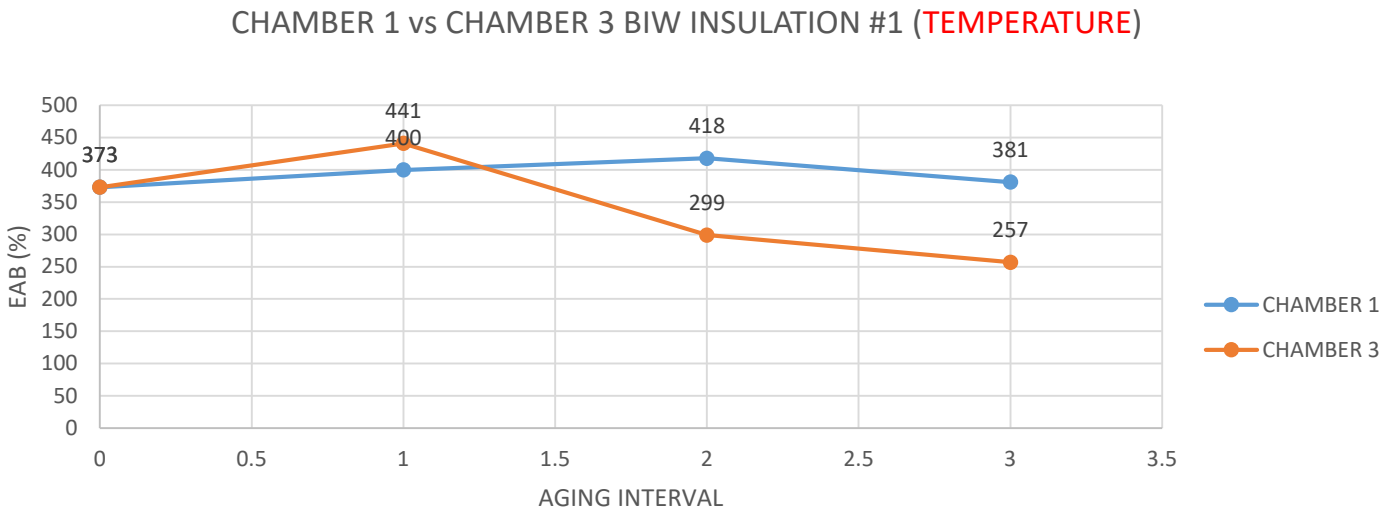
CHAMBER COMPARION (OKONITE #1)



CHAMBER 1 vs CHAMBER 3 OKONITE INSULATION #1 (TEMPERATURE)		
INTERVAL	CHAMBER 1	CHAMBER 3
0	342	342
1	316	311
2	300	233
3	254	216

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

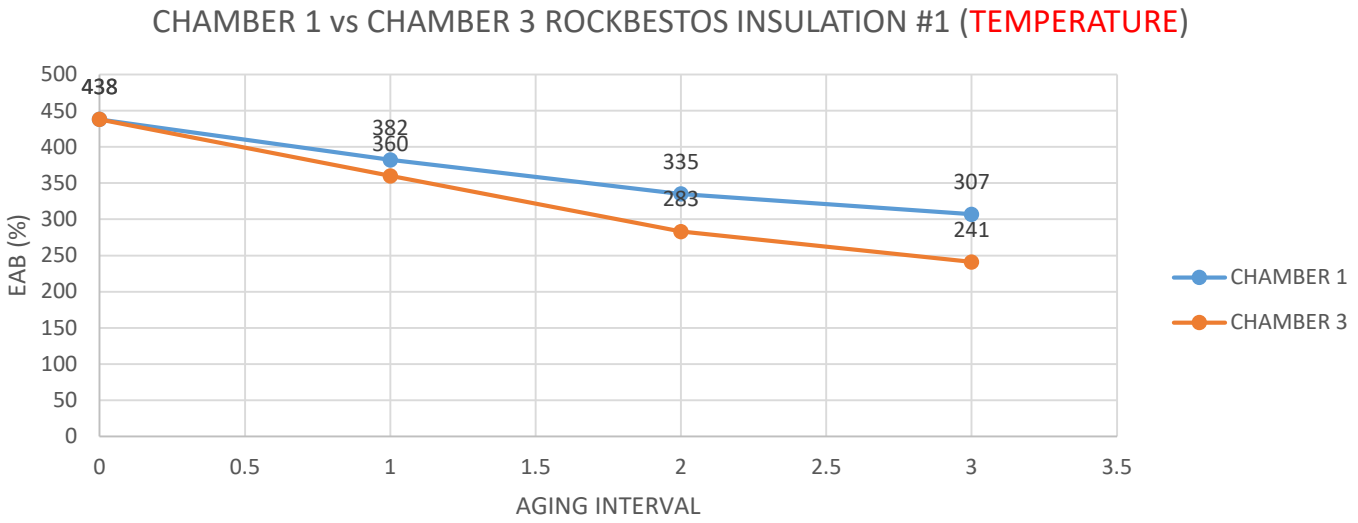
CHAMBER COMPARION (BIW #1)



CHAMBER 1 vs CHAMBER 3 BIW INSULATION #1 (TEMPERATURE)		
INTERVAL	CHAMBER 1	CHAMBER 3
0	373	373
1	400	441
2	418	299
3	381	257

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

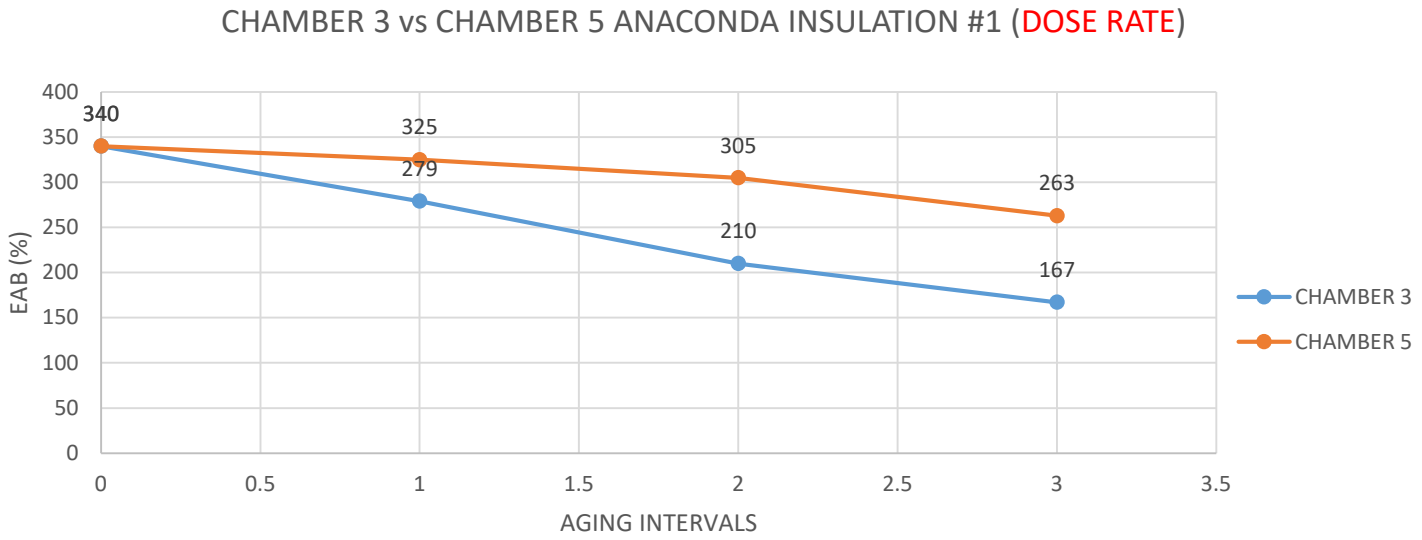
CHAMBER COMPARION (ROCKBESTOS #1)



CHAMBER 1 vs CHAMBER 3 ROCKBESTOS INSULATION #1 (TEMPERATURE)		
INTERVAL	CHAMBER 1	CHAMBER 3
0	438	438
1	382	360
2	335	283
3	307	241

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

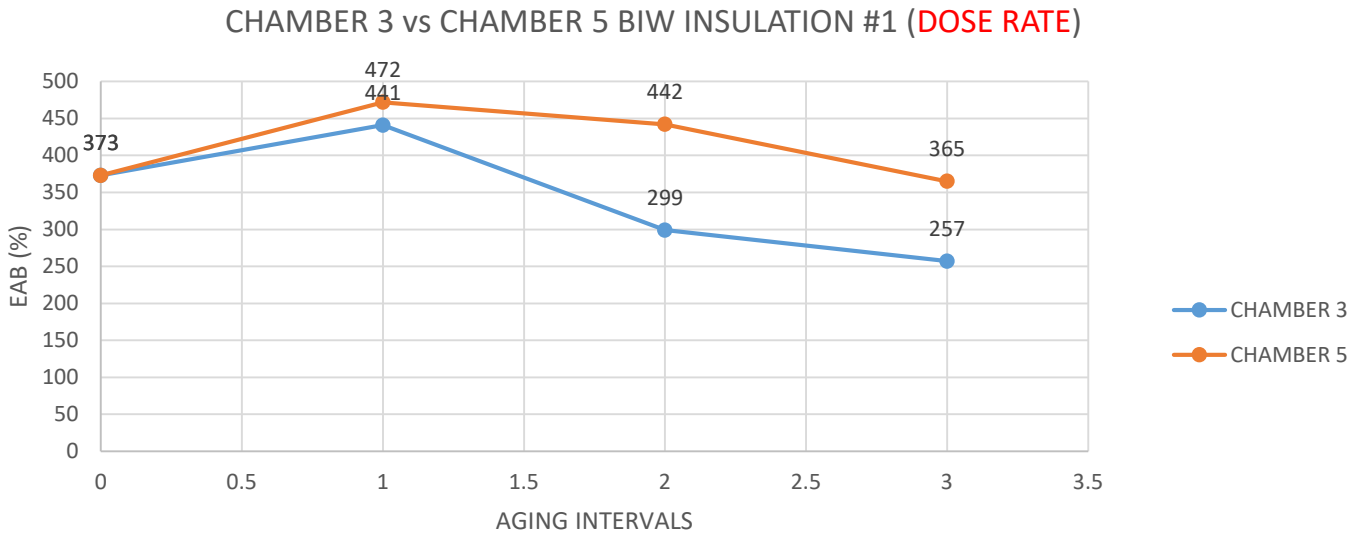
CHAMBER COMPARION (ANACONDA #1)



CHAMBER 3 vs CHAMBER 5 ANACONDA INSULATION #1 (DOSE RATE)		
INTERVAL	CHAMBER 3	CHAMBER 5
0	340	340
1	279	325
2	210	305
3	167	263

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

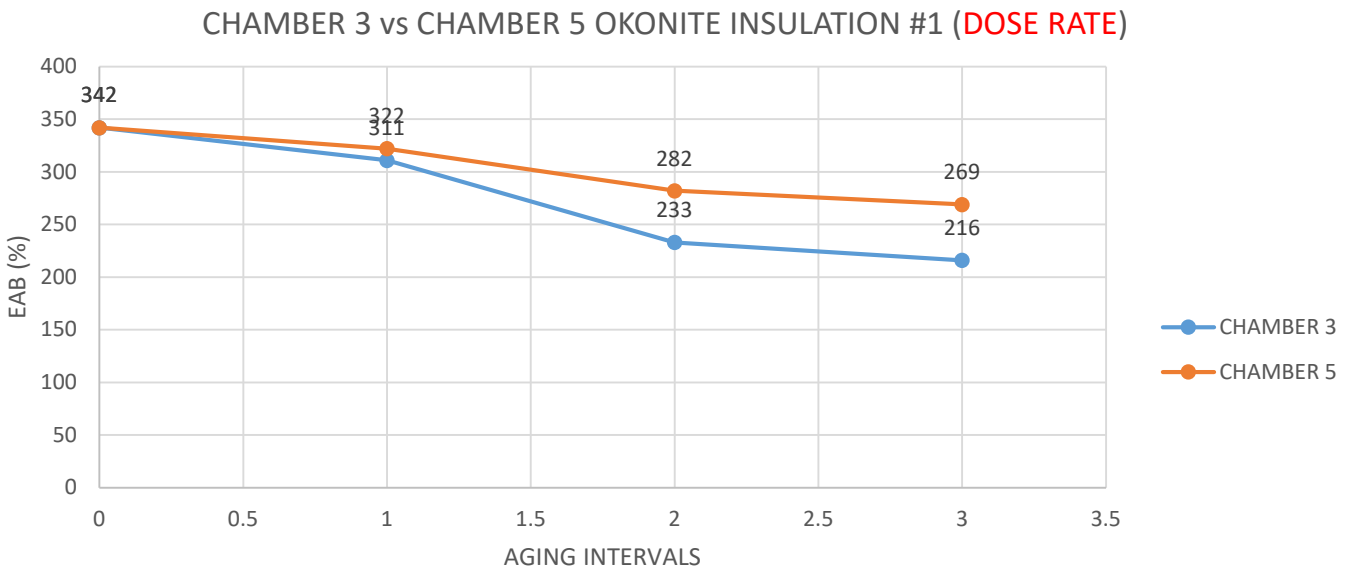
CHAMBER COMPARION (BIW #1)



CHAMBER 3 vs CHAMBER 5 BIW INSULATION #1 (DOSE RATE)		
INTERVAL	CHAMBER 3	CHAMBER 5
0	373	373
1	441	472
2	299	442
3	257	365

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

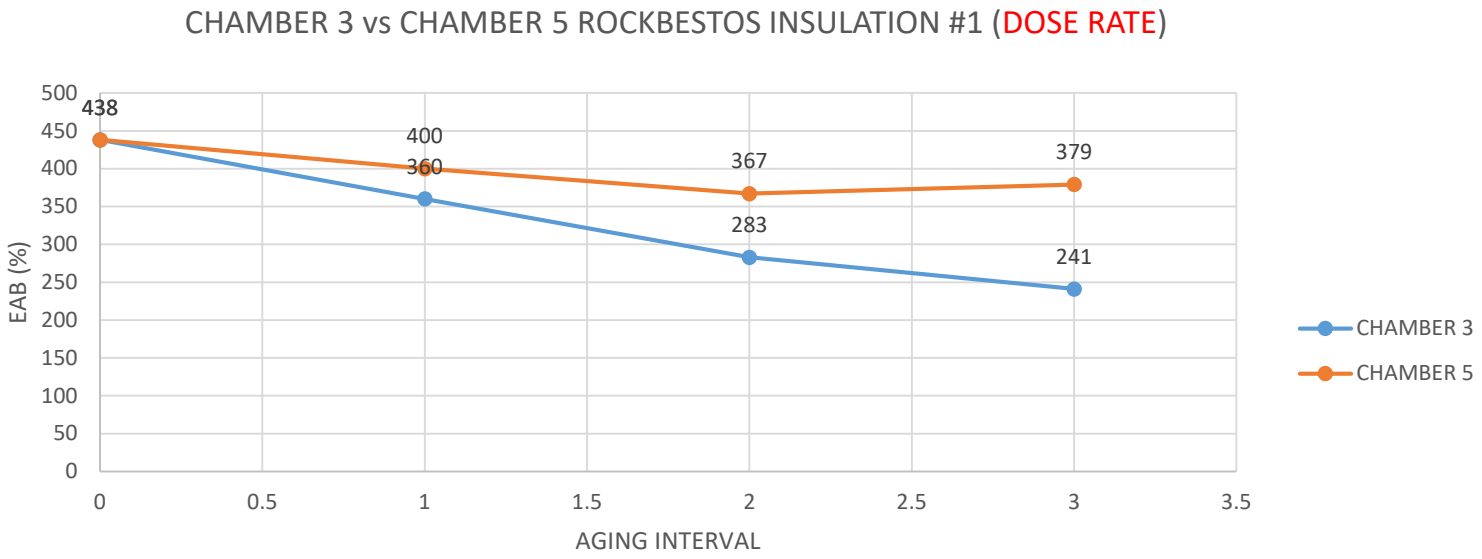
CHAMBER COMPARION (OKONITE #1)



CHAMBER 3 vs CHAMBER 5 OKONITE INSULATION #1 (DOSE RATE)		
INTERVAL	CHAMBER 3	CHAMBER 5
0	342	342
1	311	322
2	233	282
3	216	269

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

CHAMBER COMPARION (ROCKBESTOS #1)



CHAMBER 3 vs CHAMBER 5 ROCKBESTOS INSULATION #1 (DOSE RATE)		
INTERVAL	CHAMBER 3	CHAMBER 5
0	438	438
1	360	400
2	283	367
3	241	379

AGING COMPARISON	
Chamber #2 (81C, @69G/h, @50% RH)	Chamber #3 (81C, @69G/h, @0% RH)
Chamber #3 (81C, @69G/h, @0% RH)	Chamber #1 (55C, @69G/h, @0% RH)
Chamber #4 (81C, @20G/h, @50% RH)	Chamber #2 (81C, @69G/h, @50% RH)
Chamber #5 (81C, @20G/h, @0% RH)	Chamber #3 (81C, @69G/h, @0% RH)

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

NEXT STEPS FOR THE NRC's CABLE AGING PROJECT

- COMPLETE THE CABLES' THERMAL AND RADIATION AGING AT SANDIA
- CONTINUE TO COLLECT AND ANALYZE THE DATA FOR THE 4th, 5th, 6th, 7th, 8th INTERVAL
- COMPLETE THE FINAL REPORT THAT DISCUSSES THE FOLLOWING:
  - CONDITION MONITORING METHODS ASSESSED
  - THE CABLES CONCURRENT THERMAL AND RADIATION AGING
- SHIP THE CABLE MANDRELS TO THE CONTRACTOR HIRED TO PERFORM THE LOSS-OF-COOLANT TEST

DEVELOPMENT OF AN INTERNATIONAL PLATFORM WHERE RESEARCH IS DISCUSSED AND SHARED

PURPOSE

ADVANCE THE COMMON UNDERSTANDING OF CABLE AGING RELATED ISSUES WITH THE INTERNATIONAL STAKEHOLDERS

- ❑ POTENTIAL BENEFITS:
  - FACILITATE INTERNATIONAL RESEARCH COORDINATION
  - DECREASE DUPLICATION OF RESEARCH
  - BETTER LEVERAGE RESOURCES INTENDED FOR RESEARCH
  - PROMOTES COLLABORATION ON RESEARCH ACTIVITIES AND TECHNICAL DISCUSSIONS

- ❑ LEAD INSTITUTION
  - NRC LED INITIATIVE
  - INTERNATIONAL ORGANIZATIONS (IAEA, NEA)