



BATTCON 2006

**FLOODED (VLA),
SEALED (VRLA), GEL, AGM TYPE,
FLAT PLATE, TUBULAR PLATE:
THE WHEN, WHERE, AND WHY. HOW DOES
THE END USER DECIDE ON THE BEST
SOLUTION?**

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ENERGY FROM BATTERIES



GLOBAL MARKET – GLOBAL BATTERIES ?

	North America	Europe	Far East
25 to 200Ah	12V AGM block	12V AGM block	12V AGM block
300 to 3000Ah	VLA flat AGM horizontal	VLA tubular GEL	- AGM vertical

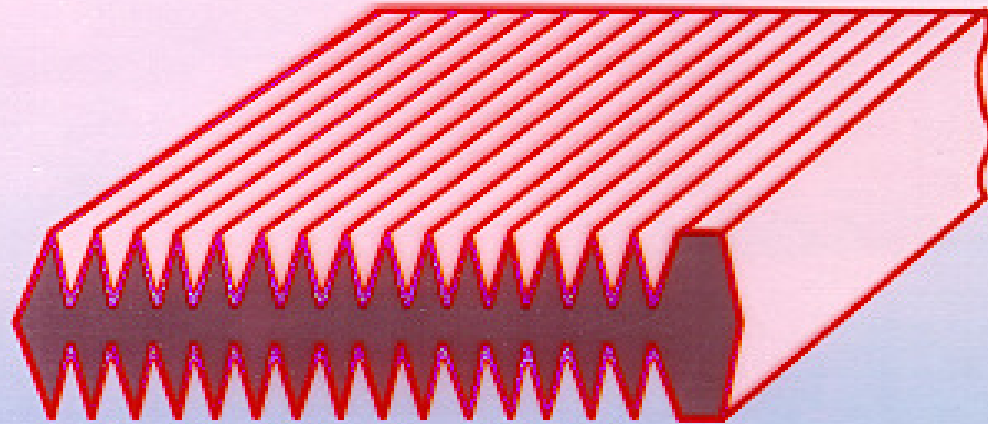
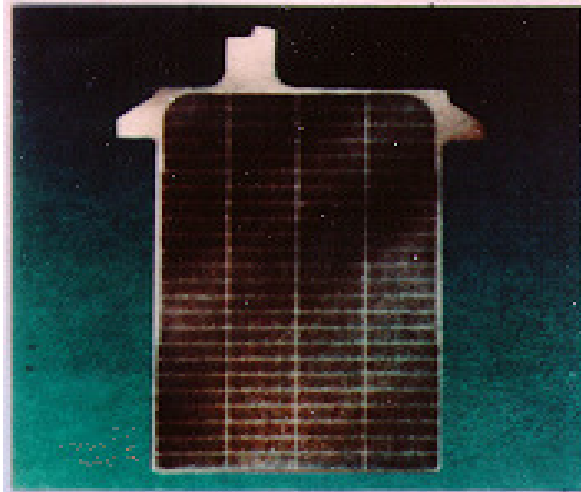
TYPE COMPARISON

PERFORMANCE AND ENDURANCE

TUBULAR		FLAT	
VLA	VRLA	VLA	VRLA
OPzS	OPzV	OGi	OGiV

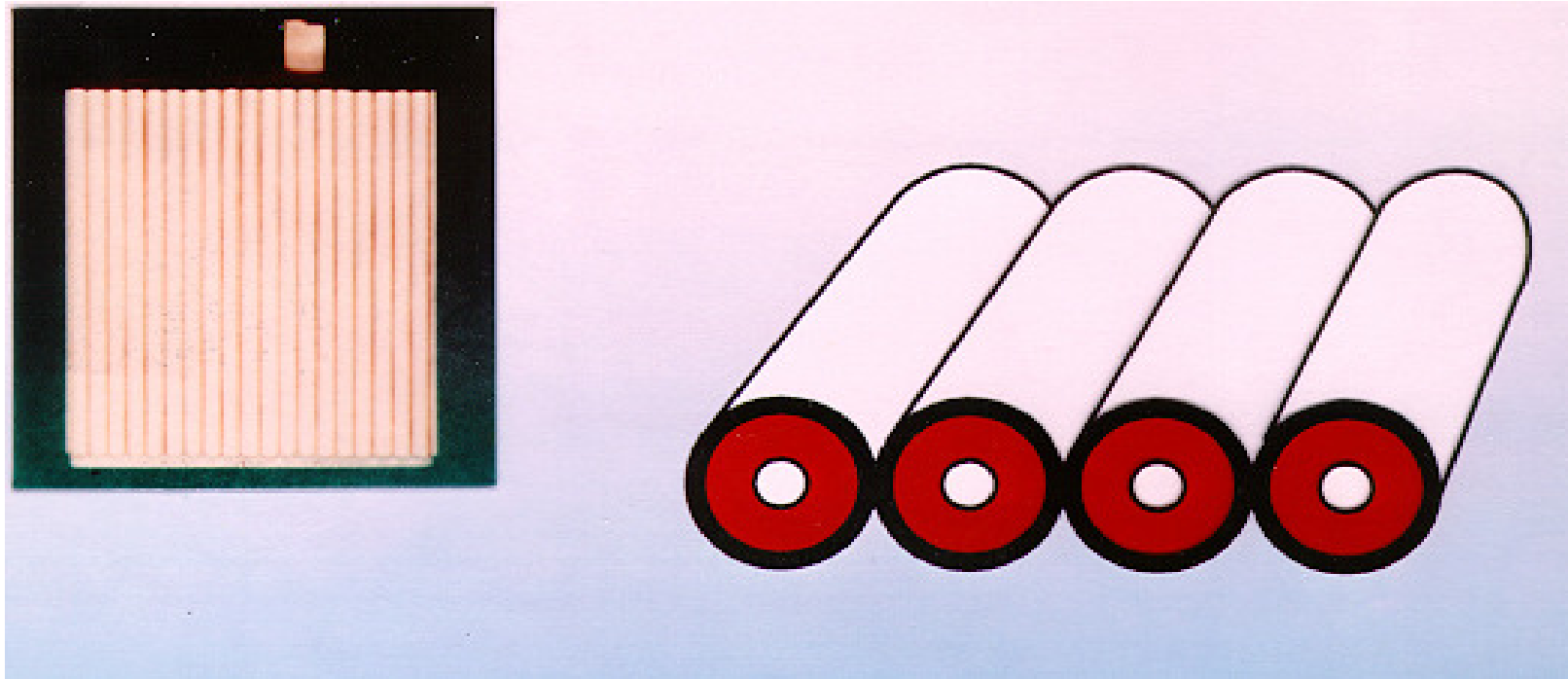
AGM	GEL
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POSITIVE PLANTÈ PLATE



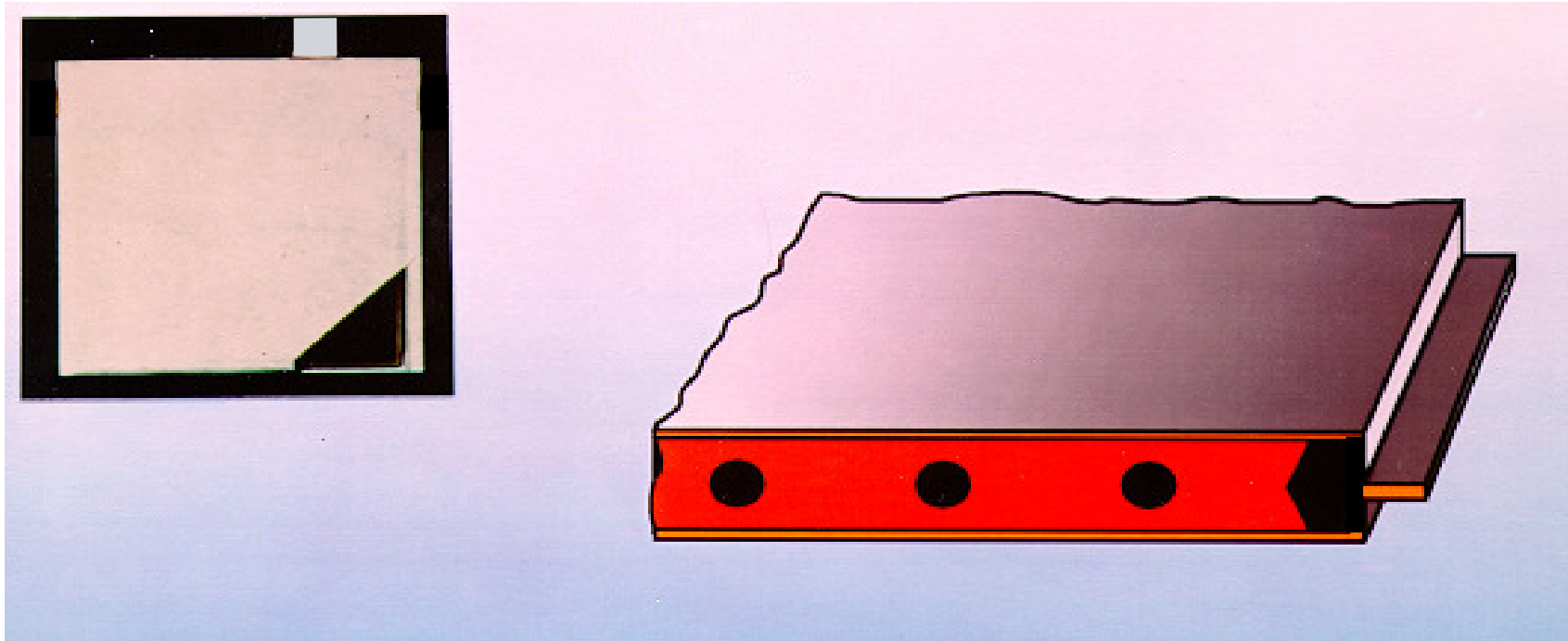
- Gravity cast grid with enlarged surface by lamellas
- Active mass (PbO_2) is produced by corrosion
- High power output
- Long operational life
- Low cycle stability (ca. 200 cycles)
- High cost battery, old-fashioned

POSITIVE TUBULAR PLATE



- Gauntlets: radial pressure, no horizontal bars
- Circular rods, pressure cast, Lead-selenium (OPzS), Lead-calcium (OPzV)
- High porosity by read-lead filling
- **Highest operational life**
- **Highest endurance of cycles**
- **8mm thickness of the electrode restricts the high power performance**

POSITIVE ROUND - GRID FLAT PLATE



- Circular rods like in tubular plates; but 50% more plates
- Lead-selenium alloy, fine grains, low corrosion
- High power output
- Good cycle endurance
- Long operational life



COMPARISON

VLA TUBULAR PLATE VERSUS VLA FLAT PLATE

ENERGY FROM BATTERIES

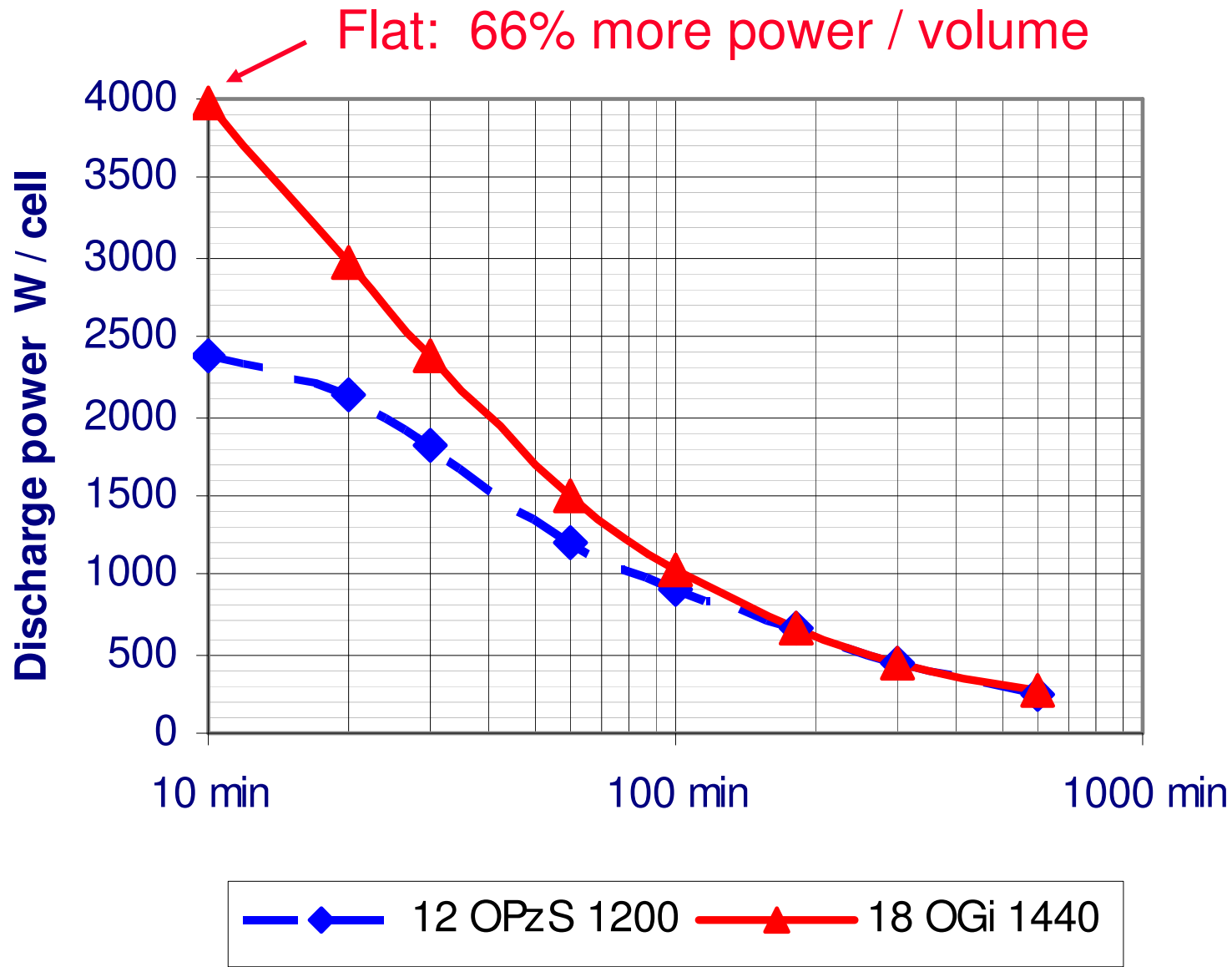


PERFORMANCE COMPARISON

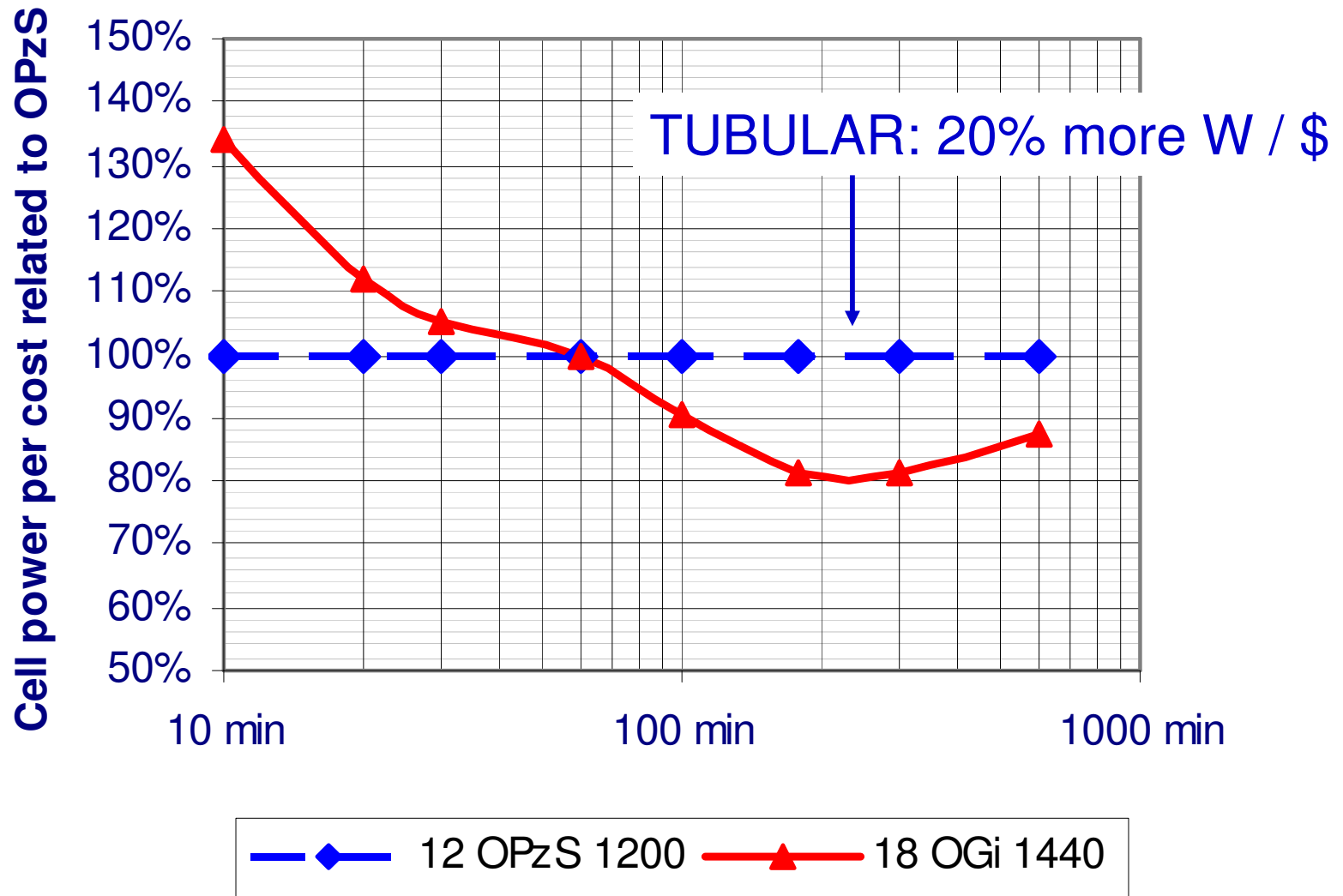


	FLAT	TUBULAR
Type	18 OGi 1440	12 OPzS 1200
C10, 25°C, 1,80V	1350Ah	1340Ah
Weight	102 kg, 224,7 lb	88 kg, 193,8 lb
Size	L x W x H = 215 x 277 x 710 mm	
Plates, thickness	18 pos. plates, 4,8mm	12 pos. plates, 8,0mm
Inner resistance	0,125 mOhm	0,23 mOhm

DISCHARGE POWER: FLAT VS TUBULAR



POWER PER COST: FLAT VS TUBULAR



ACCELERATED LIFE TIME TEST






QUALIFICATION FOR NUCLEAR POWER PLANTS:

IEEE 535-1986: 20 days at 145F (62,8 °C) equals 1 year

ENERGY FROM BATTERIES



ACCELERATED LIFE TIME TEST: SAMPLES

			
	<i>OPzS</i> vented	<i>OPzV</i> valve-regulated	<i>OGi</i> vented
type	tubular	tubular - GEL	flat
density float V	1,24g/ml 2,23V	1,24g/ml 2,25V	1,24g/ml 2,23V
samples	6 cells 200Ah	3 cells 200Ah	3 cells 480Ah
samples	6 cells 490Ah	3 cells 490Ah	3 cells 800Ah
samples	6 cells 2000Ah	3 cells 2000Ah	3 cells 1520Ah

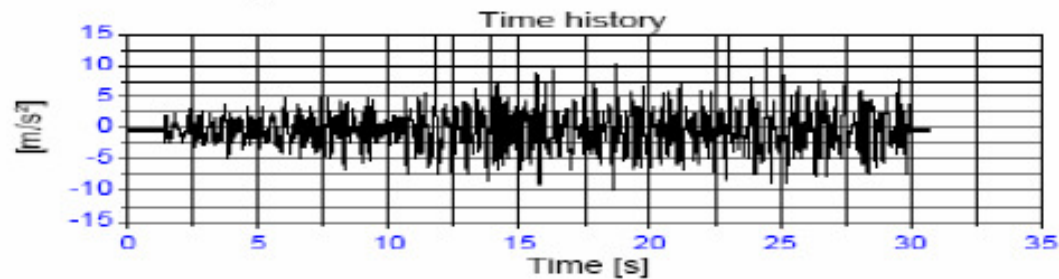
SEISMIC TEST IN THREE DIMENSIONS



**5 times seismic
test à 30s,
1 times air plane
crash test à 30s**

measuring point: shake-table z-dir.

RRS SSE



ENERGY FROM BATTERIES



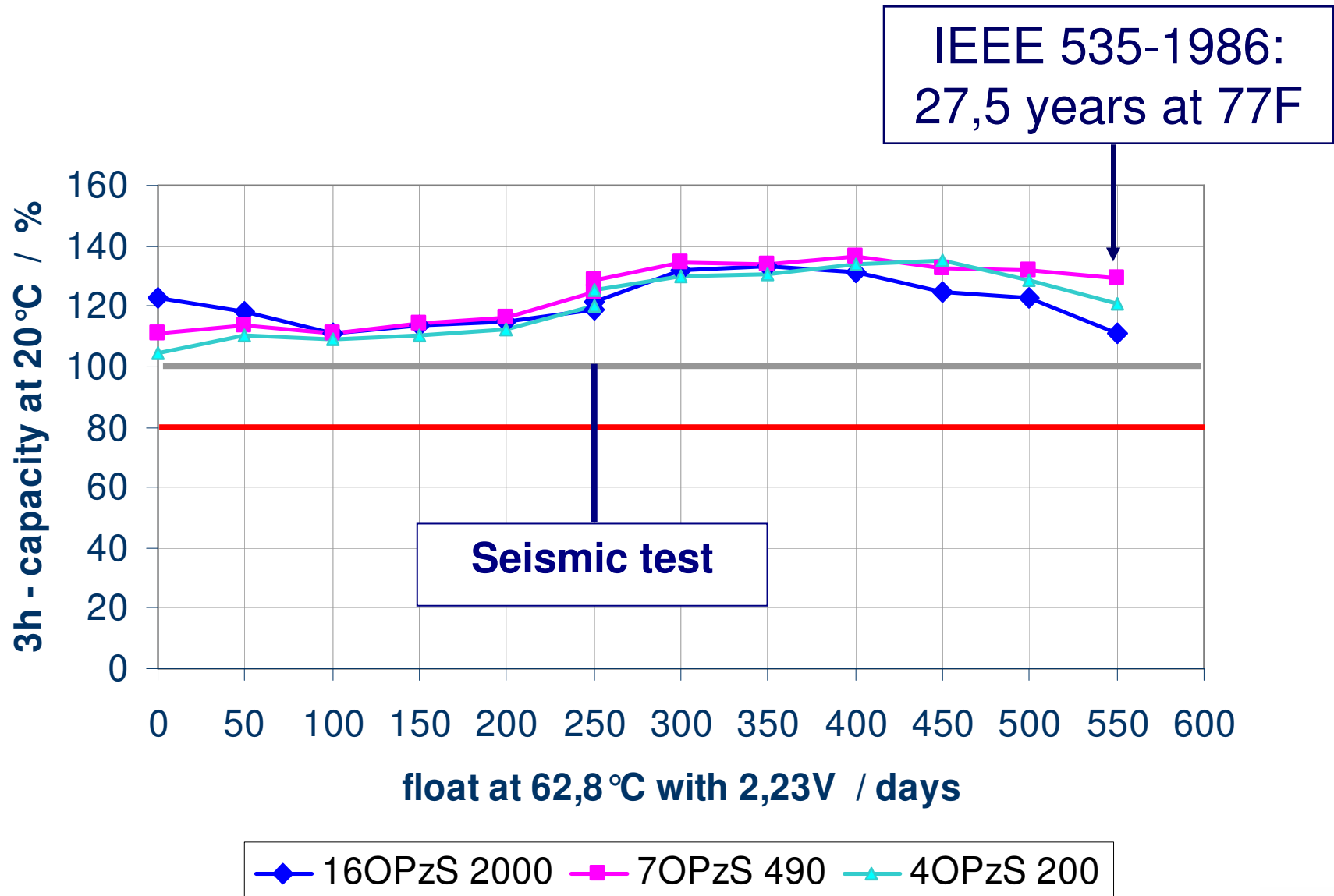
AIRPLANE CRASH TEST



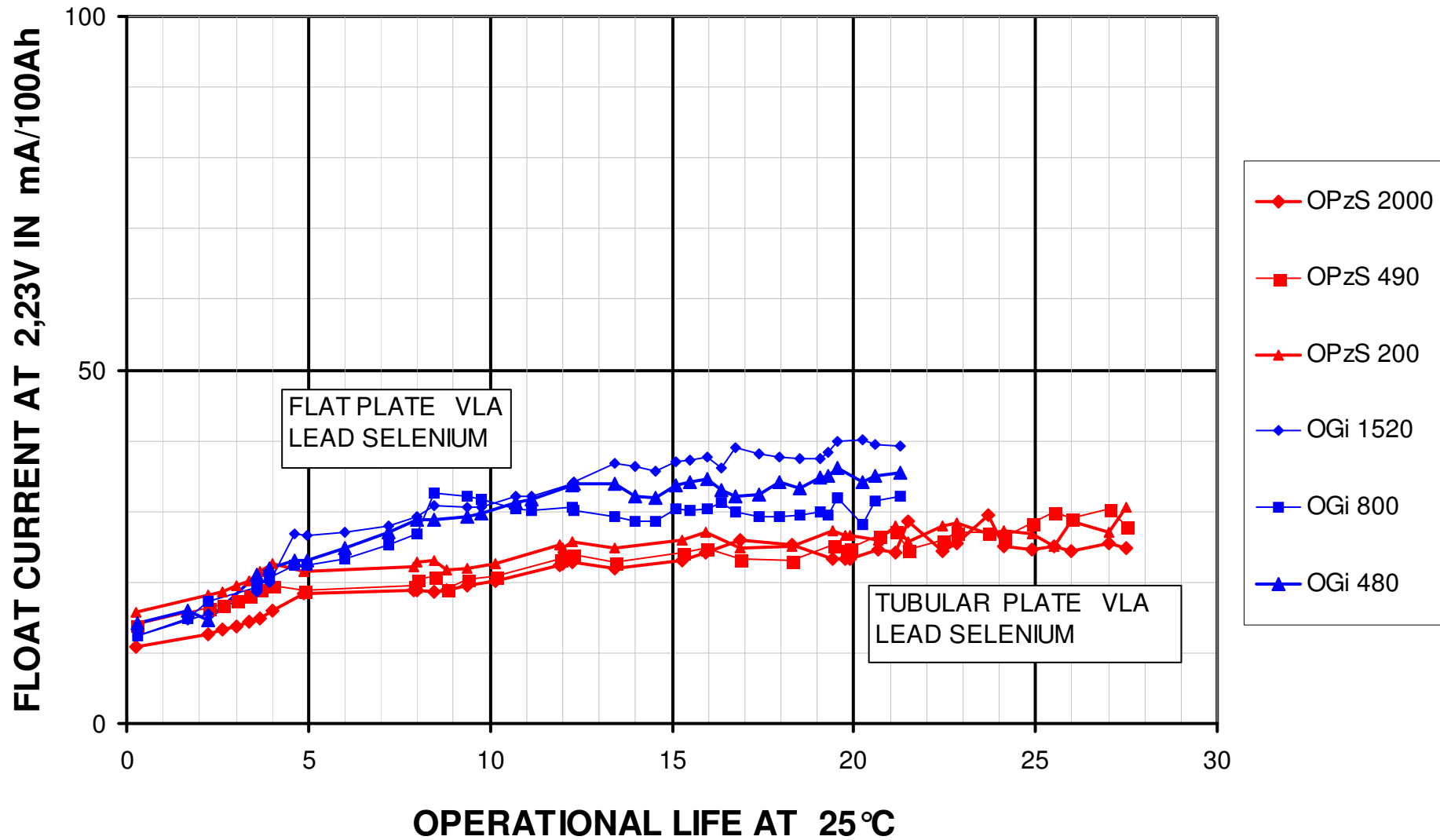
ENERGY FROM BATTERIES



TUBULAR PLATE CELLS: 550 days at 145F



FLOAT CURRENTS OF TUBULAR AND FLAT



PLATES AFTER 550 DAYS AT 145F



Negative plate
2.8% PbSO_4

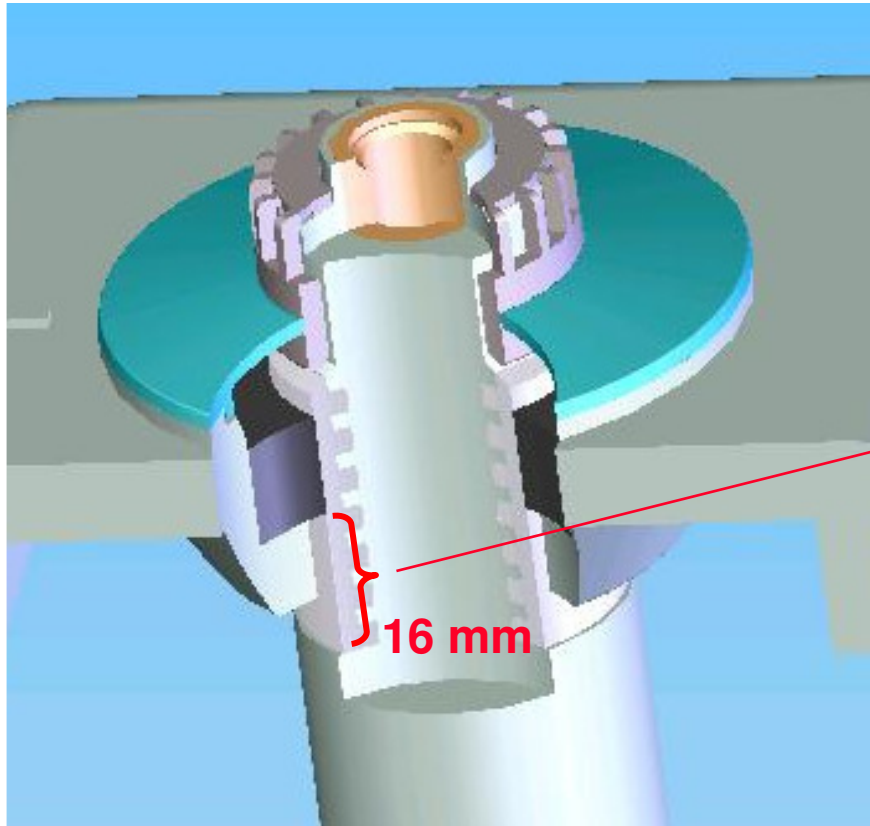


Positive plate
94.6% PbO_2

Growth of *OPzS* poles at life's end



Cross section of the terminal



- Labyrinth in the lead pole
- Primer onto the labyrinth
- ABS injection-moulding like a panzer
- Sliding pole: during growth a clean uncorroded pole shaft is moving upwards and maintains the 100% seal of the rubber ring.
- Washers in polarity colors
- Service ring for impedance measurements, IP25 protected
- Copper inserts for OGi, brass inserts for OPzS and OPzV.

ENDURANCE COMPARISON

	Flat plate OGi	Tubular plate OPzS
On float with 2,23V at 62,8°C	425 days	550 days
IEEE 535-1986	21,3 years at 25°C	27,5 years at 25°C
	33 years at 20°C	42,7 years at 20°C
Float current increase in 20 years	Factor 2	Factor 3
Cycles IEC 60 896-1 75% DOD C4	1200	1700



COMPARISON VRLA VERSUS VLA

ENERGY FROM BATTERIES



ADVANTAGES VRLA VERSUS VLA

- GAS EVOLUTION ONLY 10%,
VENTILATION REQUIREMENT ONLY 20% (EN 50 272-2)
- LESS PROVISION AGAINST ACID LEAKAGE
- NO HANDLING WITH ACID AND WATER
- NO IMPURITY PROBLEMS WITH REFILLING WATER
- NO SHORT CIRCUITS DUE TO ACCUMULATED MUD

DISADVANTAGES VRLA VERSUS VLA

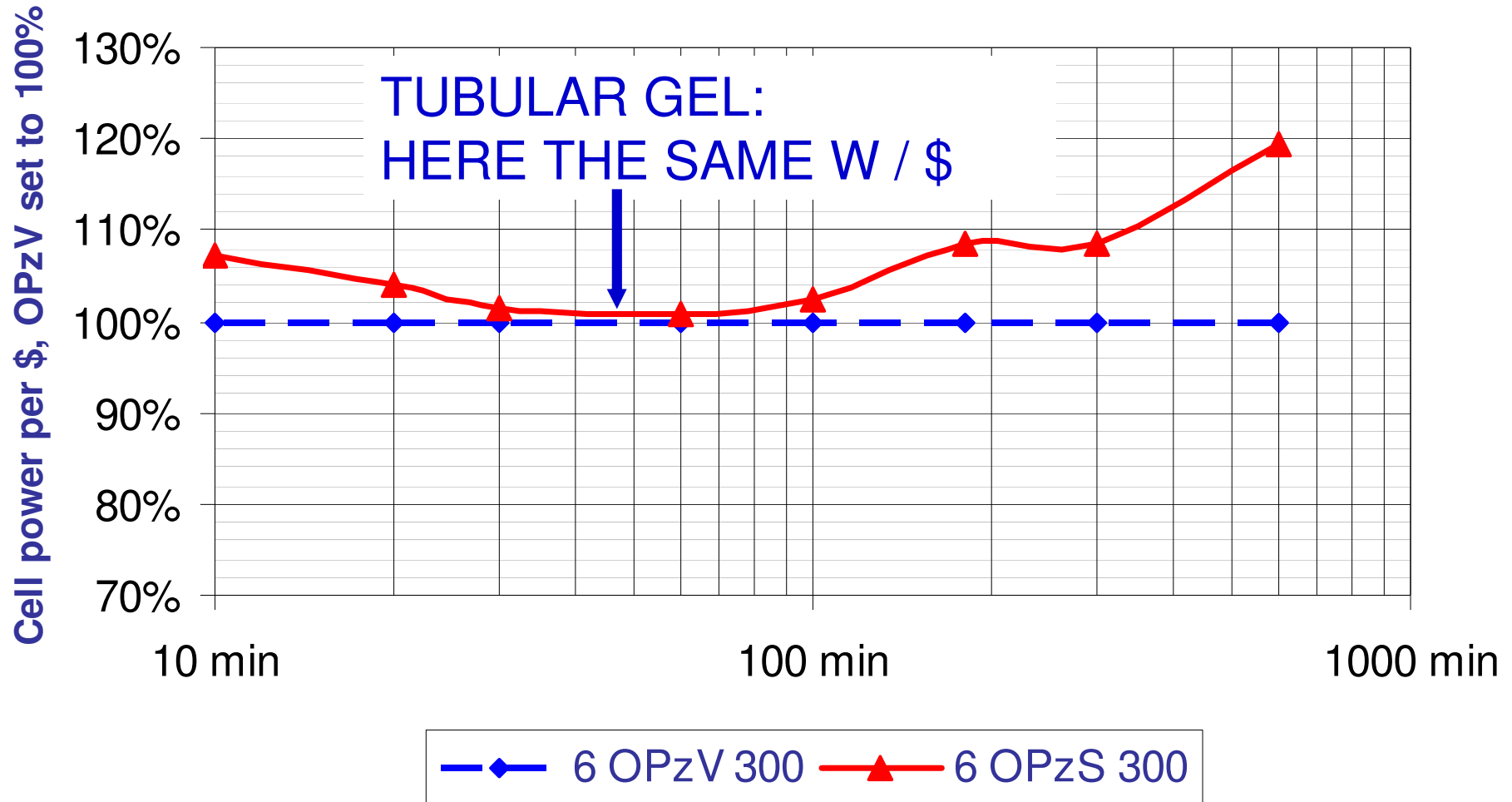
- OXYGEN INGRESS DISCHARGES THE NEGATIVE PLATE
- OXYGEN RECOMBINATION REDUCES NEGATIVE POLARISATION: IN UNFAVOURABLE DESIGNS DISCHARGE OF NEGATIVE DURING FLOAT!
- MAX. TEMPERATURE 45°C INSTEAD of 55°C
- LESS INSPECTION METHODS – LESS AWARENESS OF HEALTH

PERFORMANCE COMPARISON

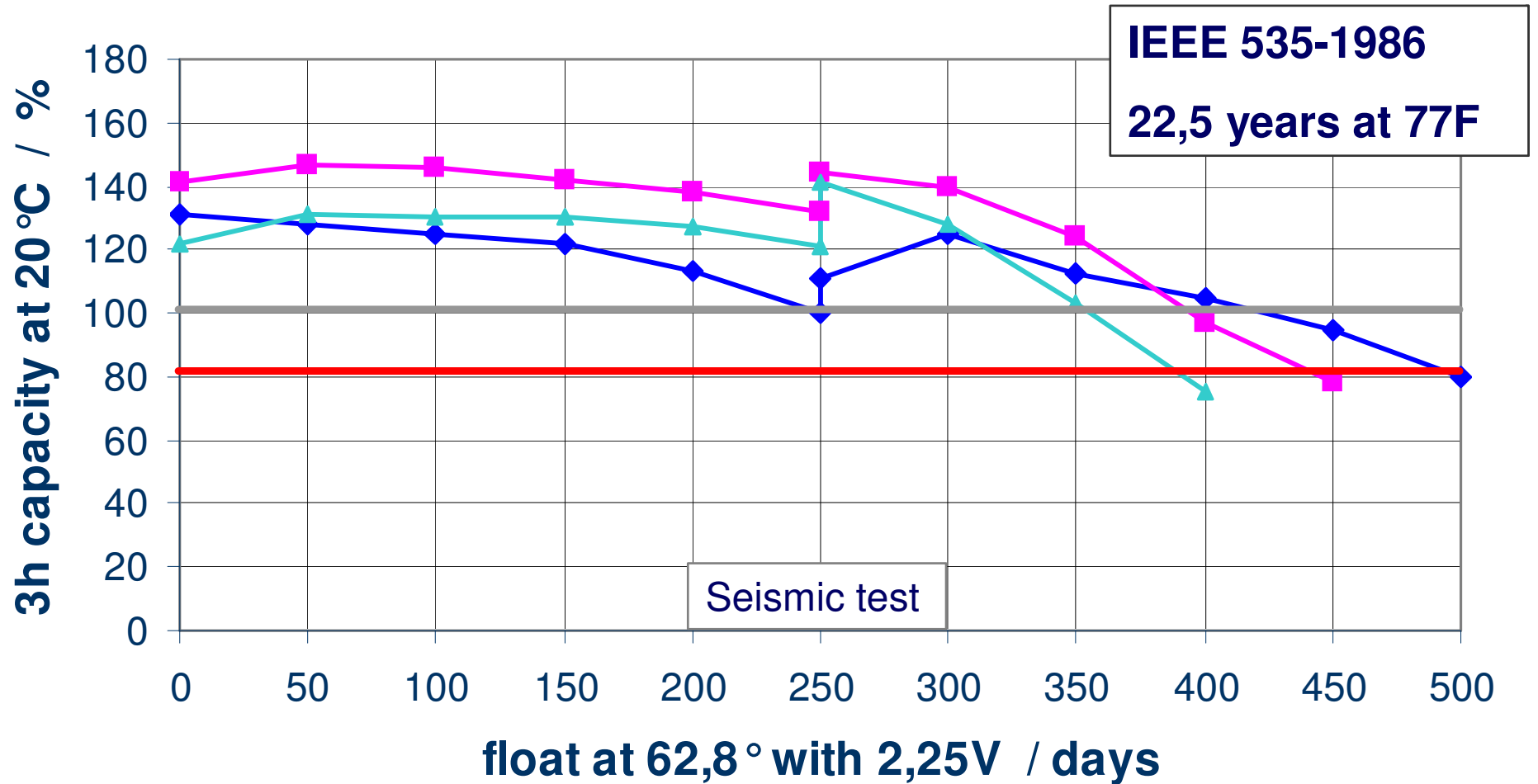


	VRLA TUBULAR GEL	VLA TUBULAR
Type	6 OPzV 300	6 OPzS 300
C10, 25°C, 1,80V	326 Ah	317 Ah
Weight	23,3 kg, 51,3 lb	23kg, 50,7lb
Size	L x W x H = 380/3 x 205 x 380 mm	
Plates, thickness	6 pos. plates, 8,4mm	6 pos. plates, 8,0mm
Inner resistance	1,8 mOhm	1,6mOhm

POWER PER COST VRLA VERSUS VLA



TUBULAR GEL: 450 DAYS AT 145F

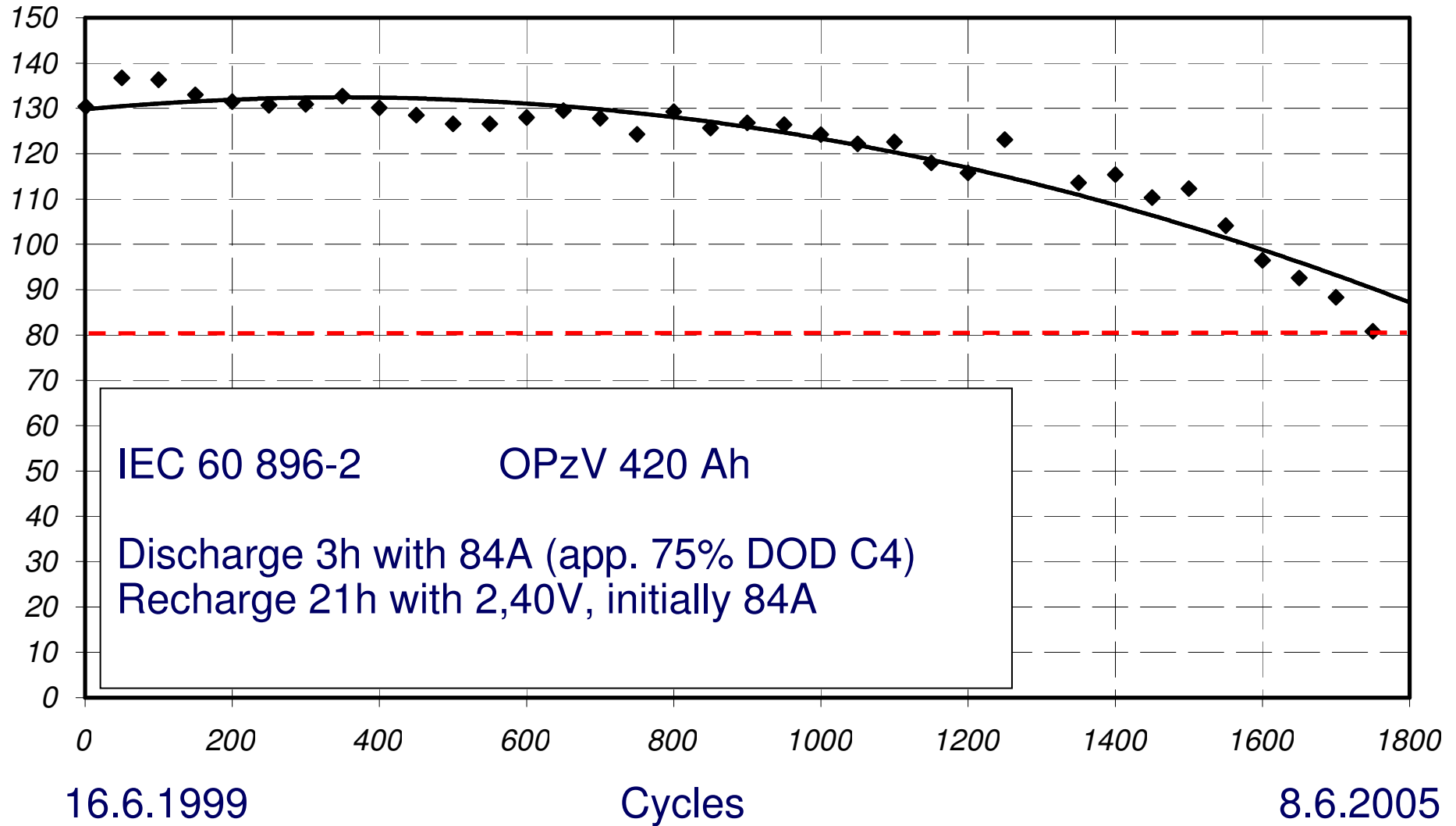


—◆— 16OPzV 2000 —■— 7OPzV 490 —▲— 4OPzV 200

TUBULAR GEL (OPzV)

CYCLE TEST

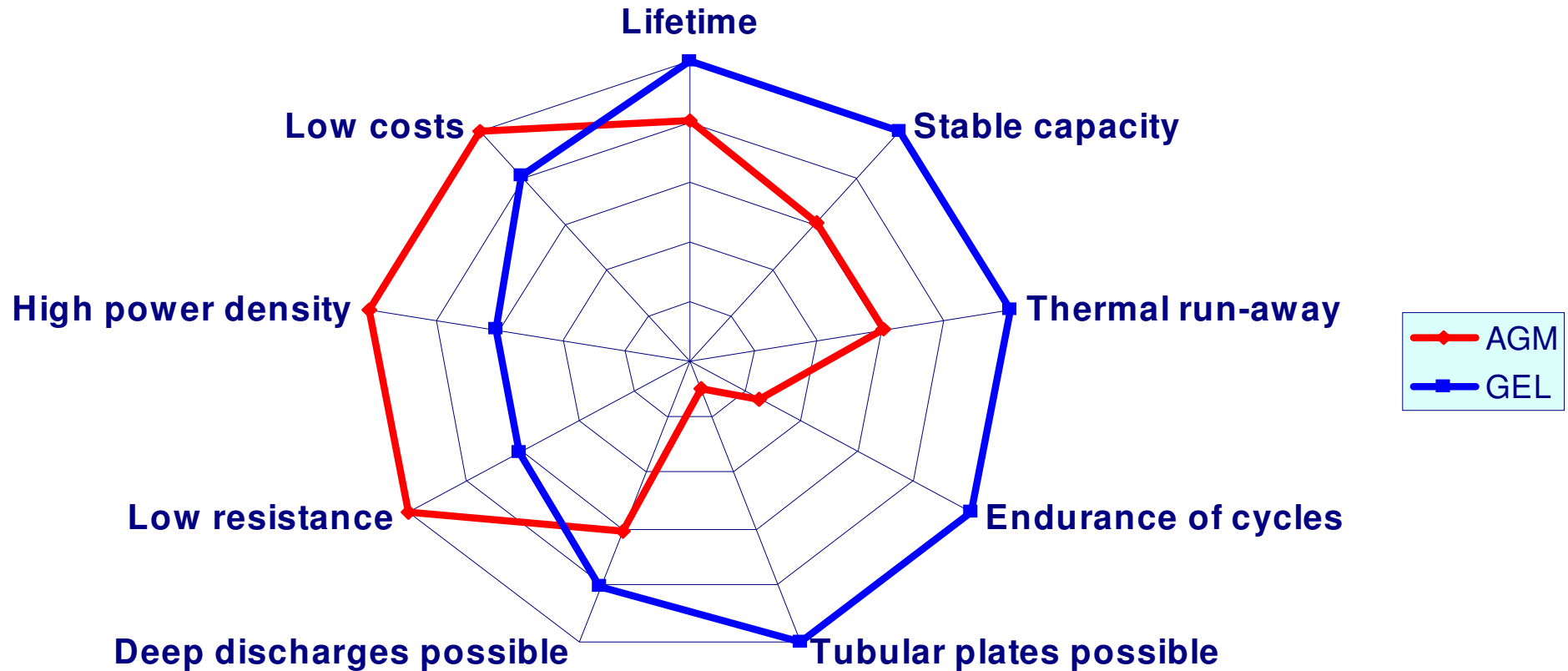
C10



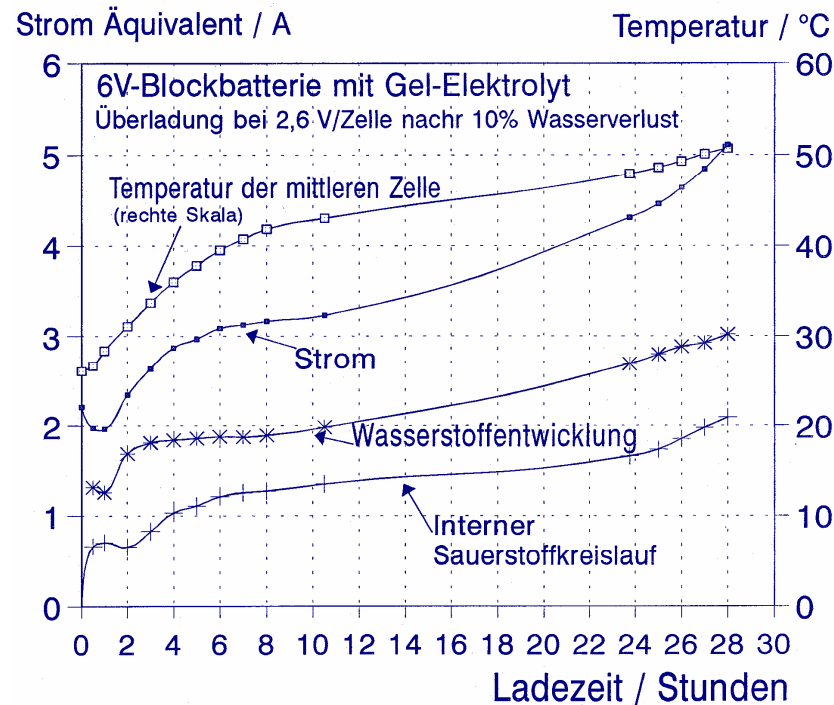
ENDURANCE COMPARISON VRLA VS VLA

	VRLA tubular GEL OPzV	VLA tubular OPzS
On float with 2,23V at 62,8°C	450 days	550 days
IEEE 535-1986	22,5 years at 25°C	27,5 years at 25°C
	35 years at 20°C	42,7 years at 20°C
Float current increase in 20 years	Factor 1	Factor 2
Cycles IEC 60 896, 75% DOD C4	> 1700	> 1700

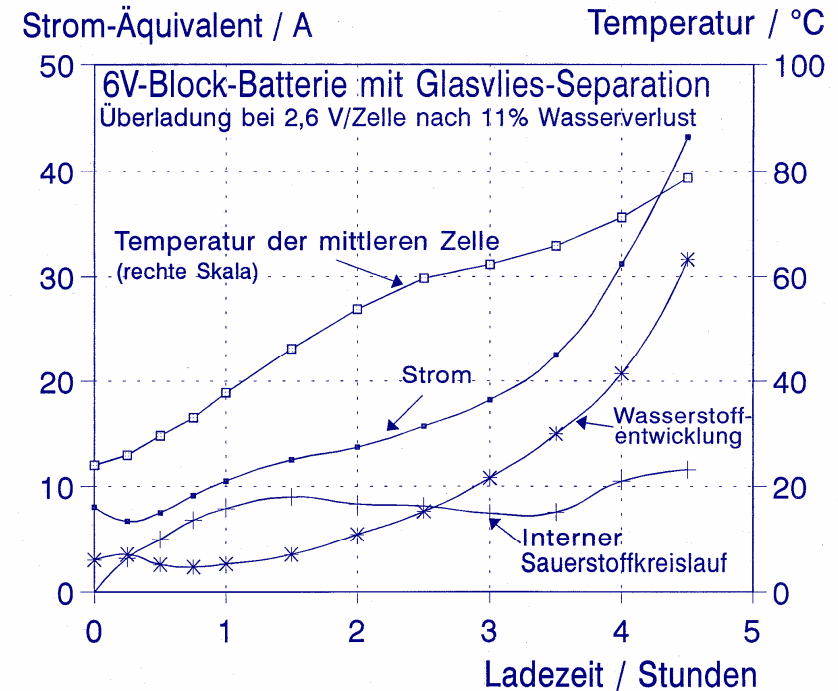
COMPARISON VRLA: GEL VERSUS AGM



GEL - AGM thermal-runaway-simulation



- $T_{\max} = 50^{\circ}\text{C}$ after 28 h
- total current increases to 5A
- 6V 68Ah GEL



- $T_{\max} = 80^{\circ}\text{C}$ after 4,5 h
- total current increases to 40A
- 6V 68Ah AGM

cited from: D. Berndt, E. Meißner, W. Rusch, Aging effects...., Proceedings 15.INTELEC, Paris, 1993

CONCLUSION

- For applications with high safety level, like utilities, bank data centers, telecom central stations etc.
VLA is preferred.
Flat plate batteries < 60 min < tubular plate batteries
- UPS: bridging time < 60 min,
life < 10 years, low cost: AGM is preferred
life > 10 years, high safety: GEL flat plate is preferred.
- TELECOM: bridging time > 60 min, life 20 years
TUBULAR GEL is preferred.
- SOLAR: high cycle life
TUBULAR GEL is preferred.