UTILITY REQUIREMENTS FOR BATTERY ENERGY STORAGE AND THEIR EFFECTS ON BATTERY TEST PROGRAMS

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The utilization of energy storage units in electric power supply systems can be divided into the following applications

(i) load coverage
(ii) load levelling
(iii) instantaneous reserve
(iv) load frequency control

Limits between these applications are vague and unsuitable for the definition of the typical operational stress of a storage device. Additionally, the effects of different operational modes on various storage types are non-uniform.

The first step on commencement of investigations into the utility applications of electro-chemical storage was to define the utility requirements

(i) high plant and component service life
(ii) low energy losses

UTILITY REQUIREMENT	SERVICE LIFE ↓	LOSSES ↓	MAX. CURRENT ↓	AVAILABLE ENERGY ↓	POWER AVAILABILITY ↓
BATTERY PROPERTY	BATTERY LIFE	ROUND TRIP WH-EFFICIENCY	$\frac{I_{max}}{I_{10}}$	$\frac{C(I_{max})}{C_{10}}$	$\frac{I_{Cmax}}{\Delta C}$
OPERATION					
LOAD COVERAGE	11	12	13	14	15
LOAD LEVELLING	21	22	23	24	25
INSTANTANEOUS RESERVE	31	32	33	34	35
LOAD-FREQU.-CONTROL	41	42	43	44	45

Fig. 1. Comparison of different batteries under utility application aspects.

(iii) high power
(iv) high energy storage capacity
(v) good plant availability

The second and more difficult step was to convert these requirements into "battery-related" terms. This resulted in Fig. 1, which proved to be a universal tool

(i) to define necessary qualities
(ii) to deduce appropriate test methods
(iii) to compare competing types of storage

The utility applications of a storage technology cannot be judged until reliable information is available to fill in the matrix fields concerned. On the other hand, test methods and procedures can be deduced directly according to the lack of information.