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Integration of Power Systems

By J. M. GAYLORD

POWER engineers are talking a great deal these days about "integration." They do not refer to the mathematical operation of the college classroom, but rather to the practical procedure of operating two or more power systems as a unit, the purpose being to utilize more fully the installed generating and transmitting facilities, to minimize spinning reserve, and to save fuel.

In the days of free enterprise each power tycoon was a rugged individualist who wanted to stand on his own feet. His system was complete, self-sustaining and independent. It had enough generating equipment to supply the load and ample spinning reserve to meet emergencies. Interconnections with other systems were considered as troublesome complications to be tolerated only if you were sure you were getting the best of the bargain. In private power companies an additional generator was a welcome means of increasing operating capital, and in government and municipal plants the taxpayer footed the bill. Why interconnect and give up some of your independence when you could buy all the generators you needed?

The public knew so little about the power business that it did not complain too strenuously as long as there was a surplus of everything, but the war made radical changes in our thinking. Tremendous new demands for war purposes developed rapidly as the defense program took form and the upward trend of the load was greatly accelerated. The production of aluminum and magnesium particularly added large power demands with large energy requirements because of high load factors.

Ordinarily such increases in loads would have been met by the construction of new generating plants, but materials were in great demand for the production of war equipment and could not be spared for less urgent purposes. The vital importance of power in the war program was fully appreciated from the first, and the Office of War Utilities took control of the situation to assure an ample supply for essential uses. Fortunately for the country, many of the engineers of that organization were practical power men, borrowed from the industry. Requests for additional equipment were passed on by en-

gineers qualified by long experience to determine the necessity of the proposed extensions. The engineers of the utilities, as well as those in the Government service, knew perfectly well that operating economies could be effected by cooperation and interchange between systems, and the impetus of a national emergency promptly overcame the long-standing resistance to integrated operation.

INTEGRATION IN THE PACIFIC SOUTHWEST

To the credit of the electric utilities the response to the Government's suggestion was immediate, sincere and effective. Practical cooperation was accomplished through such organizations as the Pacific Southwest Power Interchange Committee, which was formed in the Spring of 1943, and consists of engineers representing the principal power organizations of California, Nevada, and Arizona. The committee presents a typical cross-section of the power supply business and demonstrates that engineers representing all schools of thought as to ownership and control of utilities can work together harmoniously and effectively for the general good of the community.

The committee is self-governing under the general direction of the Office of War Utilities, and meets monthly to consider current problems affecting power supply. Estimates of the power requirements and resources for a year or more in the future are prepared and a monthly summary is made of actual results compared with the estimates. Rainfall affecting hydroelectric plants is reported for all watersheds, and the use of fuel oil and gas is carefully watched and reported. Overhaul schedules, outages of generating equipment, major load changes and all other matters affecting the general situation as to power supply and demand are discussed and recommendations made for new facilities when no other means of supply can be found. Interconnection and interchange facilities are matters of first importance in the work of the committee.

The results of integration have been gratifying. No power user has lacked a supply sufficient for all essential purposes. Capacities of transmission facilities have been stretched beyond generally accepted limits; spinning

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reserve has been practically eliminated in some instances; equipment has been operated at the limit of its capacity, but all essential demands have been supplied and the war program has not been handicapped by shortage of power. Fuel has been conserved and essential materials which otherwise would have gone into new generating and transmission facilities have been saved for urgent military needs.

LOOKING TO THE FUTURE

Hydroelectric power production, particularly in the West, is subject to very great variations between dry and wet years. No two watersheds are equally affected by such variations. Integrated operation of hydro developments on different watersheds tends to equalize the supply and minimize the use of fuel in auxiliary steam plants which are a part of every combined power system. In spite of all economies the war has caused a terrific drain on the fuel supplies of the country and this fact emphasizes the importance of conservation of such natural resources. The community will suffer if the lessons learned under the stress of a national crisis are not

carried over to times of peace. Integrated operation which has proved so advantageous under government supervision during wartime should be continued voluntarily.

Plans are being made for extensive new developments of hydroelectric power. There are ardent advocates of immense government-operated power pools and equally ardent advocates of so-called private operation of power systems. Each plan has its advantages and disadvantages. The rivalry between these two schools of thought tests the mettle of the best men in the power business and tends to correct abuses on both sides of the fence. Engineering principles are universal. Engineers are confronted by the same problem, regardless of the political and social ideas of governing bodies, and engineers, regardless of their affiliations, can work together and get results, as has been so fully demonstrated during this war when national emergency has breached the political barriers between so-called public and private enterprise.

Integration of power systems is essential to a broad conservation program, and the successful cooperation effective under stress of war should be continued in times of peace, to the end that the community shall be provided with an adequate and reliable power supply at the lowest possible cost, and with the least possible draft on the irreplaceable national resources of the country.

C. I. T. Men In Service

DECEASED

Allen, Richard	'38	*	U.S.N.R.	Lost at Sea
Ashworth, Thos., Jr.	'41	*	U.S.N.R.	Killed in Plane Crash
Blumenthal, W. D.	'42	Cpl.	U.S.A.	Missing in Action
Brahty, J. H. A.	'32	Lt. Cmdr.	U.S.N.R.	Killed in Plane Crash
Hebel, Francis	'34	Lt. (j.g.)	U.S.N.R.	Killed at Pearl Harbor 1941
Losey, R. M.	'35	*	U.S.A.	Killed in Bomb- ing Raid
Rowell, R. M.	'38	*	U.S.A.	Missing in Action
Schneider, C. J.	'39	*	U.S.M.C.	Killed in Action
Van Fleet, J. R.	'38	*	U.S.N.R.	Killed in Training Flight

The following is a list of men who have received degrees from the California Institute of Technology and who are now in military service. Information regarding additions or changes in rank or address should be addressed to the Alumni Office, California Institute of Technology.

Name	Class	Rank	Service	Location
Abbey, E. K.	'41	Lt.	U.S.N.R.	Overseas
Ackerman, J. B.	'38	Colonel	U.S.A.	*
Adams, P. L.	'44	*	U.S.N.R.	*
Ahuja, V. B.	'44	Lt.	Army of Mexico	Mexico
Albach, W. H.	'37	Lt.	U.S.N.R.	*
Alsaker, A. K.	'38	Lt. (j.g.)	U.S.N.R.	*
Allen, J. R.	'42	*	U.S.N.R.	*
Allen, P. H., Jr.	'42	Ensign	U.S.N.R.	*
Allingham, R. E.	'44	Ensign	U.S.N.R.	*
Allyne, A. B.	'26	Major	U.S.A.	Maryland
Altmaier, R. D.	'42	Ensign	U.S.N.R.	Washington, D.C.
Anderson, D. W.	'32	Lt. Cmdr.	U.S.N.R.	New York, N. Y.
Anderson, Keith	'40	Pvt.	U.S.A.	Overseas
Anderson, M. M.	'31	*	U.S.N.R.	Nevada
Anderson, R. E.	'42	Lt.	U.S.N.R.	Anacostia, D.C.
Andrews, R. A.	'42	*	U.S.A.	*
Antonenko, B. P.	'39	*	U.S.A.	Chanute Field, Ill.
Arnold, D. R.	'43	Lt. (j.g.)	U.S.N.R.	Mare Island, Calif.
Arnold, H. A.	'39	Lt.	U.S.N.R.	Massachusetts

*Information lacking.

Name	Class	Rank	Service	Location
Arnold, J. K.	'41	Capt.	U.S.A.	Hawaii
Arnold, M. W.	'37	Capt.	U.S.A.	Washington, D.C.
Ashley, C. L.	'26	Lt.	U.S.N.R.	*
Atchison, E. M.	'44	*	U.S.N.R.	*
Atherton, T. L.	'25	Capt.	U.S.M.C.	Overseas
Atkins, E. R., Jr.	'43	Lt. (j.g.)	U.S.N.R.	Overseas
Atkinson, T. G.	'42	Lt. (j.g.)	U.S.N.R.	Overseas
Axtman, Grice	'41	Ensign	U.S.N.R.	Washington, D.C.
Bacon, J. W., Jr.	'43	Lt.	U.S.A.	*
Bair, W. P.	'44	Ensign	U.S.N.R.	*
Baird, R. C.	'42	Major	U.S.A.	*
Baker, J. R.	'38	Ensign	U.S.N.R.	*
Ballard, W. O. B.	'44	*	U.S.N.R.	*
Banta, A. P.	'28	Major	U.S.A.	Overseas
Barfield, H. P.	'44	Lt.	U.S.A.	*
Barnes, D. P.	'30	Lt. Col.	U.S.A.	Overseas
Barnes, F. A.	'44	Ensign	U.S.N.R.	New York
Barnes, O. H.	'26	*	U.S.A.	Overseas
Baronowski, J. J.	'44	Lt. Cmdr.	U.S.N.	*
Bartlett, E. R., Jr.	'42	Lt. (j.g.)	U.S.N.R.	*
Bashor, R. H.	'43	Lt. (j.g.)	U.S.N.R.	Overseas
Baskin, A. C.	'37	Lt.	U.S.N.	*
Bassett, J. V.	'41	*	U.S.A.	*
Bassler, E. W.	'44	Ensign	U.S.N.R.	*
Bauer, F. K.	'42	Cpl.	U.S.A.	*
Baxter, A. N.	'45	*	U.S.N.R.	*
Beakley, W. M.	'35	Lt.	U.S.N.R.	*
Beanfield, B. F.	'39	Lt.	U.S.N.R.	Philadelphia, Pa.
Beardsley, G. F.	'39	*	U.S.N.	New York
Beauchamp, E. E.	'44	Ensign	U.S.N.R.	*
Beckstead, M. W.	'43	Ensign	U.S.N.R.	*
Beek, B. B.	'44	Ensign	U.S.N.R.	*
Beers, K. H.	'42	Ensign	U.S.N.R.	Overseas
Behrens, F. A., Jr.	'44	Ensign	U.S.N.R.	Overseas
Bell, A. E.	'42	*	U.S.N.R.	*
Bell, W. E.	'44	*	U.S.N.R.	*
Benjamin, D. G.	'44	Ensign	U.S.N.R.	*
Benson, G. L., Jr.	'44	*	U.S.N.R.	*
Belzer, T. R.	'37	Lt. Col.	U.S.M.C.	Overseas
Benioff, Ben	'22	Lt. Col.	U.S.A.	Salt Lake City, Utah
Bennett, G. G.	'44	Ensign	U.S.N.R.	*
Bennett, R. L.	'44	Ensign	U.S.N.R.	Washington, D.C.
Benton, Robert	'43	S 1/c	U.S.N.R.	California
Berhower, R. F.	'45	*	U.S.N.R.	*
Bergh, P. S.	'42	*	U.S.N.R.	*
Bergren, W. R.	'32	Capt.	U.S.A.	Overseas
Berry, F. A., Jr.	'37	Lt.	U.S.N.	*