Electrical Power Generation and Distribution in Boeing-787

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Power Generation – 787

The Boeing 787 electrical system is of a hybrid voltage design. The system is comprised of "six generators-two per engine and two per APU-operating at 235 VAC" [1]. Additionally, ground power receptacles are included in the system design "for airplane servicing on the ground without the use of the APU" [1]. All of the system's "generators are directly connected to the engine gearboxes' and can be operated "at a variable frequency (360 to 800 hertz) proportional to the engine speed" [1].

All of the following are included in the hybrid voltage system of the 787 [1]:

- 235 VAC
- 115 VAC (traditional)
- ± 270 VDC
- 28 VDC (traditional)

The new 235 VAC and the ± 270 VDC voltage types stem from the new "no-bleed electrical architecture that results in a greatly expanded electrical system" that is capable of "*generating twice as much electricity as previous Boeing airplane models*" [1].

Power Distribution - 787

In previous aircraft, bleed-air systems, were pneumatic air intake and compressor systems that would provide electric power to various airplane components; i.e. "air-conditioning packs and wing anti-ice systems," among many others [1].

With the new 787 no-bleed architecture, which moves away from the previous pneumatic school of thought, to the electrical, Boeing is hoping to achieve the following [1]:

- Fuel savings of about 3%
- Extract as much as 35% less power from the engines

Aside: The previous pneumatic bleed-air system generally developed more power than was needed "in most conditions, causing excess energy to be dumped overboard" [1].

- Increased performance of the Auxiliary Power Unit (APU), due to a simpler APU design
    - All of the APU "components that are typically associated with the pneumatic power delivery [to the APU] are eliminated" (now relying upon electrical components) [1]
- More efficient engine cycles
- More efficient secondary power extraction, power transfer, and energy usage

Power Distribution – 787 (Continued)

The 787's electrical system uses a remote distribution system that saves weight and is expected to reduce maintenance costs.

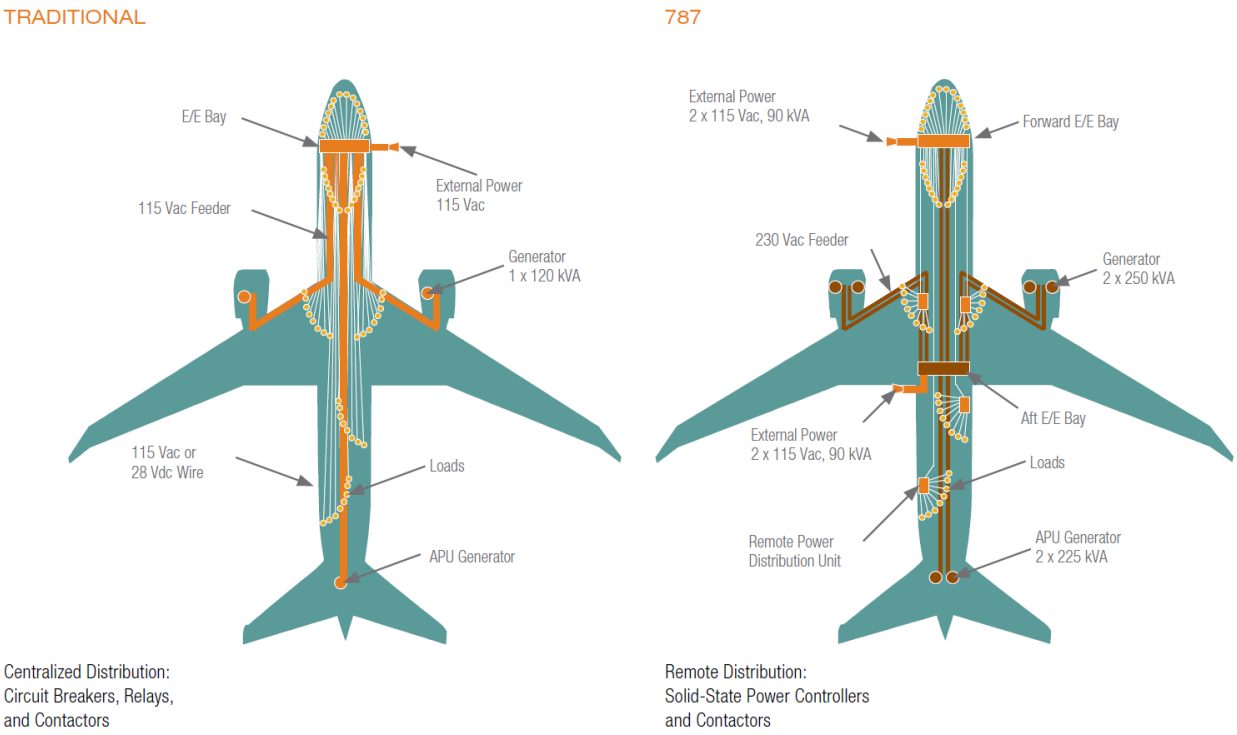

Figure 1. Breakdown Comparing the Electrical Networks of a Generic Airplane, and the 787

As is illustrated in Figure.1, "two electrical/electronic (E/E) bays, one forward and one aft, as well as a number of Remote Power Distribution Units (RPDU)," which are used for supporting airplane electrical equipment, can be seen [1]. The forward E/E bay, along with the RPDUs is used to supply most of the electrical equipment's needs (supplies either 115 VAC or 28 VDC), whereas the aft E/E bay supplies 235 VAC to a limited number of system components [1]. Additionally, the ± 270 VDC system is "supplied by four auto-transformer-rectifier units that convert 235 VAC power to ± 270 VDC" [1].

As a note of interest, the RPDUs are "largely based on solid state power controllers (SSPC) instead of the traditional thermal circuit breakers and relays" which are prevalent in the architecture of the Boeing 777 [1].

Power Distribution – 787 (Continued)

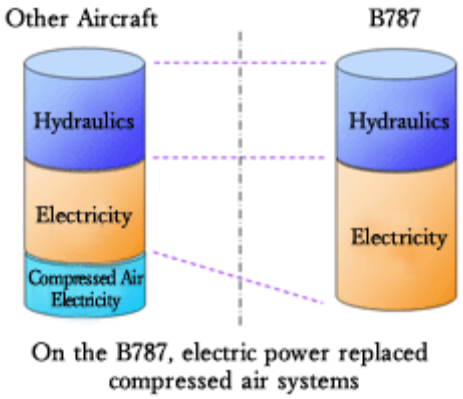

Figure 2. Power Supplies of a Generic Aircraft, Compared to a Boeing 787 [2]

As one can see, with the invention and inclusion of the no-bleed system in the Boeing 787, the percentage of systems powered by electricity has greatly increased – all compressed air power sources have been replaced by electrical systems that can achieve the same outcome [2].

Finally, as a summary, the Boeing 787 Dreamliner relies much more heavily on electricity, than any other Boeing airplane before. In order to use more electricity than any other Boeing, the 787 must also produce "more electricity – 1.5 megawatts, or four times as much as other Boeing airplanes" [3].

Works Cited:

[1] M. Sinnett, 'AERO - 787 No-Bleed Systems', *Boeing.com*, 2007. [Online]. Available: http://www.boeing.com/commercial/aeromagazine/articles/qtr_4_07/article_02_1.html. [Accessed: 03- Jun- 2015]

[2] Ana.co.jp, 'Details of B787 Electrical System | ANA SKY WEB', 2015. [Online]. Available: https://www.ana.co.jp/wws/japan/e/local/common/share/boeing787info/popup02.html. [Accessed: 03- Jun- 2015]

[3] *787 Dreamliner Electrical System*, 1st ed. Seattle, Washington: Boeing Commercial Airplanes, 2015, p. 2 [Online]. Available: http://www.boeing.com/787-media-resource/docs/SOS_electrical_backgrounder.pdf. [Accessed: 03- Jun- 2015]