24-Hour average load

Electric Power Load Analysis (EPLA)

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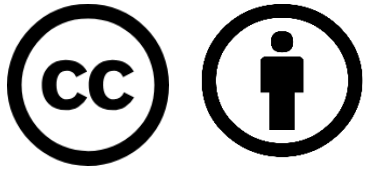
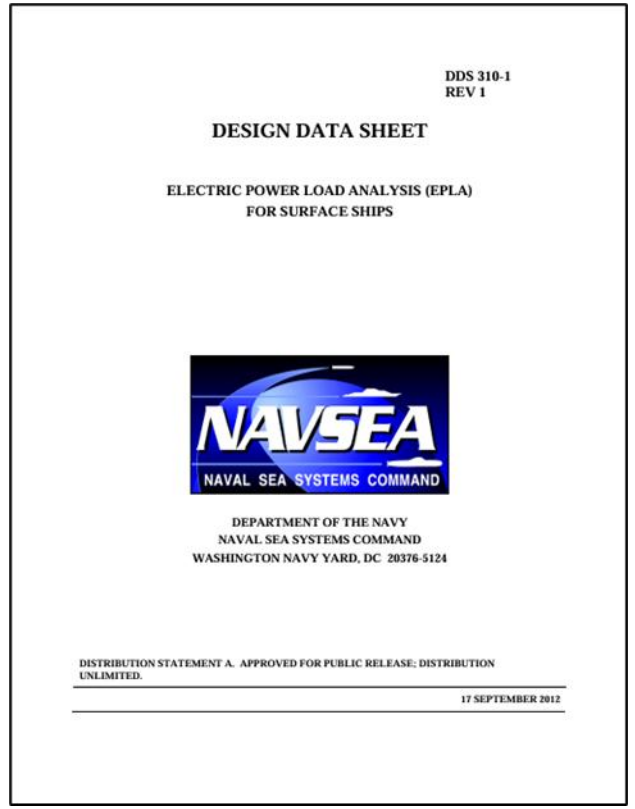


Essential Questions

What is the 24-hour average load and what is it used for?	Understand
When is it appropriate to use the 24-hour average load parametric equation?	Understand
How is the 24-hour average load calculated?	Apply

24-hour average load

- Used to calculate the average load for generator sets over a 24-hour period for the purpose of calculating fuel consumption rates
- Fuel consumption rates used for:
  - Endurance fuel calculations (DPC 200-1)
  - Annual energy usage calculations (DPC 200-2)
- Calculation methods
  - Load factor analysis
  - Stochastic analysis
  - Modeling and simulation analysis
  - 24-hour average load parametric equation
- See details in DPC 310-1



DDS 310-1
REV 1

DESIGN DATA SHEET

ELECTRIC POWER LOAD ANALYSIS (EPLA)
FOR SURFACE SHIPS

NAVSEA
NAVAL SEA SYSTEMS COMMAND

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON NAVY YARD, DC 20376-5124

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Load modeling considerations

- The total load is usually calculated at the total ship level rather than for specific power system equipment.
  - If the ship is operated in split plant, then the total load for each independent power system is calculated.
- Loads that are correlated (likely to be “on” at the same time, or likely to be “off” at the same time) need not be modeled together
  - Determining a load’s long-term average is sufficient.
- Accounting for cycling loads being at their peak value is not required
  - Zonal load factor analysis is not applicable.
- If for a given type of load (fire pumps for example) if only a subset of the loads is on during a given operational condition, then it usually does not matter which loads (of a particular type of load) comprise the subset.

Load factor analysis

- Load factors should be based on long term averages
- Tables in DPC 310-1 should not be directly used for 24-hour average computations; these tables are for equipment sizing
- Tables in IEEE 45.1 may be used if better information not available
- Ideally, load factors should be based on measured data
  - May require adjustment if the design under analysis differs from the system measured
  - May require adjustment if the equipment under analysis is intended to operate differently than the system measured

Stochastic analysis

- Mean value of the sum of the loads obtained by Monte Carlo analysis (or equivalent) should be used.
- Enough samples should be calculated to reduce error in the mean value estimate to a desirable level.

Modeling and simulation analysis

- The average value of the time-based waveform is used
- Should use a total simulation time on the order of 2400 hours to ensure a good estimate of the 24-hour average load

24-hour average load parametric equation

- Should only be used in early-stage design
- In preliminary design and later, use an alternate method
- Based on 100° F loads calculated for equipment sizing
- Surface ships other than aircraft carriers and large deck amphibious ships:

  $P_{24\_hour\_ave} = P_{prop\_steering} + 0.75(P_{cruise} - P_{prop\_steering})$
- Aircraft carriers and large deck amphibious ships

  $P_{24\_hour\_ave} = P_{prop\_steering} + 0.60(P_{cruise} - P_{prop\_steering})$
- Where:

  $P_{24\_hour\_ave}$ = 24-hour average ship service load
  $P_{prop\_steering}$ = Propulsion plant and steering systems loads
  P_{cruise} = Cruising ship operating condition load with margins and service life allowance