Turbofan Generator Fuel Consumption

Facts:

Pratt Whitney Engine Rated for 44,000 HP

From FAA Testing JT8 Fuel Flow (Jet A Fuel Fuel)
Idle - 959 lbs/hr
Idle Out – 998 lbs/hr
30% - 2499 lbs/hr
85% - 6630 lbs/hr

Jet A Fuel Weight – 6.7 lbs/gal

Typical conversion factor 746 Watts = 1 HP

Calculations:

For a 1 MW Generator:
(1 HP/746 Watts)*(1,000,000 Watts) = 1,340 HP
1,340 HP/44,000 HP = 0.03 or 3% of the engine capacity
The engine cannot operate at less than the Idle or Idle Out Mode
The 998 lbs/hr fuel flow for Jet A obtained by FAA testing applies
(1 gal/6.7 lbs)*(998 lbs/hr)*(1 hr/60 min) = 2.48 gal/min
2.48 gal Jet A Fuel = 334253.4 BTU/min
Heat Rate: (334253.4 BTU/Min)*(60 Min/1 Hr)*(1/1000 Kw) = 20,055 BTU/KwHr

For a 20 MW Generator:
(1 HP/746 Watts)*(20,000,000 Watts) = 26,809 HP
26,809 HP/44,000 HP = 0.61 or 61% of the engine capacity
Estimated Jet A Fuel Flow from FAA Testing (75.1)*(61) = 4581 lbs/hr
(1 gal/6.7 lbs)*(4581 lbs/hr)*(1 hr/60 min) = 11.4 gal/min
11.4 gal Jet A Fuel = 1536487.3 BTU/min
Heat Rate: (1536487 BTU/Min)*(60 Min/1 Hr)*(1/20000 Kw) = 4609.5 BTU/KwHr

Fuel Comparisons by BTU

For 20 MW TurbineGenerators:

1536487 BTU/Min
4609 BTU/KwHr by Calculation
6209 BTU/Min Including Estimated Losses

Jet A Fuel:
11.4 Gallons/Min
1536487.3 BTU/Min

Natural Gas or Methane:
(1536487 BTU/Min)*(1 Cubic Ft/ 1030 BTU) = 1492 Cubic Ft/Min

Landfill Gas:
(1536487 BTU/Min)*(1 Cubic Ft/ 500 BTU) = 3072 Cubic Ft/Min

Kerosene:
(1536487 BTU/Min)*(1 Gal/ 135000 BTU) = 11.3 Gal/Min

Biodiesel:
(1536487 BTU/Min)*(1 Gal/ 120000 BTU) = 12.83 Gal/Min

#2 Fuel Oil:
(1536487 BTU/Min)*(1 Gal/ 138500 BTU) = 11.1 Gal/Min

#4 Fuel Oil:
(1536487 BTU/Min)*(1 Gal/ 145000 BTU) = 10.5 Gal/Min

#6 Fuel Oil:
(1536487 BTU/Min)*(1 Gal/ 153000 BTU) = 10.0 Gal/Min

Revenue For a 20MW Generator Running 24 Hours a Day for 7 Days a week using Natural Gas as Fuel:

1536487 BTU/Min
4609 BTU/KwHr by Calculation
6209 BTU/Min Including Estimated Losses
1492 Cubic Ft/Min
For Electricity: 3412 BTU/KwHr

Cost of Natural Gas in Tennessee:
$13.87/ 1000 CubicFt
Revenue Rate: $0.14/KwHr

Yearly Revenue:
($0.14/KwHr)*(24Hr/Day)*(365 Days/Year)*(20,000 Kw) =
$24,460,800.00/Year

Yearly Fuel Costs:
($13.87/1000 CuFt)*(1492 CuFt/Min)*(60Min/Hr)*24Hr/Day)*(365 Day/Year) =
$10,876,787.00/Year

Total Profit:
($24,460,800/Year)-($10,876,787) **= $13,584,013**