

## 1 INTRODUCTION

This document explains parsed data from the SES 4.1 output when the supplemental train output is included. Calculations are performed on this data. The data can be converted from Imperial Units to International System (IP to SI units).

This feature and proposed calculation were requested and sponsored by Sener.

## 2 EXTRACTED DATA

If SES's Form 1C, Supplementary Output Option prints train supplementary information (option 2, 3,4, or 5), Next-Out parses the data in Figure 1 and Table 1.

0.00 SECONDS													
2 TRAIN(S) ARE OPERATIONAL													
TIME	R T	LOCATION	SPEED	ACCELERATION	AIR DRAG	COEF. OF AIR DRAG	TRACTIVE EFFORT	MOTOR CURRENT	LINE CURRENT	FLYWHEEL SPEED	GRID TEMP.	DECEL.	HEAT GEN.
TRAIN NO.	T Y	(FEET)	(MPH)	(MPH/SEC)	(LBS)		(LBS/MOTOR)	(AMPS)	(AMPS)	(RPM)	(DEG F)	(DEG F)	(BTU/SEC-FT)
1	1 1	2877.21	19.25	3.00	0.	0.00	5412.	900.	959.	0.	276.0	740.1	0.434
2	2 2	2744.71	11.00	3.00	0.	0.00	6693.	900.	756.	10000.	241.6	751.3	0.369

  

HEAT GENERATION (BTU/SEC-TRAIN)													
HEAT REJECTION (BTU/SEC-FT)													
TRAIN NO.	R T	MODE	AUXILIARIES	PROPULSION 3RD RAIL	POWER (W/TRAIN)	REGENERATED 3RD RAIL	FROM FLYWHEEL	ACCEL GRID	DECEL GRID	MECH	PROPUL SENS	AUX SENS	AUX LATENT
1	1 1	2	349000.	0.	0.	0.	0.000	0.000	0.000	0.000	0.000	0.434	0.0502
2	2 2	2	324000.	0.	0.	0.	0.000	0.000	0.000	0.000	0.000	0.369	0.0223

Figure 1: Supplementary Data Parsed from SES 4.1

Table 1: Variable Names and Units

Variable and Column Name in Excel Output	Full description	SI Unit	IP Unit
Mode	Train Operating Mode, see SES User's Manual Section 8.	#	#
Auxiliaries	Propulsion power, Auxliaries	kW/train	kW/train
Propulsion_3rd_Rail	Propulsion power, Propulsion for Traction Power	kW/train	kW/train
Regenerated_3rd_Rail	Propulsion Power, Regenerated by Third Rail	kW/train	kW/train
From_Flywheel_TRA	Propulsion Power, From Flywheel	kW/train	kW/train
Accel_Grid	Heat Generation, Acceleration Grid	kW/train	Btu/s-train
Decel_Grid	Heat Generation, Deceleration Grid	kW/train	Btu/s-train
Mech	Heat Generation, Mechanical	kW/train	Btu/s-train
Propul_Sens	Heat Rejection, Propulsion Sensible	W/m	Btu/s-ft
Aux_Sens	Heat Rejection, Auxiliary Sensible	W/m	Btu/s-ft
Aux_Latent	Heat Rejection, Auxiliary Latent	W/m	Btu/s-ft
Train_Length_NO	Length of the train from Form 9A	m	ft
Propul_Sens_per_Train_NO	Propul_Sens multiplied by train length	kW/train	Btu/s-train
Aux_Sens_per_Train_NO	Aux_Sens multiplied by train length	kW/train	Btu/s-train
Aux_Latent_per_Train_NO	Aux_Latent multiplied by train length	kW/train	Btu/s-train
Calculated_Heat_Rejection_NO	See Section 3	kW/train	Btu/s-train

### 3 CALCULATIONS

Column headers for values calculated by Next-Out end in the suffix “\_NO”. The calculations below are in NO\_parser\_train\_supplementary.py, which is a helper function in NO\_parser.py. The train length from Form 9A is added for each train type in the supplementary data.

#### 3.1 HEAT REJECTION PER TRAIN

The heat rejection data with the units BTU/SEC-FT is assumed to be the heat distributed over the entire length of the train in SES.

$$\text{Eq 1. } \text{Propul\_Sens\_per\_Train\_NO} \frac{\text{BTU}}{\text{Sec*Train}} = \text{Propul\_Sens\_per\_Train\_NO} \frac{\text{BTU}}{\text{Sec*FT}} * \text{Train Length} \frac{\text{FT}}{\text{Train}}$$

$$\text{Eq 2. } \text{Aux\_Sens\_per\_Train\_NO} \frac{\text{BTU}}{\text{Sec*Train}} = \text{Aux\_Sens\_per\_Train\_NO} \frac{\text{BTU}}{\text{Sec*FT}} * \text{Train Length} \frac{\text{FT}}{\text{Train}}$$

$$\text{Eq 3. } \text{Aux\_Latent\_per\_Train\_NO} \frac{\text{BTU}}{\text{Sec*Train}} = \text{Aux\_Latent\_per\_Train\_NO} \frac{\text{BTU}}{\text{Sec*FT}} * \text{Train Length} \frac{\text{FT}}{\text{Train}}$$

#### 3.2 CALCULATED ENERGY REJECTION

The Calculated Energy uses the formula below, requested from Sener.

$$\begin{aligned} \text{Eq 4. } \text{Calculated\_Energy\_NO} \frac{\text{BTU}}{\text{Sec*Train}} &= \text{Propul\_Sens\_per\_Train\_NO} \frac{\text{BTU}}{\text{Sec*Train}} \\ &\quad - \text{Accel\_grid} \frac{\text{BTU}}{\text{Sec*Train}} \\ &\quad - \text{Mech} \frac{\text{BTU}}{\text{Sec*Train}} \end{aligned}$$

### 4 CONVERSION

If the Output Conversion option is IP to SI, IP values are converted to SI. Conversion values are in the IP\_TO\_SI dictionary in NO\_constants.py. The conversion factor for BTU/(SEC-FT) to W/m is 3463.123 per the formula below.

$$\text{Eq 1. } \frac{\text{BTU}}{\text{sec*ft}} * \frac{1055.056 \text{ W}}{\text{BTU/sec}} * \frac{1 \text{ ft}}{0.3048 \text{ m}} = 3463.123 \frac{\text{W}}{\text{m}}$$