

General Inputs

$anchorSamplePeriod := 64 \cdot min$ $sleepEnergy := 2 \cdot J$ $sleepVolts := 28.0 \cdot V$ $wakeFromSleepEnergy := 2 \cdot J$

$$sleepAmps := \frac{sleepEnergy}{anchorSamplePeriod \cdot sleepVolts} = (1.86 \cdot 10^{-5}) A$$

Science instrument parameters (from Dana for 2000 meter profile)

$isusSampleEnergy := 3620 \cdot J$ $sbe41SampleEnergy := 3040 \cdot J$ $pHSampleEnergy := 1280 \cdot J$

$FLBBSampleEnergy := 160 \cdot J$ $optodeSampleEnergy := 100 \cdot J$ $OCRSampleEnergy := 100 \cdot J$

$sampleEnergy2000 := isusSampleEnergy + sbe41SampleEnergy + pHSampleEnergy$
 $+ FLBBSampleEnergy + optodeSampleEnergy + OCRSampleEnergy$

$$sampleEnergy2000 = (8.3 \cdot 10^3) J$$

$$sampleEnergy200 := 0.5 \cdot sampleEnergy2000 = (4.15 \cdot 10^3) J$$

Mission Profile parameters

$profileDepth := 200 \cdot m$ $numProfiles := 100$ $samplesPerProfile := 40$ $descendSpeed := 0.2 \cdot \frac{m}{sec}$

$ascendSpeed := 0.1 \cdot \frac{m}{sec}$ $numAnchorSamples := 40$

$initCoreEnergy := 158 \cdot J$ $initPlatformEnergy := 1376 \cdot J$ $setBellowsEnergy := 6600 \cdot J$ $initialRecoveryEnergy := 165 J$

$preMissionDelayEnergy := 66 \cdot J$ $initProfileEnergy := 119 \cdot J$ $decreaseBuoyancyEnergy := 10461 \cdot J$

$$initialDescendEnergy := 1022 \cdot \mathbf{J} \quad maintainDescendEnergy := 10 \cdot \frac{\mathbf{J}}{\mathbf{m}} \quad anchorEnergy := 100 \cdot \mathbf{J} \quad deanchorEnergy := 7837 \cdot \mathbf{J}$$

$$startCPModeEnergy := 207 \cdot \mathbf{J} \quad initialAscendEnergy := 554 \cdot \mathbf{J} \quad maintainAscendEnergy := 10 \cdot \frac{\mathbf{J}}{\mathbf{m}}$$

$$dumpCPModeEnergy := 100 \cdot \mathbf{J} \quad surfaceOpsEnergy := 562 \cdot \mathbf{J} \quad surfaceOpsTime := 15 \cdot \mathbf{min}$$

$$profileSetupEnergy := initCoreEnergy + initPlatformEnergy + initialRecoveryEnergy \downarrow \\ + preMissionDelayEnergy$$

$$profileSetupEnergy = (1.765 \cdot 10^3) \mathbf{J}$$

$$totalProfileEnergy := initProfileEnergy + decreaseBuoyancyEnergy + initialDescendEnergy \downarrow \\ + (maintainDescendEnergy \cdot profileDepth) + anchorEnergy + dumpCPModeEnergy + deanchorEnergy \downarrow \\ + initialAscendEnergy + (maintainAscendEnergy \cdot profileDepth) + surfaceOpsEnergy + sampleEnergy200$$

$$totalProfileEnergy = (2.891 \cdot 10^4) \mathbf{J}$$

Anchor parameters

$$totalAnchorTime := (numAnchorSamples - 1) \cdot anchorSamplePeriod = 41.6 \mathbf{hr}$$

$$totalAnchorEnergy := anchorEnergy + ((numAnchorSamples - 1) \cdot wakeFromSleepEnergy) \downarrow \\ + (numAnchorSamples \cdot sampleEnergy200) \downarrow \\ + (numAnchorSamples - 1) \cdot (anchorSamplePeriod \cdot sleepVolts \cdot sleepAmps)$$

$$totalAnchorEnergy = (1.663 \cdot 10^5) \mathbf{J}$$

Totals

$$missionProfileEnergy := profileSetupEnergy + numProfiles \cdot (totalProfileEnergy + totalAnchorEnergy) = (1.952 \cdot 10^7) \text{ J}$$

$$profileTime := \frac{profileDepth}{descendSpeed} + \frac{profileDepth}{ascendSpeed} + totalAnchorTime + surfaceOpsTime = 42.683 \text{ hr}$$

$$missionTime := numProfiles \cdot profileTime = 177.847 \text{ day}$$

Battery pack parameters (Li primary)

$$numBatteries := 32 \quad batteryVolts := 28 \cdot V \quad batteryCharge := 3.3 \cdot amp \cdot hr \quad selfDischarge := \frac{0.03}{yr} = (9.507 \cdot 10^{-10}) \frac{1}{s}$$

$$generalDerating := 0.8$$

$$batteryEnergy := batteryVolts \cdot batteryCharge = (3.326 \cdot 10^5) \text{ J}$$

$$packEnergyTheor := numBatteries \cdot batteryEnergy = (1.064 \cdot 10^7) \text{ J}$$

$$packEnergy := generalDerating \cdot (packEnergyTheor \cdot (1 - (selfDischarge \cdot missionTime))) = (8.391 \cdot 10^6) \text{ J}$$

$$\frac{missionProfileEnergy}{packEnergy} = 2.326$$

$totalMissionTime := numProfiles \cdot (profileTime + totalAnchorTime) = 351.181 \text{ day}$

Battery pack parameters

$numBatteries := 32$ $batteryVolts := 28 \cdot V$ $batteryCharge := 3.3 \cdot \text{amp} \cdot \text{hr}$ $selfDischarge := \frac{0.03}{\text{yr}} = (9.507 \cdot 10^{-10}) \frac{1}{s}$

$$\text{batteryEnergy} := \text{batteryVolts} \cdot \text{batteryCharge} = (3.326 \cdot 10^5) \text{ J}$$

$$\text{packEnergy} := \text{numBatteries} \cdot \text{batteryEnergy} = (1.064 \cdot 10^7) \text{ J}$$

$$\text{missionSelfDischarge} := \text{selfDischarge} \cdot \text{totalMissionTime} = 0.029$$

$$\text{packEnergy} := \text{packEnergy} \cdot (1 - \text{missionSelfDischarge}) = (1.034 \cdot 10^7) \text{ J}$$

$$\text{packUsage} := \frac{\text{missionEnergy}}{\text{packEnergy}} = ?$$