TetherNotes

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1 Benthic Lander Tether Specifications

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Project: 901704 Benthic Observation System

This notebook lays out the basic calculations for the tether strentgh ratings sent out for quotes under the benthic lander project.

1.1 Tether Load Ratings

Air weight of the Lander and potential added weights and depressor weights shall not exceed 500lbs wet weight.

```
In [2]: F_gear = 500*4.448/1000 # 500lbs converted to kN
        F_tether = 0.0300*80*9.81/1000 # 0.3km*80kg/km*9.81m/s2

        SWL = 2*(F_gear + F_tether) # double static load for dynamic loading
        print('SWL: {:,.4} kN \t| {:,.5} lbf'.format(SWL, SWL*224.8))

        NBL = 7*(SWL) # Complies with CFR 189 for installation on the Western Flyer
        print('NBL: {:,.4} kN \t| {:,.5} lbf'.format(NBL, NBL*224.8))
```

```
SWL: 4.495 kN          | 1,010.5 lbf
NBL: 31.47 kN          | 7,073.5 lbf
```

1.2 Deck Load Requirements

As per CFR189 the wire must be weakest link to the vessel, so for any such specfied cable, all ship structure and handling gear (i.e. winches, sheaves) must handle the breaking strength of the wire with an added safety factor of 1.5.

```
In [3]: GearSWL = 1.5*NBL
        print('Gear Working Load: {:,.4} kN \t| {:,.6} lbf'.format(GearSWL, GearSWL*224.8))
```

```
Gear Working Load: 47.2 kN          | 10,610.2 lbf
```

1.3 Resultant Horsepower Requirements

In order to size the winch, we require sufficient pulling force to exceed the breaking strength of the wire and power enough to deliver that force in a time that results in efficient operations.

In [4]:
```
%matplotlib inline
from pylab import *
import numpy as np
```

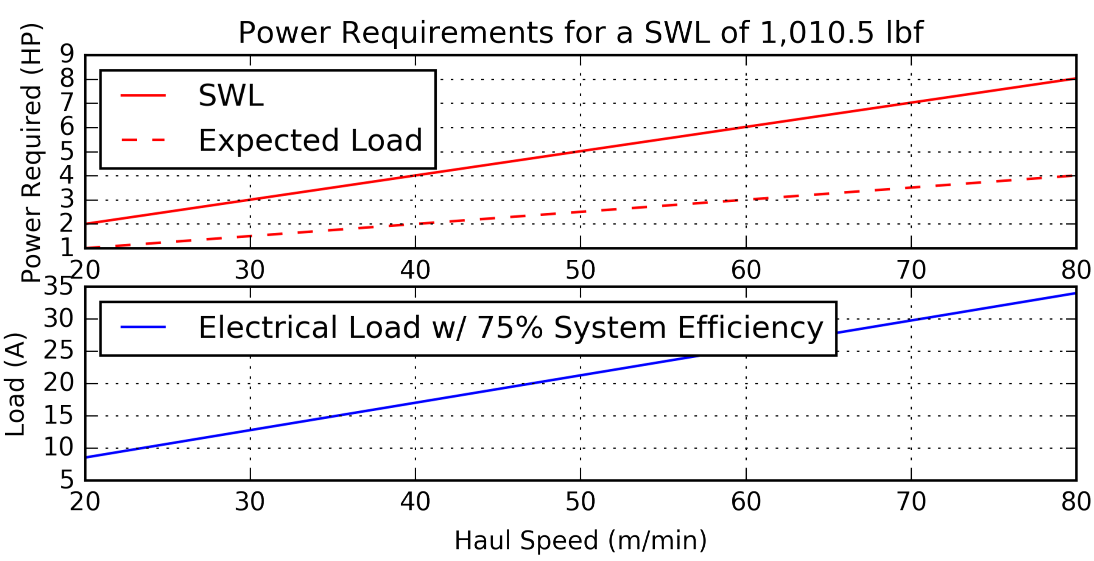
In [5]:
```
Speeds = np.linspace(20, 80, 100) #meters per minute
PowerkW   = SWL * Speeds/60# kN * m/s = kilowatts
PowerHP   = PowerkW*1000/745.7 # horsepower
Load220VAC = PowerkW*1250/220
```

In [22]:
```
fig, axes = plt.subplots(figsize=(7,3),nrows=2, ncols=1)

fig.set_dpi(300)

axes[0].plot(Speeds, PowerHP,'r', label="SWL")
axes[0].plot(Speeds, PowerHP/2,'r--', label="Expected Load")
axes[0].legend(loc=2)
axes[0].set_ylabel('Power Required (HP)')
axes[0].set_title('Power Requirements for a SWL of {:,.5} lbf'.format(SWL*224.8))
axes[0].grid(True)

axes[1].plot(Speeds, Load220VAC,'b', label="Electrical Load w/ 75% System Efficiency")
axes[1].legend(loc=2)
axes[1].set_ylabel('Load (A)')
axes[1].set_xlabel('Haul Speed (m/min)')
axes[1].grid(True)
```



1.4 Length Requirements

Allow for assumed scope needed to operate at a desired watchcircle and in high current drag offsets. Maybe do a better catenary analysis to help dictate clump weight requirements in various sea states.

```
In [23]: #Floated length (m)
         L_floated = 10
         #Max Depth (m)
         L_depth = 300
         # Watch Circle (m)
         L_watch = 20
         # Calculate needed amount to reach 300m depth, adding 10% for cable catenary
         L_cable = (1.1)*L_depth + L_floated + L_watch

         print("Cable length required minimum: {} m".format(L_cable))
```

```
Cable length required minimum: 360.0 m
```

```
In [ ]:
```